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The Best of Catchment Connections

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Foreword

As the future custodians of South Australia's natural resources, it is essential that today's young citizens are able to take an active role in caring for their local environment.

Educators can play an important role in building the environmental knowledge needed to foster a lasting appreciation of the natural world around us. However, teaching about the environment is no easy task. The topic is large and many are faced with question of, 'Where do I begin?'.

To equip educators, the Adelaide and Mount Lofty Ranges Natural Resources Management Board has produced an exciting resource titled *Best of Catchment Connections*. The resource has been developed by trained educators and environmental experts to provide teachers with a systematic approach to teaching about catchments and ecosystems. The resource has a very local flavour and provides useful materials and addresses a range of issues that are specific to the Adelaide region.

The original *Catchment Connections* series took the form of four folders, each of which covers a particular area of learning. The four areas are: understanding catchments, understanding ecosystems, human impacts and taking action. It was developed specifically for use in the Southern Area. It is now available online.

To complement this extremely popular resource, the Board has now created a condensed version of the full folder series to assist in distributing this education resource even more widely. The abridged version is aptly titled *Best of Catchment Connections* and those teachers who find this document useful are strongly encouraged to seek out and use the full suite of *Catchment Connections* material.

I would like to commend you for your interest in environmental education and trust that you will find the *Best of Catchment Connections* helpful in teaching your learners about issues that affect us all.

Government of South Australia
Adelaide and Mount Lofty Ranges
Natural Resources Management Board

Yvonne Sneddon
Presiding Member

Special thanks to the Authors

Catchment Connections was developed as a partnership project between the Onkaparinga Catchment Water Management Board and the Onkaparinga Waterwatch Network. *(The Catchment Board is now a part of the Adelaide and Mount Lofty Ranges Natural Resources Management Board).*

The Board would particular like to acknowledge the efforts of those staff members who turned *Catchment Connections* from an idea into a reality-

Matthew Cattanach (formerly of the Onkaparinga Waterwatch Network)
Sheralee Cox (formerly of the Onkaparinga Waterwatch Network)
Caroline Dorr (Adelaide and Mount Lofty Ranges NRM Board)

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Best of Catchment Connections: An introduction

To all those teachers in the Adelaide area who want to integrate environmental education into their teaching program, *Best of Catchment Connections* is for you!

Inside you will find:

- A unit of work.
- General information.
- Suggested excursions.
- Lesson plans, experiments and work sheets.
- Other available resources.
- Student opportunities to take action.

This environmental education resource is a summary of Folders 1 to 4 of the *Catchment Connections* series which is available at www.waterwatchadelaide.net.au

Frequently asked questions about *Best of Catchment Connections* & our programs

Who can get a copy?

Copies of *Best of Catchment Connections* have been distributed to all schools in the Adelaide and Mount Lofty Ranges region (AMLR NRM Board region). It is also available to download from www.waterwatchadelaide.net.au

Where can I get the most up-to-date information about what is available in Environmental Education / Education for Sustainabity / Natural Resource Management Education relevant to the Adelaide and Mount Lofty Ranges Area?

See our website at:

www.waterwatchadelaide.net.au

Print materials become out-of-date very quickly. We endeavour to provide an excellent resource for you via the web.

Why has the *Best of Catchment Connections* booklet been produced?

This booklet has been produced to make the *Catchment Connections* environmental education resources available to the widest number of teachers possible.

What if our school doesn't have folders 1 to 4 of the *Catchment Connections* series?

These folders were originally produced for schools in the Southern Adelaide region and are currently out of print. However, anyone can access them at our website.

I need a worksheet, it's not in the *Best of Catchment Connections* booklet. Where can I find it?

All the work sheets, activities, lesson plans referred to in this booklet can be found either online or, if you are in the Southern area, in your schools copy of *Catchment Connections - Folders 1 - 4*.

I want to teach about the environment but am not sure where to start.

In this booklet you will find a sample unit of work that will get you started. The unit is designed to be flexible so you can adapt it to the level of understanding of your students. The unit utilises materials from the *Best of Catchment Connections* booklet, the *Catchment Connections folder series* and other environmental education resources.

I want plant and animal identification charts for my class. Where can I find these?

All *Catchment Connections* identification charts can be found in the folder series in your library if you are in the Southern Area. If you do not have access to the resource in this way, please contact Waterwatch Southern Adelaide directly on 8370 1298 or by emailing info@onkawaterwatch.org and we can send you the files.

What are the overarching environmental concepts students should understand?

Interdependence: Humans are inseparable from the environment. We rely totally on the environment for our survival from the food we eat, the clothing we wear to the air we breathe.

Resource management: There are a range of renewable and finite resources that humans can utilise to satisfy their needs and wants according to the lifestyle choices they make.

Diversity: Biological, cultural, social and economic diversity all add value to our lives, and the impact of losing this diversity should be explored.

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The natural environment: This is made up of many organisms interacting with other living and non living creatures. Students should be allowed to explore and develop a connection with their local environment.

Values and lifestyle choices: The ecological balance of natural ecosytems is affected by the everyday choices of people. Students need to understand the way their choices (e.g. dropping litter on the ground) impact on the environment.

Social participation: Student concern for the environment should lead to action to help solve problems in the local area.

What learning approaches work well with environmental education?

Environmental education is multi-disciplinary in nature and provides many opportunities for students to be involved in hands-on learning experiences. These experiences are followed up by feedback, reflection, critical analysis and the application of ideas and skills to new situations. Many hands-on activities have been included in this education resource.

The unit of work included in this booklet takes on the inquiry learning approach. This is one approach recommended and outlined in the National Environmental Education Statement for Australian Schools (2005. P. 21):

"Inquiry learning encourages students to respond to their own concern or curiosity and to investigate and act on an environmental issue. Students are encouraged to think through and solve problems associated with that issue. They are responsible for collecting and analysing data in order to reach their own conclusions and to decide on appropriate courses of action."

Where can I take my class for a field excursion?

The school grounds are often a great place for providing students with an opportunity to explore activities such as bird watching, bug collecting and plant identification. Outside of the school grounds there are many opportunities that are outlined in this booklet.

How can my students take action to improve the environment?

There are many ways your students can take action to improve their environment. These include writing letters to all levels of government, planting local native plants in the school grounds and initiating a recycling program in the school. Some of these opportunities are listed in this booklet.

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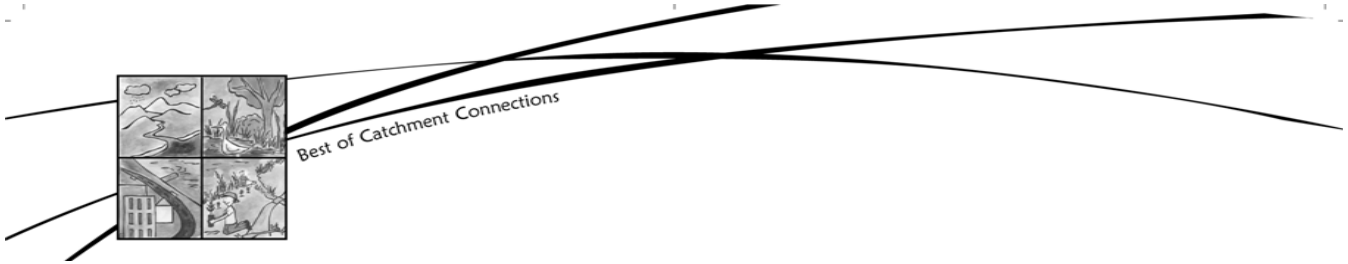

Unit of work: Caring for our catchments

Year levels:

3-7 (possibly adapted for R-10)

Background:

This unit provides a general guide for teachers interested in developing an inquiry learning unit on an environmental topic. The broad topic of Catchments works well from an inquiry perspective as it allows for many possibilities for learners to develop research questions.

This unit uses material from a range of environmental education resources and websites available to schools across the Adelaide and Mount Lofty Ranges Natural Resource Management Boards area. Waterwatch education resources are used extensively and Waterwatch education officer support is available for excursions if required.

The unit encourages the use of a teaching and learning strategy known as inquiry learning. This approach is recommended and outlined in the National Environmental Education Statement (NEES) for Australian Schools:

"Inquiry learning encourages students to respond to their own concern or curiosity and to investigate and act on an environmental issue. Students are encouraged to think through and solve problems associated with that issue. They are responsible for collecting and analysing data in order to reach their own conclusions and to decide on appropriate courses of action."

An inquiry learning model from NEES is detailed below:

Tuning in
Identifying and defining the issue. This involves activities that are designed to:

- generate interest
- establish current knowledge
- draw on past experiences
- identify possible aspects for investigating.

Deciding directions
Formulation of hypothesis involving

- choosing a focus
- extending the scope
- identifying and refining questions.

Organising ourselves
Accessing equipment, materials, ideas, and resources necessary for us to begin our investigation.

Finding out
Students collect data.

Sorting out
Processing and analysis of data.

Refining the issue
This involves:

- organising the presentation of data
- comparing and contrasting findings
- discussing the issues of hypotheses
- evaluating.

Making connections
Students draw conclusions and communicate their findings to others. This involves:

- interpreting information
- confirming, rejecting or modifying hypothesis or predictions
- suggesting solutions to problems.

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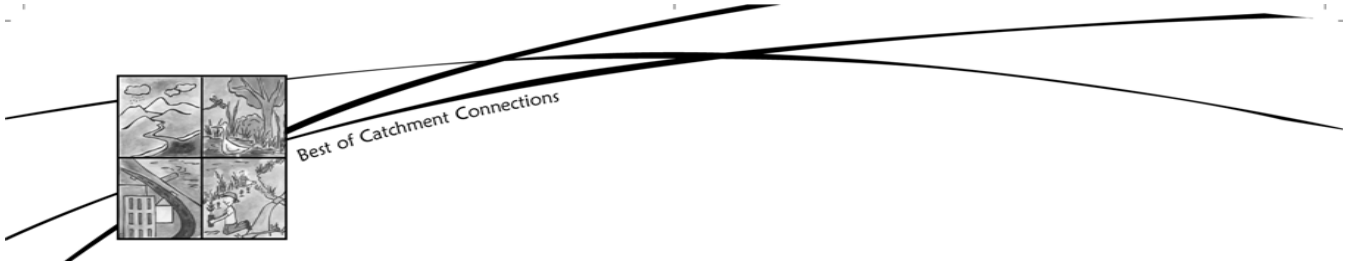

Taking action
Provides students with an opportunity to implement solutions for environmental problems that have been identified.

Suggestions for other topics of inquiry in the environmental field:
Frogs
Pond Life
Air pollution
From Rivers to the sea
Coast Care
Biodiversity
Habitats
Dolphins
Mangroves
Wetlands

SACSA additions/learning outcomes
The unit of work contains a blank column for writing in SACSA links/learning outcomes. This will assist teachers to tailor the unit to their own teaching program needs

Austrialian Sustainable Schools Initiative – South Australia (AuSSI-SA)
For teachers who are interested in engaging the whole school community in working towards sustainability,

Waterwatch Adelaide Website
For kids activities, teacher resources, information packs, excursion locations and a curriculum guide go to:**http://www.waterwatchadelaide.net.au/**

School and Community Links
When teaching about environmental topics it is advisable that teachers take the opportunity to support students to be involved with environmental initiatives that are already being undertaken at the school. Examples include: composting, recycling, litter reduction campaigns, Waterwatch, gardening, Ourpatch, Airwatch, and Gutter Guardians.

Links with the community should also be explored so that parents, community groups, and service providers or involved with student learning where appropriate.

Equipment and support
Equipment required for this unit may be borrowed from your nearest Waterwatch team. Contact details below:

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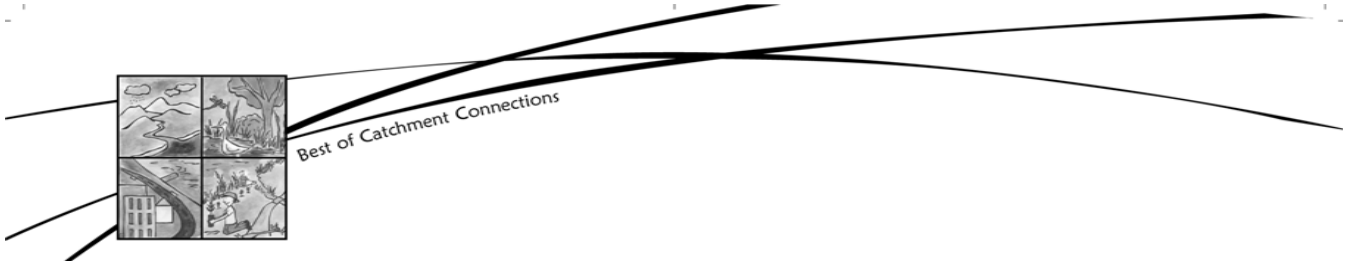

CARING FOR OUR CATCHMENT: A UNIT OF WORK FOR SCHOOLS IN THE ADELAIDE MOUNT LOFTY RANGES NRM BOARD'S AREA

Phases	Activities	Assessment opportunities	Resources	SACSA links/ learning outcomes
Tuning in	Introduction to catchments: Introduce a **catchment** as an area of land where rainwater collects. Activities: • Show the *Water: Learning and Living* poster and ask students to consider which pathway rainfall/water will take on its journey from the hills to the sea. • Show the Catchment Mural • Mind map class ideas about catchments. • Develop student questions about catchments. Questions: What is a catchment? Who lives in a catchment? What are the people in the catchment doing? Can you give an example of another kind of catchment? Which parts of the catchment do you think would be clean and healthy? Which parts of the catchment may be unhealthy or polluted? What kinds of pollution might you find in the catchment? Where would you like to live in this catchment? Why? What are people doing to help the catchment? What are people doing that may harm the catchment? Can you group the helpful and harmful things that people do according to a particular characteristic? Think about connections. Is a connection between activities in		*Water: Learning and Living* poster: available from your school Library (Contact Central Adelaide Waterwatch if it is not available) Information on catchments: http://www.cwmb.sa.gov.au/kwc/programs/about_catchments/index.htm Teacher resource pack with information and catchment activities: http://www.cwmb.sa.gov.au/kwc/programs/teaching_resource_packs.htm Catchment Mural: available for loan from your local Waterwatch Co-ordinator *Water, Learning and Living Mural Support Poster* (with inquiry questions included)	

	the hills and activities near the sea? Explain. What is not found in a catchment? What is the name of the main river in your catchment? Do you think you are causing harm to your catchment? Explain. What do you think a perfect catchment would look like?			
	Make a catchment model: Provide students with the opportunity to build their own catchment model. A good activity would allow students to experiment by pouring water on their catchment and observing the flow of water from the high areas to the lower places. Activities: • Milk Carton Catchments: Students fill milk cartons (cut in half lengthways) and fill them with soil to make mini catchments. More information is provided at: http://www.waterwatchadelaide.net.au • Giant class room model: Make a giant catchment using a tarp or sheet of plastic draped over tables and chairs. Arrange the tarp so that a valley and river channel is formed in the middle and place a large bucket or container at the bottom to represent the sea. Add props to your catchment and then use a watering can to simulate rainfall. Observe the path that water takes as it flows from the hill to the sea. • Outdoor catchments: Make a catchment by piling up sand in a sand pit. Cover the sand with a tarp and observe the flow of water from the hills to the sea. • Papier Mache catchments: Students use Papier Mache to make their own mini catchments • Silt city: Investigate the different amounts of stormwater run-off in the city compared with the country. More information is provided at: www.waterwatchadelaide.net.au		Milk carton catchment activity: http://www.cwmb.sa.gov.au/kwc/programs/about_catchments/making_catchments.htm Silt city activity: www.waterwatchadelaide.net.au	

	Questions: If you could design a catchment what would it be like? Compare your design with the reality of the catchment where you live? What are the differences? What do you feel are the most important parts of a catchment? Compare farming land with the surburbs? What are the differences? Why would more stormwater run-off occur in the suburbs after a storn? Do smaller catchments always join to create larger catchments? Can you think of examples of catchments that do not end in the sea?			
	My Catchment: Show students a map of the local catchment and point out major features. Activities: • Photocopy pages from a street directory and glue them together. Students chart the path of stormwater from their neighbourhood to the sea. • Photocopy the catchment map and ask students to map areas of significance. Their home, school, shops etc. • Walk around the school grounds and find the location of gutters, downpipes and stormwater drains. See if you can find where the pipes flow to. • Students develop a picture, pamphlets, role-play, story or song that describes the pathway of rain from their area to the sea. Questions: Where do you live in the catchment? What are the names of some nearby streams in your catchment?		(Catchment maps available form your local Waterwatch Co-ordinator)	

	Are there any obvious pollution problems in your catchment? Predict what would happen n your area if there was a heavy storm? Where would the water go? Are there any items that would be carried by the water into the local stream? How many different ways can water travel from your area into a local creek or stream? What are the implications of the statement; 'we all live in a catchment'?			
	<u>Human impacts on catchments</u>: Activities: • Catchment Capers: A role play activity investigating the impact of different people on the catchment • Danny the Drip: Presented as a story this activity provides a dramatic visual simulation of the way pollution enters our waterways Questions: Can you develop a proposal that would help reduce pollution in the catchment? What laws would you make to protect the health of the catchment? Can you develop a set of instructions for somebody who is living in a catchment to help stop them polluting? Consolidation Tasks: - Stormwater worksheet - Pollution worksheet		Catchment capers lesson plan Danny the drip lesson plan Stormwater worksheet Pollution worksheet	
Deciding Directions &	<u>Data collection planning</u>: Students further develop research questions about catchments and plan research and investigations to help answer their questions. Activities:		Macroinvertebrate sampling gear: available for loan from your local Waterwatch contact. Instructions for catching Macroinvertebrates: www.waterwatchadelaide.net.au	

Organising Ourselves	• Water quality monitoring: Measure the salinity, turbidity, pH, and nutrients (phosphate and nitrate) to identify possible environmental problems at your local waterway. • Macroinvertebrate collection: The kinds of water bugs you collect in your local waterway will give you an idea of the health of the local catchment. • School litter survey: Find out how much litter from the school might be going down the drain and to the local creek. • Home stormwater impact audit: Students survey behaviours of their family to find out what impacts the family are having on the catchment. • Community survey: Find out if people in your area are aware of activities that can harm the local catchment. • Local business survey: Are businesses in your area taking care to reduce their impact on the catchment. • Catchment tour: Follow your local waterway from the hills to the sea. Students collect data along the way about land use and impacts of land use on stormwater. • Catchment habitat survey: Find out about the health of the habitat along your local waterway. What plants, birds, fish, frogs and other animals are using the local stream as a habitat? • Stormwater pollution survey: Walk from your school to the local stream and identify possible sources of stormwater pollution along the way. • Photo study: Walk around your chosen area and take photos of points of interest. Questions: What kind of data will you collect? Where will you collect your data? What equipment or resources will you need?		Instructions for making a monitoring net: www.waterwatchadelaide.net.au Waste education resources: http://www.wow.sa.gov.au/ Catchment tour itinerary planning: www.waterwatchadelaide.net.au	

	What assistance, and support from teachers, adults, community members do you require? What questions are you asking in your investigation? What is your hypothesis or idea that you are investigating? What would the local environment be like if it was in very good health? Will your investigation focus on a single issue or are you doing a general survey of an area? How will you record your data?			
Finding Out	Students go into the field and carry out their data collection:			
Sorting Out & Refining the Issue	Data interpretation: Students summarise and analyse collected data and identify good and concerning findings. Students develop theories about the causes of any concerning results. Activities: • Use some of your data to draw a graph • Compare your data with findings from other students • Write a recount of your experience • Draw a map showing the area you visited and identifying any problems Questions: Did you find any problems in your local environment? What are the possible causes of these problems? What things did you find that you liked?			
	Problem solving: Students research and develop solutions to identified environmental problems.			
	Future Visioning: Activities: Students imagine what their catchment should look like in the		http://www.oxfam.org.uk/coolplanet/teachers/ywmw/activity10.htm A simple futures tree activity for an environmental unit based	

	future (when they are adults). They draw their vision. Their vision is shared with individuals, groups or the class. Students compare their vision with the reality found in their investigation. Students consider the changes that would need to occur for their vision to become a reality. Some possible tools for considering the changes that are required are included below (from Tilbury and Wortman, 2004): • Futures trees; draw a tree and write a possible change on the trunk of the tree. List the impacted groups on the main branches, and the linked consequences on successively smaller branches. • A history of the future; learners construct a visual history or story board showing the changes that would be required for their vision of the future to become a reality. • Timelines; construct a timeline showing changes that have occurred to the present and extend this timeline into the future showing the changes that would be required for your vision to become a reality. Questions: What's the difference between your vision and what you see today? How does your vision compare with the student next to you? What are the similarities and the differences? What needs to happen to make your vision a reality? Have you done anything today to help make your vision a reality? Have you done anything today that works against your vision? Compare and contrast how your life would be if your vision became a reality and if the future was pretty much like the present?		on trees.	
	Critical questioning:		http://www.wwf.org.uk/filelibrary/pdf/1848_toolboxloresv2.pdf	

	Activities: • Causes and consequence tree (pg 25 Linking Thinking Toolbox); Students write the identified problem in the centre of a page. Then they describe in words the most important parts of the situation that have brought about the problem. Write each of these in the bottom half of the page and link them together according to how each part influences the other part. In the upper part of the page draw the effects that the problem gives rise to. Try to include things like values, beliefs, priorities and interests of people in your diagram. • Rich pictures diagram (adapted from pg 25 Linking Thinking Toolbox); Use pictures, symbols and cartoons to represent the problem and all the interrelated situations that cause and are caused by the problem. Pin your pictures on a board, or glue them to butchers paper and draw arrows between the situations to create a graphical representation of the problem that has been investigated. • Mind Map: Draw a mind map of all the issues that relate to your identified problem. • Consequences wheel: Place your identified problem in the middle and draw links showing the range of consequences that occur because of your problem. Student Questions: What are the main causes of your problem? How are these causes creating the problem? What are the reasons for these causes? Keep delving into causes and reasons until you find the root of your identified problem. What subsequent problems does your main problem cause? What are the flow on effects?		Linking Thinking Toolbox, WWF Scotland	

	Do any of your choices or actions contribute to the problem? Explore the impact of this problem on your vision for a sustainable future? What steps need to be taken by you, the school community, society, to reduce or stop the impact of this problem on your vision for a sustainable future?			
Making Connections	<u>Presentation of environmental problem</u>: Students develop a presentation to inform others about the environmental problem and their intended solution. Students choose from a range of presentation styles including drama, posters, songs, pamphlet, PowerPoint, speech, video.			
	<u>Catchment solutions, group presentations</u>: Students carry out presentations to class or wider audience.			
Taking Action	<u>Taking action</u>: Students implement their Catchment solution. Further suggestions for taking action activities could also be implemented. Activities: • Gutter guardians: Students clean up the gutters around the school removing leaves, litter and dirt. The material saved from entering stormwater and the local creek is weighed. • Litter campaign: Reduce litter around the school, make posters, run a bin user competition, begin recycling, present a performance at the school assembly. • Local creek clean-up: Clean up an area along your local creek. • Tree planting: Participate in a local tree planting event, or plant local natives in your school garden.		Grow a great school – Urban Forrests Ourpatch Local Friends Groups Waterwatch KESAB – Clean-up Australia Day Wipe Out Waste *(add contact information for these organisations)*	
Reflection and Evaluation	<u>Student reflection and evaluation:</u> Students reflect on activities undertaken and evaluate the effectiveness of their solution measures. Further areas for action may be identified and implemented.		www.waterwatchadelaide.net.au	

	Activities: • School Litter Audit: Perform an audit before and after students have taken action. • Follow up data collection: Take pictures or re-do data collection to test for any impact of the action you took. • Ongoing personal actions: Students should identify personal actions that they will carry out on an ongoing basis to help solve the problem they identified. • Personal environmental audit: Students measure their environmental/ carbon footprint and develop a plan to reduce it. Questions: Explain how your actions have helped to address your identified problem. What were your successes? Would you have done anything differently? What steps will you need to take in the future for your future vision to become a reality?			

1. What is a catchment?

Concepts

- A catchment is an area of land that catches rainfall and directs it to the nearest waterway.
- We all live in a catchment.

What is a catchment?

A catchment is an area of land that catches rainfall and sends it into a waterway (e.g. a creek, river, lake or the sea).

A river catchment extends from the highest point of the surrounding hills. The catchment area is far larger than the area of the waterway itself.

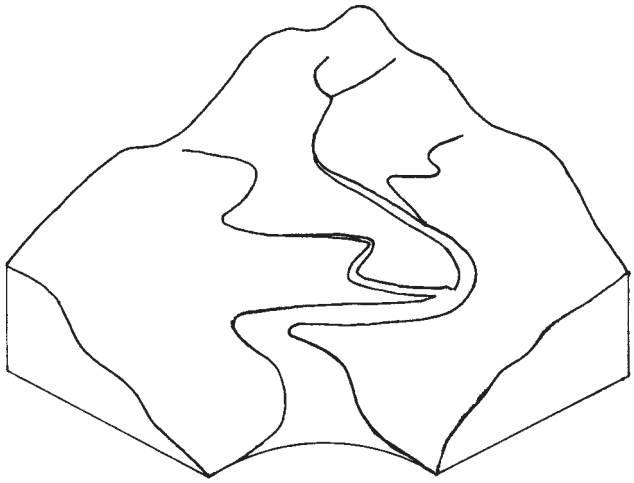

Diagram 1: Rainfall landing in this catchment is directed into the creeks then the river and eventually the sea

A rainwater tank provides a good demonstration of how a "catchment" works. The roof of a house is the catchment area, the gutters and pipes are like the creeks/drains that take the water to its final collection point (the tank). So any rain that hits the roof/catchment is directed into the tank/waterway.

The concept of catchments can be hard to communicate, so learning about them in different ways is necessary to develop a good understanding.

Who lives in a catchment?

Everyone lives in a catchment! Inside catchments you can find plants and animals, farms and houses, suburbs and national parks, roads and railway lines as well as people going about their daily lives.

In urban areas, houses, schools and factories are directly connected to waterways by the system of gutters and drains on roads. Any rubbish or pollution on roads, driveways and other hard surfaces can be washed into gutters, then down drains. Drains direct water into the nearest waterway, which in turn runs into the main river or the sea. So what we do at home and school impacts upon waterways.

In rural areas, drainage patterns are more obvious as surface runoff flows downward towards a stream, dam or wetland. Water that soaks into the ground, enters a groundwater catchment, which may also eventually re-enter surface waterways.

Lesson ideas

Activities available in the full set of Catchment Connections folders online at www.waterwatchadelaide.on.net:

- Water: Learning and Living poster (back section, folder 1) - Ask students to use their finger to follow the path of water that has fallen into the catchment as rain.

Additional ideas:

- Demonstrate a catchment using a tarp or plastic sheet. Raise it slightly along either side so that water poured onto it runs to the middle of the tarp. Turn the demonstration into a catchment model by painting the plastic with water, fields and houses and sticking on plastic trees and animals.

Recommended resources

www.amlrnrm.sa.gov.au
Information about catchments in the Adelaide region.

http://www.healthywaterways.org/filelibrary/FILE20 03318153218.pdf

Provides an excellent catchment diagram.

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Catchments of the Northern Adelaide and Barossa Region

The Northern Adelaide and Barossa Region encompasses the catchments of Light River, Gawler River, North and South Para River, Little Para River, Smith Creek, Cobbler Creek and Dry Creek.

Concepts

- The Northern Adelaide and Barossa Region contains many water courses that all provide significant benefit to the populations of the area.
- The catchment is home to some of our state's most productive agricultural land - the premium grape growing regions of the Barossa and the horticultural regions of the Northern Adelaide Plains.
- The catchment also supports around 320,000 people who live in some 125,000 homes, and is home to over 25% of the State's manufacturing output.

Aboriginal Significance

Prior to European settlement, the region was occupied by the Ngadjuri, Kaurna and Peramangk indigenous groups.

What were the watercourses like before European settlement?

Dry Creek and the Little Para River were ephemeral waterways before European settlement, meaning that during summer stream beds dried out to leave a chain of ponds. The North Para River was a near permanent waterway before European settlement, while the Gawler River was made up of several small streams that spilled onto the floodplains surrounding the area in times of high water flow.

What happens to the water flow today?

Today, the watercourses of the Northern Adelaide and Barossa Region have been altered for human settlement. Reservoirs store water for urban usage and channels and drains now divert some water away from its original course and away from floodplains. Water is used in the area primarily for domestic use, industry (like Cheetham's salt fields) and agriculture and horticulture.

Lesson Ideas

- Catchment questions worksheet: Students identify areas of personal interest throughout the catchment.
- Virtual Catchment Crawl: Run your own catchment exploration from the classroom using our Virtual Catchment Crawl pack. Pack can be hired free of charge.

Additional Ideas

- Research the pre-European and post-European history of your catchment. What major changes have occurred?
- Create a 3D catchment map using modelling clay or paper-mache.
- Research another catchment in Australia or overseas and compare it with one of the catchments in the Northern Adelaide and Barossa Region.
- Create a mural, poster or book about the features of one of the catchments in the Northern Adelaide and Barossa Region.
- Establish contact with a school in another part of the Northern Adelaide and Barossa Region and ask them what their area looks like.

Recommended resources

http://www.amlrnrm.sa.gov.au/

This site contains information about all Adelaide and Mount Lofty Ranges catchment areas including the Northern Adelaide and Barossa area.

http://www.sacentral.sa.gov.au

This site has links to all of the local councils under the Government section, so you can find out what your council is doing in terms of environmental sustainability.

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The River Torrens Catchment

Prior to European settlement, the catchments we now know as the Torrens, Patawalonga and Port River were all linked via a natural coastal wetland known as the "Reedbeds". In the 1930s, a channel was dug in the lower reaches of the River Torrens, giving the river a mouth and direct route out to sea. Over time human modifications have changed the paths and flows of these natural watercourses so they are no longer considered one catchment. In 1998 the former Torrens Catchment Water Management Board symbolically re-linked the Torrens and Port Catchments in their Management Plans. However, there is no exchange of water between them.

Concepts

The River Torrens is one of the longest water courses in South Australia. The River begins at Mount Pleasant in the Mount Lofty Ranges and flows a 90km path through the townships of Birdwood, Gumeracha and Cudlee Creek, emerging from the foothills and winding its way over the Adelaide Plains. The River discharges to Gulf St Vincent at Henley Beach via an artificial outlet. The last 3.5km of the River, known as Breakout Creek, acts as a major urban stormwater outlet which has associated impacts on the beach and near-shore environment.

The catchment area is approximately 620 km² consisting of the Torrens catchment and Torrens rural/urban regions and includes the River Torrens and its tributaries; Stony Creek, Angas Creek, Kenton Creek, Cudlee Creek, Kangaroo Creek, First, Second, Third, Fourth, Fifth and Sixth Creeks. Major land uses in the catchment include: pasture for livestock (with some now being converted to viticulture), recreation/parks, horticultural, industrial, residential and urban.

Renaming the Torrens

Karra-Wirri-Parri, meaning Red Gum-Forest-River was the name given to the Torrens by the Adelaide City Council in March 2000 to acknowledge Kaurna heritage. The name was developed and approved by Kaurna elders. The Kaurna are the traditional Aboriginal people of the Adelaide Plains.

Aboriginal Significance

Waterways are an important part of Aboriginal cultural heritage. Streams and lakes feature in Dreaming stories and are sites of camps and ceremonies. The Lower Torrens was an important source of food, water, shelter and materials for arts and crafts for the Aboriginal people living in the region.

What was the Torrens like before Europeans arrived?

The Torrens was a summer-time chain of water holes densely populated by large gum trees. As it flowed through the area where Adelaide City is sited, the river flow was sometimes invisible beneath the gravel stream bed. The River was prone to flooding in winter and did not reach the sea.

The Torrens was separated from the coast by large coastal dunes. The Torrens' waters dissipated in the dunes and collected in a vast shallow freshwater wetland, called *The Reedbeds*. The Torrens slowly flowed south to the Patawalonga River or north via Kirkcaldy Creek to the Port River and out to sea. The Torrens only flowed to sea following heavy rains.

What happens to the water flow today?

The hydrology of the Torrens River catchment is influenced by the operation of the metropolitan Adelaide water supply system. To supplement the metropolitan area's growing needs the flow is augmented with water pumped from the Murray River at Mannum via the Mannum-Adelaide Pipeline. Some of this water enters the Torrens near Birdwood and water from the Pipeline is also transferred to other catchments north of Adelaide. Water harvested from the Torrens is diverted into the Millbrook, Kangaroo Creek and Hope Valley reservoirs. Both Millbrook and Hope-Valley Reservoirs are "off-line", with water being diverted to these reservoirs, whereas the Kangaroo Creek reservoir is on the Torrens.

Water is diverted from the Torrens at the Gumeracha Weir, into Millbrook Reservoir. Water is then released from Millbrook into the Kangaroo Creek Reservoir (water from Millbrook can also be pumped back into the Mannum-Adelaide Pipeline). The water from Kangaroo Creek is then released into the Torrens and diverted at the Gorge Weir to maintain water levels in Hope Valley Reservoir. The water is then treated and filtered before being supplied to metropolitan Adelaide for consumption.

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The Patawalonga Catchment

The Patawalonga catchment has a series of rivers and creeks running through several sub-catchments that combine to make the Patawalonga catchment. Sub-catchments include the Sturt River, Brown Hill Creek, Keswick Creek, Airport Drain, Local Patawalonga Basin and coastal catchments. The major drainage system is the Sturt River which begins near Heathfield and flows through Coromandel Valley, Marion and Glenelg before discharging into Gulf St Vincent through the Patawalonga Basin. Brown Hill, Keswick, Glen Osmond and Parklands Creeks also discharge through the Basin. The area is not a single catchment and, as well as the major streams listed, includes a number of urban drainage systems which outfall directly to the Gulf.

The Patawalonga catchment area is approximately 235km^2 and over 50% of the area is used for residential, industrial, commercial and associated intense development uses. The upper reaches of the Sturt River catchment are predominantly agricultural with significant areas of native vegetation, rural living and some primary production as well as expanding areas of urban development. Downstream of Sturt Rd, the catchment is completely urban. The Brown Hill and Keswick Creek catchments both have rural and urban areas. The Airport Drain is completely urbanized and the Patawalonga Basin catchment is an intensely developed area. The Coastal catchment drains from urban areas that include residential, commercial and light industry.

Is your school in the Patawalonga catchment?

What does Patawalonga mean?
The name Patawalonga is derived from the Kaurna name '*Patta-wilya-ngga*', which means 'The place of the branches of the swamp gum'.

Aboriginal significance
Prior to European settlement, the Kaurna people were supported by the Sturt River and surrounding bush, which provided valuable food and shelter. Brown Hill Creek provided a permanent water supply and was important for camping, hunting and gathering. The Reedbeds, a series of freshwater lagoons connecting the Patawalonga Estuary (no longer an estuary and currently known as the Patawalonga Basin) to the Torrens and Port Rivers, were visited by the Kaurna during the spring and summer months, with the dunes and red gums providing shelter and reeds providing materials for the making of baskets and mats.

What was the catchment like before Europeans arrived?
Before European settlement, the Patawalonga Basin and its sub-catchments were prone to flooding which fed the coastal wetlands and lagoons. The Patawalonga basin was an estuary, subject to daily tidal fluctuations. The dominant vegetation included saltwater swamp paperbark, saltbush, samphire shrub land and open woodlands. Further inland the estuary gave way to brackish and seasonally fresh water swamps, with extensive beds of reeds and rushes.

Brown Hill Creek was a well defined, meandering channel with water the year round. Its flat plains were dotted with billabongs seasonally inundated during winter. Large river red gums and blue gums lined Brown Hill Creek and its billabongs. Further upstream permanent springs fed the creek with good quality water.

The Sturt River was an incised meandering stream watered by springs all year round and in turn, the river watered the rich alluvial flood plains. During heavy rains, the Sturt River would overtop its banks and flood the Adelaide Plains and settle out into the lagoons of the former Patawalonga Estuary and Reedbeds.

What happens to River and Creek flows today?
The Patawalonga catchment is not used as a source for public water supply. Urban development has greatly impacted on the catchment environment as well as the receiving waters of the Patawalonga Basin and the Gulf of St Vincent. Natural river and creek lines have been straightened and replaced with concrete channels, constructed to avoid flooding by conveying water as quickly as possible to sea.

The Sturt River receives regular discharges of treated sewage from the Heathfield Wastewater Treatment Plant, resulting in near-permanently flowing sections of the waterway. In the upper catchment, runoff from urban areas is generally piped directly into creek lines. Below Sturt Road, the Sturt River becomes a concrete lined trapezoidal channel; most stormwater runoff is piped directly to this channel (Morphettville Racecourse wetland intercepts some).

The urban parts of Brown Hill Creek have also been heavily modified and are defined by an open concrete stormwater drainage system constructed by local government. The original creek line has been straightened to efficiently divert high flows quickly away from properties. There is very limited inflow into the channel, apart from the concrete channel south of Adelaide Airport. Brown Hill Creek is met by Keswick Creek, which takes flows from the Glen Osmond and Parklands Creeks, as well as accepting inflows from urban stormwater drainage systems. Keswick Creek discharges into a formed earth channel just before its confluence with Brown Hill Creek. The water from both creeks flows south then west along the Airport boundary

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to the Patawalonga Basin and out to sea via the Barcoo Outlet. If a large rain event causes above average flows through the Patawalonga catchment network, the gates into the Patawalonga lake can be opened so that the water has two exits into Gulf St Vincent, the Barcoo Outlet or the weir at the end of the Basin.

The Airport Drain and local Patawalonga Basin catchments carry stormwater runoff from residential, commercial and industrial developments, and discharge directly into the Patawalonga Basin.

The Port River catchment

Concepts

The Port River catchment is approximately 139 km². This area is not a single catchment area but a series of small urban catchments from which runoff is collected, almost exclusively by local stormwater systems. The water is discharged to the Port River system directly through West Lakes, or through the Barker Inlet, or the Range and Magazine Creek Wetlands to the Barker Inlet and Port River estuary.

The Port catchment is highly urbanised with a mixture of industrial, commercial and residential land uses with some open space.

Is your school in the Port Catchment?

Aboriginal Significance

The Kaurna name for Port Adelaide is Yerta Bulti, meaning 'land of sleep'. Other names for the region include Palti, which means 'stretched out or flat".

What was the Port River catchment like before Europeans?

The Port Adelaide region and Le Fevre Peninsula had freshwater creeks, extensive native pine, sheoak, tea-tree, honeysuckle forests, mangrove swamps and samphire marsh; where birdlife was prolific. Gum blossoms provided an important food source and the wood was used for shelters, spear and tool making. Native flax grew in the swamps and was essential for the making of sophisticated nets used in the hunt for fish, kangaroos and emus. Tidal creeks and sand hills provided the Kaurna people with reeds and rushes for producing mats, baskets and clothing. The natural freshwater wells provided a constant source of quality drinking water.

Prior to the construction of Breakout Creek in the 1930s (the final 3.5km of the Torrens to the outlet at Henley Beach), freshwater from the Torrens River flowed north through the swampy Reedbeds, behind the coastal dunes and entered the Port River via Kircaldy Creek. However, the development and urbanisation of Adelaide has since changed the volume and timing of freshwater inputs into the Port River. Today freshwater inputs are primarily from urban stormwater drains.

What happens to the water flow today?

Unlike the greater Torrens Catchment, the Port Catchment is not used as a source for public water supply. Urban and industrial development of the Port Adelaide region has greatly impacted the catchment and the receiving waters of the Port River, Barker Inlet, West Lakes and Gulf St Vincent. Subsequent urbanisation has increased the area of impervious surfaces, such as paved roads and roofing, reducing the volume of water that infiltrates the ground and has probably increased the total discharge of stormwater runoff to the Port River.

Although more water may now be entering the Port River, stormwater quality is poorer and the duration of flows shorter. The flow-through system constructed in the 1970s, which draws seawater into West Lakes and discharges it through the Port River, has probably changed the flow and salinity of the Port River. The average flow of water is 500 ML/day. The exact impact of these changes is unclear but it is certain that they have lowered the quality of water entering the Port River. It is also likely that the seasonal variability of some parts of the Port River are different today from that before development and urbanisation.

Physical changes to the structure of the Port River have also influenced water flows. Dredging has changed the river's channel structure, and removal of vegetation such as mangroves and seagrass in the upper reaches of the river has changed the stability of sediments.

Stormwater Networks of the Port Environs that drain to the Barker Inlet, West Lakes, Gulf St Vincent and the Port River.

The Torrens Road drain, which runs through the City of Adelaide, northwest through Woodville, Rosewater and Port Adelaide, discharges into the Magazine Creek Wetlands at Wingfield. Stormwater from Kilburn, Blair Athol and Enfield drainage systems discharge at Gillman into the Range Wetlands. Areas of Prospect and Devon Park, Dudley Park and Regency Park discharge into an open earth channel heading north to the Barker Inlet Wetlands.

Stormwater drainage into West Lakes occurs through a

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numbe of small drains on the eastern and western side of West Lakes as well as major drains on Port Road, Trimmer Parade, Cudmore Terrace, West Lakes Boulevard and Wellington St.

Along the coastline, spanning Henley Beach to North Haven, a large number of drains discharge directly into Gulf St Vincent. Many of the drains have small pumping stations which lift stormwater over the sandhills. At North Haven and Taperoo larger stormwater pipes discharge to the Gulf.

Stormwater from the eastern Le Fevre Peninsula, Ethelton, Glanville, Peterhead and Taperoo discharges directly to the Port River. Stormwater drainage from the commercial centre and many industries of Port Adelaide also discharge directly into the Port River.

References:

- Initial Catchment Water Management Plan for Extension to the Torrens Catchment Area, BC Tonkin and Associates and TCWMB, May 1998
- Ambient Water Quality Monitoring: Port River Estuary 1995-2000, EPA
- Torrens Comprehensive Catchment Water Management Plan, August 2001 Draft for Consultation 1.5.3 Port Adelaide Catchment pp.7-8.
- Section 4: The Environmental and Cultural Prehistory of Glanville and the Port Adelaide Region.
- Barker Inlet and Environs Management Plan, Draft (Port box in warehouse) Concepts

The Onkaparinga catchment

Concepts

- The Onkaparinga River is a major South Australian river.
- Changes to the flow of the Onkaparinga River have occured to help supply drinking water to residents of the Adelaide region.

The Onkaparinga River is one of the longest watercourses in South Australia. The river begins near Mount Torrens in the Mount Lofty Ranges and flows through townships including Woodside, Mylor and Clarendon before flowing onto the southern Adelaide plains. The river ends at Port Noarlunga after passing through an estuarine zone of about 10km.

The catchment area is approximately 564 km^2 and contains farms, national parks, suburbs and industrial areas. Tributaries of the Onkaparinga (smaller streams that feed into the river) include: Aldgate Creek, Cox Creek, Lenswood Creek, Inverbrackie Creek, Echunga Creek and Kangarilla Creek.

Is your school in the Onkaparinga catchment?

It is important to note that there are more catchments in Southern Adelaide than just the Onkaparinga River catchment. There are several smaller creeks and rivers to the south of Adelaide that lie in their own catchments and are not connected to the Onkaparinga River. These smaller catchments include Field River, Pedler Creek, Waterfall Creek, Willunga Creek, Christies Creek, Sellicks Creek and Maslins Creek. We call these the southern coastal catchments. Refer to the map in this topic to determine the name of the catchment in which your school is located.

What does Onkaparinga mean?

The name Onkaparinga is derived from the Kaurna language: '*Ngangki-parri-unga*', meaning 'The Place of the Woman's River.'

Aboriginal significance

Waterways are an important part of Aboriginal cultural heritage. Streams and lakes feature in Dreaming stories and are sites of camps and ceremonies. The Onkaparinga River was an important source of food and water for Aboriginal groups living in the region.

What was the river like before Europeans arrived?

Before European settlement, the Onkaparinga River was ephemeral, which means the river did not flow all year round. During summer, dry stream beds separated large pools. This still occurs in some parts of the river such as the Onkaparinga Gorge.

What happens to the water flow today?

The hydrology of the Onkaparinga River catchment is influenced by the operation of the metropolitan Adelaide water supply system. Water is pumped in from the River Murray and a series of reservoirs and weirs. River Murray water is pumped into the Onkaparinga River at Hahndorf where it flows to the Mount Bold Reservoir. Water is then released from Mount Bold Reservoir to be diverted via Clarendon Weir to the Happy Valley Reservoir, where it is treated and filtered before being supplied to metropolitan Adelaide for consumption (refer to *Catchment Connections* - Folder 3 - Water for People for more detail)

Lesson ideas

Activities contained within this resource:

- Catchment questions worksheet - Students identify areas of personal interest throughout the catchment. The Onkaparinga catchment map provided at the back of Catchment Connections - Folder 1 provides some extra detail to assist students in finding some locations.
- Catchment crawl excursion - either run it yourself or contact Waterwatch Southern Adelaide to book an Education Officer to come with you.

Additional ideas:

- Research the pre and post European history of the catchment.
- Create a 3D catchment map using modelling clay or papier-mache.
- Establish contact with a school in another part of the catchment and ask them what their area looks like.
- Research another catchment in Australia or overseas and compare it to the Onkaparinga River.
- Create a mural, poster or book about the Onkaparinga's unique features.

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Map 1 Onkaparinga Catchment - Note that the separate catchments of the Onkaparinga River, Field River, Peddler Creek, Christies Creek. and several other small creeks are grouped together and called the Onkaparinga Catchment

Recommended resources:

www.amlrnrm.sa.gov.au

Contains information about the Onkaparinga Catchment as well as other metropolitan catchments.

http://www.users.bigpond.com/sch57/portnoarlunga/portnorfront.html

Provides current and historical information about the Port Noarlunga region.

Catchment Questions

1. What is the name of the catchment you live in?

   _____

2. What is the biggest creek or river in your catchment?

   _____

3. What is the smallest river or creek in your catchment?

   _____

4. Name some animals you might find in your local catchment:

   _____ _____

   _____ _____

5. Name two types of pollution that might harm these animals.

   _____ _____

6. Complete the following on your catchment map:

   a. On the map key draw a different symbol in each of the empty boxes. For your house you might choose a + symbol.

   b. Now look on the map and try to find the places listed in the map key.

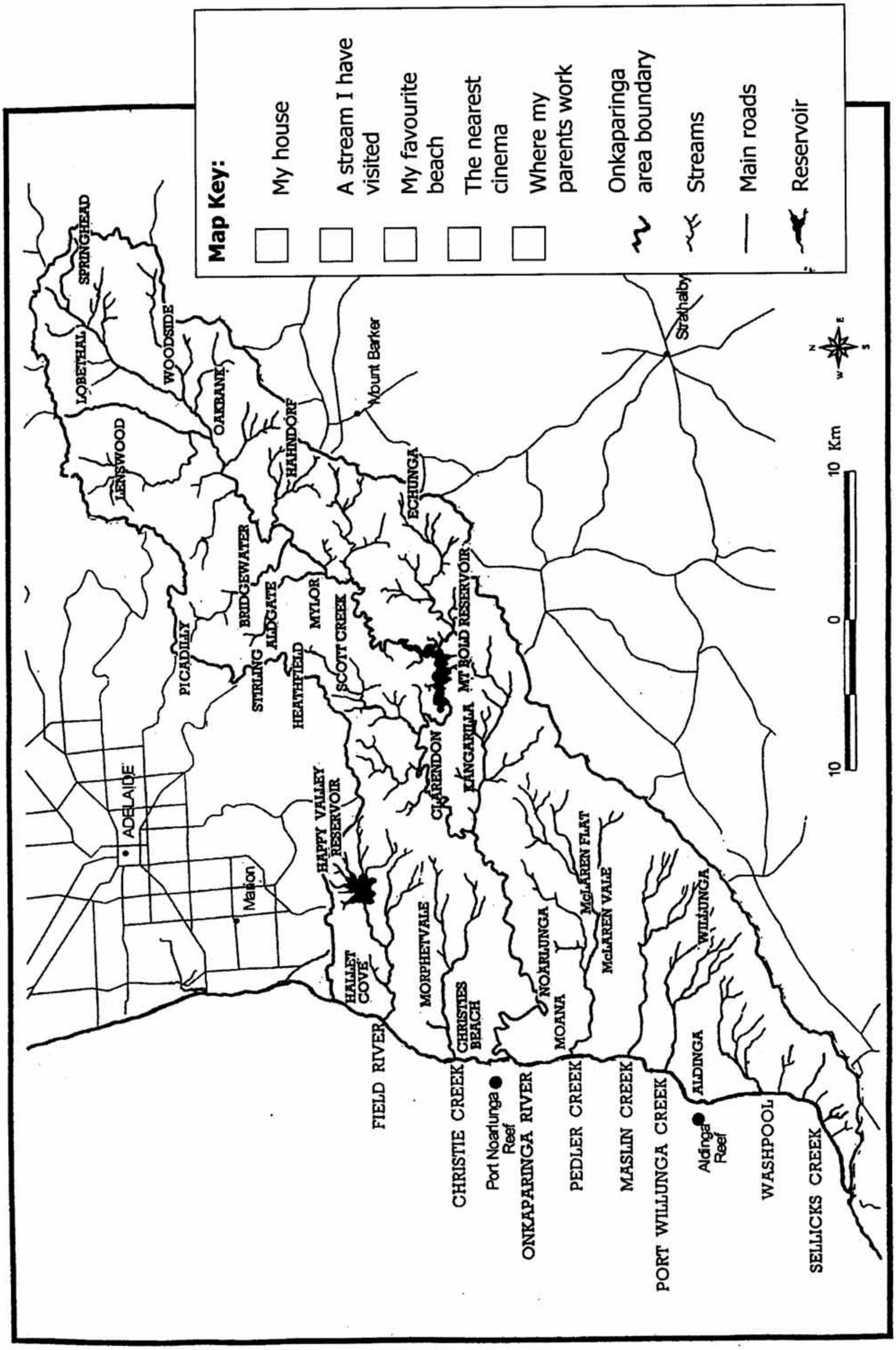
   c. At each location you find on the map draw in the correct symbol. For example guess where your house is and draw a + on the map.

   d. Use colour pencil to shade in the area of your catchment on the map.

What is a catchment?

A catchment is made up of connected creeks and rivers and the land that surrounds them. Rain landing in one catchment cannot end up in the creek of another catchment. Why?

Where's my catchment?



For maps of other catchments in the Adelaide region, see www.amlrnrm.sa.gov.au

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2. Caring for our catchments

Concepts

- The health of a catchment can be improved by extracting less water from streams, reducing pollution and controlling feral species.
- A healthy river can be recognised by clearly defined characteristics.

What can be done to improve the health of catchments?

The effect of each type of land use on the catchment can be reduced by improving management practices. Specific ideas to reduce the impact of different land uses on the catchment are included as "pollution solution" hints in the *Catchment Capers* exercise provided with this topic. *More detailed solutions to catchment problems are provided in Catchment Connections Folder 4: Taking Action.*

A catchment's health depends on both the aquatic ecosystems, and the terrestrial (land) environment. It is therefore important that the whole catchment be considered if improvements to water quality and aquatic habitat are to be successful. This concept is the basis of 'Integrated Catchment Management,' an approach to environmental management.

Broadly, the following measures could be used to improve catchment health:

Revegetation - using local native species, revegetation will provide a number of functions, such as preventing erosion of soil into waterways, stabilising stream banks, filtering water, providing habitat for native species of animals, preventing rising watertables (a cause of salinity) and improving the biodiversity of the catchment.

Stream restoration - returning waterways to a condition resembling their original natural form. Removing exotic pest plants which smother native vegetation and cause erosion, planting indigenous vegetation, installing erosion control structures and placing woody debris are some methods of stream restoration. These aim to provide habitat, stabilise banks and slow fast water flows which cause erosion.

Water conservation - by reducing the amount of water taken from waterways, we can ensure that the water requirements of the ecosystem can be met. For example, currently, about 70% of flow does not reach the mouth of the Onkaparinga because so much is diverted for water consumption.

Elimination of feral species - feral plants and animals reduce the catchment's biodiversity and can have a negative effect on water quality. Eliminating weeds and feral animals will remove a significant threat facing natural ecosystems.

Pollution prevention

Rural pollution - Preventing stock access to waterways through fencing and alternative water sources helps improve water quality**.** It is also necessary to limit chemical use and follow best-practice guidelines, and to revegetate waterways to prevent erosion.

Stormwater pollution - 'the drain is just for rain'... To improve catchment health, replace deciduous trees with natives; compost lawn clippings and other garden waste; limit fertiliser and pesticide use; do not wash car or other machinery and equipment on driveways and other sealed surfaces; pick up dog poo; dispose of rubbish correctly and fix oil leaks.

What does a healthy river look like?

An ecologically healthy river will have distinctive flow regimes, water quality and channel characteristics so that:

- the majority of plant and animal species are native and no exotic species dominate the system.
- natural ecosystem processes are maintained.
- major natural habitat features are represented and are maintained over time.
- native riparian (riverside) vegetation communities exist for the majority of its length.
- native fish and other fauna can migrate up and down the river.
- linkages between the river and its surrounding floodplain and associated wetlands are maintained.
- natural linkages with the sea or terminal lakes are maintained.
- associated estuaries and terminal lake systems are functional ecosystems.

(Source: Department of Natural Resources and Environment, 2002, *Healthy Rivers, Healthy Communities & Regional Growth - Victorian River Health Strategy*)

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Lesson ideas

Activities available in the full set of *Catchment Connections* folders:

- *Water: Learning and Living poster (back section of Folder 1)* - Students identify human activities that have an impact on the catchment. Try to work out ways to reduce these impacts. Construct a table on the whiteboard and have students suggest answers and then copy the table into their work books.

Additional ideas:

- If you were in charge of managing your local catchment, what would you do to make the catchment a healthier place? Write a story.
- Pick a catchment care category to research and produce an information brochure. Choose from revegetation, stream restoration, water conservation, pollution prevention and/or elimination of feral species.
- What can you do at home to care for the catchment? What can you do at school?
- Write a catchment care song to perform to the school.

Recommended resources

www.waterwatchadelaide.net.au

Many tips to reduce your impact on our catchment.

http://www.healthywaterways.org/filelibrary/FILE2003314183212.pdf

Fact sheet containing tips to reduce your impact on your catchment

Catchment Capers

Background

Everyone lives in a catchment! Houses and schools are directly connected to waterways by the system of gutters and drains on roads. Any rubbish or pollution on roads, driveways and other hard surfaces can be washed into gutters, then down drains. These direct water into the nearest waterway which in turn runs into the main river or the sea. What we do at home or school impacts on waterways!

Each land use in the catchment has the potential to affect water quality. Catchment Capers highlights the role different land uses play in affecting catchment health.

Look at a map of the Adelaide region and see how large our catchment areas are. The catchment area includes all the small creeks and drains that feed into the main river. Find your location on the map.

Land uses in the catchment are extremely varied. Brainstorm what land uses we might see in the catchment area. Examples from the hills include: orchards, dairy farms, vineyards, horse, sheep and cattle grazing and natural bushland. In the lower parts of the catchment land uses include: urban development, industry, high-density road networks and parks and gardens.

Activity outline

Give each student (or pair of students) a role-play card. Younger children will need help reading and understanding their role.

Ask each student or pair of students, to find pictures from a magazine or draw a picture of the impacts their role can cause. Computer clipart could also be used (a good clipart site is http://dgl.microsoft.com). Alternatively, this could be done ahead of time.

Seat the students around the 'river' (a tarp, piece of cardboard or poster paper can be used for this) and explain that they are the catchment area for this river. Comment on how clean the river looks and that when it is clean, it is a good home for animals and a healthy place to play.

Go around the class and have each student read (or help them read) their role. Emphasise that some things get into the river by going 'into the gutter and down the drain', repeat this phrase as often as possible until the students join in. Discuss how that role would affect the water, then place the picture/s into the river. As more pictures accumulate, comment on how the water is looking, e.g. who would want to swim in /drink that water? Would it be a good home for animals?

When everyone has had a turn, discuss the problems of a polluted river: not fit for swimming or fishing; poor habitat for aquatic life; could be smelly or could look bad. BUT for every pollution problem, there is a solution!

Go around again and for each problem, brainstorm solutions. Hints are given on the next page. As a solution is found, pull the related pollutant pictures out of the river, so that at the end, the river is clean. Sum up by asking class what they and their family can do to help the river. If they can give some relevant answers, the exercise has worked!

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Pollution solution hints

Wood cutter: Alternatives to cutting down native trees: using plantation timber, using heating alternatives such as gas/electricity, recycling timber off-cuts. Plant native trees to replace those felled.

Cat owner: Keep cats indoors all the time or at least from dusk-dawn; build an enclosed cat playground; have a collar with at least 2 bells.

Car driver: Fix oil leaks; avoid leaving rubber on the road by not braking suddenly or doing 'donuts'; avoid driving on sensitive areas such as riverbanks; find alternatives to car travel, e.g. walking, cycling and car pooling.

Car washer: Wash the car on the lawn so that water and detergents get used by the garden rather than go down the drain; use a car wash (most water is recycled).

Dog owner: Keep dog on lead in bushland/waterway areas; always pick up dog poo and dispose of it in a bin.

Horse owner: Don't let horses into waterways to drink; fence off waterways and provide a trough instead; collect horse manure to use on garden beds or sell it; revegetate damaged riverbanks.

Dairy farmer: Don't let cows into waterways to drink; fence off waterways and provide a trough instead; revegetate damaged riverbanks.

Gardener with exotic trees: Plant local native plants instead of exotics (avoids potential weed problems too!); collect fallen leaves and add them to compost heap or garden beds.

Gardener using fertiliser: Only use minimal amount; never use garden chemicals when rain is forecast; recycle kitchen and garden scraps into compost as an alternative to fertilisers; use native plants that are adapted to local conditions and require fewer chemicals.

Fisherman: Never leave line, tackle or bait behind; buy bait worms or dig them from the garden instead of the riverbanks; never throw back feral fish if caught.

Apple grower: Never use chemicals when rain is forecast and always follow instructions; use drip irrigation instead of sprinklers to lower water use; use organic methods of pest control.

Sheep farmer: Don't let sheep into waterways to drink; fence off waterways and provide a trough or dam instead; revegetate damaged riverbanks.

Picnic people: Always put rubbish in bin or take away if no bin is provided; a lot of rubbish can be recycled or reused; never throw fruit away as it can spread germs or weeds.

Grape grower: Never use chemicals when rain is forecast and always follow instructions; use drip irrigation instead of sprinklers to lower water use; use organic methods of pest control; use mulch and plants between rows to prevent soil erosion.

Gardener dumping weeds: Never dump weeds in or near bushland or waterways - dispose of in bins; some weeds can be destroyed by deep burial or composting.

Builder: Cover sand and gravel heaps with plastic sheets to prevent it washing away; put a barrier between the building site and the gutters/drains.

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Wood cutter

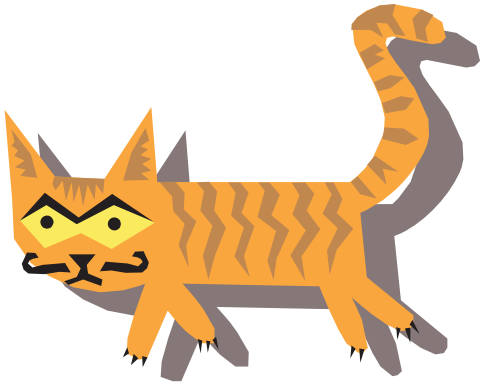
Cuts down trees for firewood
Destroys habitat for native animals

Gardener with exotic trees

Trees lose their leaves in autumn and winter
Leaves wash or blow into the river
Rotting leaves make the water dirty and smelly

Cat owner

Lets cat roam outside
Cats kill native birds, frogs and lizards



Gardener using fertiliser

Fertiliser washes into the river
Fertiliser causes algal blooms that can make the water slimy and poisonous

Car Driver

Leaks oil onto the road

Brakes quickly and leaves tyre rubber on the road

Creates air pollution

Drives through the mud near the river

Fisherman

Digs holes in the river bank to catch worms

Leaves fishing line in the water

Leaves plastic bait bags behind

Car Washer

Washes car on the driveway

Detergent runs down the gutter into the drain

Detergents pollute the water and can be toxic to animals

Apple Grower

Uses fertilisers to help trees grow

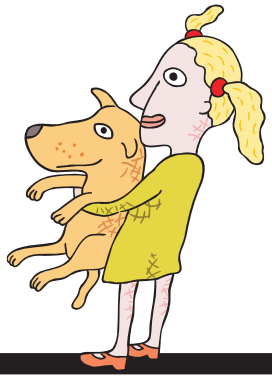
Fertilisers run into the river and cause algal blooms

Uses chemicals to kill insects

Takes water out of the river to water the crop

Dog Owner

Lets dog chase ducks in the river
Doesn't pick up dog poo (dog manure in river adds nutrients that cause algal blooms)

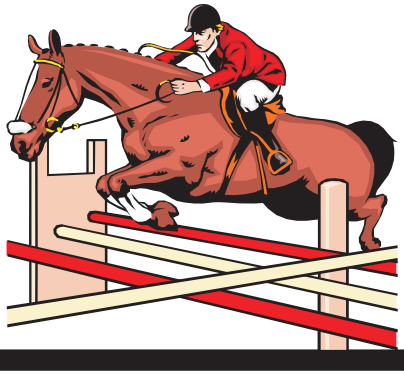


Sheep farmer

Sheep go down to the river to drink
Trample the water plants
Sheep poo in the water
Makes the river banks muddy

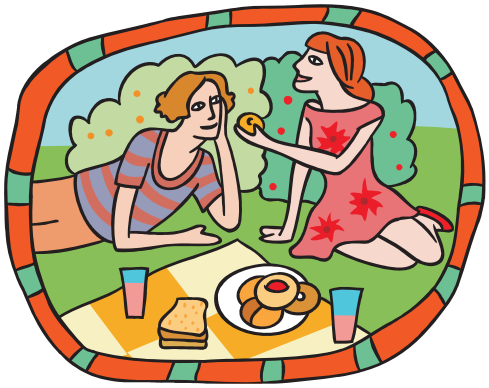
Horse Owner

Lets horse down to the river to drink
Horse tramples water plants
Horse manure in river adds nutrients that cause algal blooms



Picnic People

Leave rubbish behind
Throw fruit into the bushland and spread weeds and germs



Dairy Farmer

Lets cows in to the river to drink

Cows trample the water plants

Cow manure in river adds nutrients that cause algal blooms

Cows break up the river banks and send soil into the river

Grape grower

Takes water from the river

Uses chemicals and manure

Leaves bare soil between the rows of vines

Gardener dumping weeds

Dumps weeds into bushland or stormwater drain

Weeds spread and kill native plants and take over habitat

Builder

Lets sand and gravel wash into the gutter

Sand and gravel increase water turbidity (cloudiness)

Danny the drip

Background

Danny the Drip is an active visual exercise emphasising the variety of pollutants that can enter waterways and how they accumulate. It shows the progressive deterioration of a river as it makes its way from the hills, through the catchment and out towards the sea.

Equipment

A large clear container (e.g. flat tray, washing tub or small aquarium).

An open space, preferably outside or in a wet area.

Some envelopes and small containers (eg. Film canisters or small vegemite jars).

You can supply the 'pollutants' yourself, or:

A) distribute the names of the pollutants (and their imitations for the purpose of the exercise) to students - some doubling up is okay.

B) Ask students to bring in a small amount of their sample pollutant in a suitable spill-proof container.

Pollutants	Imitation
1. Plant food	- Dynamic lifter
2. Poo	- Coffee beans
3. Algae	- Chopped lettuce
4. Dead animals	- Plastic toy animals
5. Soil	- Soil
6. Salt	- Salt
7. Acid	- Water/ green cordial
8. Nasty chemicals	- Mustard or tomato sauce
9. Fishing line	- Fishing line
10. Rubbish	- Small items of litter
11. Lawn clippings	- Grass
12. Leaves	- Non-native leaves
13. Oil	- Cooking oil
14. Cement	- Flour/ baking soda
15. Sticks	- Twigs
16. Gravel	- Gravel or pebbles
17. Sand	- Sand
18. Petrol	- Brown vinegar
19. Rubber	- Chopped rubber bands
20. Cigarette butts	- Butts or cotton bud tips
21. Detergent	- Detergent
22. Toxic chemicals	- Coloured cordial

Lesson Outline

Half fill the container with water. Read the story (below) and when prompted, have students add pollutants into the water. At the end of the story, all the pollutants will have accumulated into a mess, demonstrating that different types of pollution can add up to cause significant problems in waterways.

The story

NB: the words in bold are the cue for adding the pollutants into the 'catchment'. Use the italicised questions to prompt discussion about catchment-friendly alternatives.

This is the story of a drop of water called Danny

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the Drip and the tales of his journey through the catchment. Danny the Drip's journey begins high up in the hills where the rain first falls onto the slopes and runs off the hills into creeks and rivers. Danny falls from the sky into one of the rivers and here begins his long and exciting journey to the sea.

As Danny the Drip travels down the river, he passes though farms and towns and sees many things that make him very sad and sick. Danny is angry because these things are polluting the water and making it a yucky, smelly place for him to live. But Danny knows that it's actually easy for people to look after the river and to prevent polluting it.

As Danny the Drip moves down through the hills he enters some farming country. Here Danny meets Farmer Joe who is growing some wheat crops for our bread. Farmer Joe has recently fertilised his crops with lots of **plant food** to make them grow. After fertilising there was a downpour of rain and the extra plant food was washed into the river. *Should farmer Joe throw lots of fertiliser on the wheat or should he only put on what is needed?*

Next door to Farmer Joe is Farmer Mary, and she keeps lots of cows. Farmer Mary's cows are allowed to drink from the river and eat the river plants. While they are eating and drinking, the cows **poo** straight into the river. The poo smells horrible and makes the water dangerous to drink for people and animals. The cow poo also acts as a fertiliser for the water plants and makes them grow more quickly. One kind of water plant, called **algae**, grows out of control because of all the poo. Poor Danny the Drip, his water is now yucky, smelly and full of slimy algae. *How can Farmer Mary stop it? Leave the cows to drink near the river, or put up a fence and keep them out?*

On the other side of the river, Mr Potts has some grazing land for sheep. Two nights ago, a fox ran through the paddocks and killed some of his sheep and some of Farmer Mary's baby cows. Farmer Mary and Mr Potts were very lazy so they decided just to dump the **dead animals** in the river and be done with it. Now Danny has to swim around with dead animals, which rot away and make the water very unhealthy! *What should Farmer Mary and Mr Potts have done with the dead animals? Dump them in the river or bury them?*

When Mr Potts bought his farm, he decided to cut down all the trees to make way for his sheep. With all the trees gone, the birds and the native animals like possums and parrots lost their homes. Even the sheep would like lots of trees for shade in summer and shelter for their little lambs from cold and rain in winter. Without plants to hold the riverbanks together, the soil comes loose. When it rains, the riverbanks collapse into the water dumping lots of **soil** into the river.

How can Danny see where he's going if his river is full of mud? *What should Mr Potts do to fix this problem? Keep cutting down trees or plant native trees and shrubs? What is the difference between a native and an introduced tree? Can you name any native trees, bushes or shrubs?*

Without trees, the soil and the river gets very **salty**. Many of the plants and animals don't drink salty water and lots of them die. Poor Danny the Drip is very unhappy now his home is getting more polluted as he makes his journey to the sea.

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How can we stop the soil and water getting saltier? Keep chopping down trees or by planting native trees and shrubs?

At the end of the hills Danny passes by a mine. The people working at the mine pump water out of the river to clean their equipment and flush the waste back into the river. There are **acids** in the waste. *What should be done with the acid waste? Let it drain into the river or take it to a chemical dump?*

After a long and winding journey through the hills, Danny the Drip finally reaches the edge of a town. Here, there are a number of small hobby farms, where people grow vegetables, fruit and grapevines. To keep the weeds and insects away from their crops, many people spray chemicals, called pesticides onto their plants. When the sprinklers come on to water the plants, the **chemicals** get washed into the gutters, down the stormwater drains and into the river, poisoning many of the plants and animals that live there. *What should these people do to stop nasty chemicals getting washed into the river? Overload the garden with chemical sprays or use small amounts of spray or even have organic gardens?*

As he continues his journey to the sea, Danny the Drip passes some people making use of the river. A man is fishing on the banks. Unfortunately his **fishing line** gets caught around a rock and is left in the water. "OH NO!!" thinks Danny the Drip "what would happen if a fish or a bird got caught up in that fishing line?" *What should the fisherman have done with his fishing line? Leave it there or untangle it?*

Around the next bend, Danny the Drip sees a group of people enjoying a picnic on the edge of the river. A gust of wind blows some of the **rubbish** off the table and down into the river. Danny the Drip is really sad now; he can't believe how careless some people can be. *What should the people have done with their rubbish? Leave it lying around or put it in a bin or recycle or compost it?*

At the park Danny the Drip sees a gardener cutting **lawns**. *What should the gardener do with the lawn clippings? Put them in a compost heap or dump them in the river?* Danny also sees an old exotic tree dropping all its autumn **leaves** into the gutter. *What should the gardener do? Leave them there to rot or rake them up and add them to her compost?* If the leaves and lawn clippings are left to rot on the ground, they will make their way into the gutters, down the stormwater drains and into the river. Then they'll use up all the oxygen and Danny's plant and animal friends would suffocate and die.

As he passes into the town, Danny the Drip spots an old school bus taking kids home. The bus driver has not serviced the bus for a long time and its engine is leaking **oil** straight onto the road. "Oh dear!" Thinks Danny the Drip "that oil will be washed into the gutters, down the stormwater drains and into the river. The ducks and other birds are not going to like this yucky, sticky oil polluting their homes and making their feathers stick together." *What should the bus driver do when he gets back to the depot? Get the oil leak fixed or let it keep dripping?*

A man is doing some **cement** work on a path leading from his house to the river and he needs to clean the cement mixer. *Where should he put the waste water? Wash it onto the path or dispose of it safely?* If he washes it onto the path, it will flow into the gutters, down the stormwater drains and

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into the river where it will pollute the water with nasty cement mix.

Around the next bend Danny the Drip sees that some road works are taking place. Many of the trees have been removed and gravel and sand is lying all over the road. *What should the road workers do? Clean it up or leave it there?* When it rains the **sticks**, **gravel** and **sand** wash into the gutters, down the stormwater drains and into the river. This makes the river very dirty and muddy and Danny the Drip can't see where he is going any more. He bumps his head on rocks and gets tangled up in leaves and branches. This is very scary for Danny the Drip and he wishes people were more careful.

People who have spent the day at work are now starting to drive home. The roads are full of traffic. **Petrol** drips out of cars and if they brake in a hurry, they leave **rubber** from their tyres on the road. Danny sees one woman in a car who has just finished smoking a cigarette. The woman flicks her **cigarette butt** out of the window and onto the road*! Is this OK or should she do something else with her butts?* If left on the road, the cigarette butts will wash into the gutters, down the stormwater drains and into the river. Danny will have to swim around in the dirty, smelly cigarette butts, petrol and rubber because every time it rains these pollutants are carried down the gutter into the stormwater drains and straight into the river which flows to the local beach. *What could motorists do to stop the damage they do to the river?*

As Danny moves towards the sea he notices someone washing their car on the driveway. The car washing **detergent** is running into the gutters, down the stormwater drains and into the river. *Where should the dirty washing water go? Should the car be washed in the driveway or on the lawn?* The detergent has lots of fertiliser in it that helps make more slimy algae grow. "OOOH! Oh No!" thinks Danny the Drip "My poor animal friends are not going to like all this algae in the water; the algae uses up oxygen and they won't be able to breathe."

Danny the Drip notices that one of the factories near the river has a pipe coming from it that leads straight into the river. When he takes a closer look he sees that there are all sorts of **toxic chemicals** coming out of the pipe. "This is just terrible," thinks Danny the Drip "don't people realise what they are doing to my home?" *What could the factories do with their chemicals to stop damaging the river? Could they use less or alternative chemicals or dispose of their waste in a better way?*

With one final bend in the river Danny the Drip finally arrives at the sea BUT LOOK AT THE WATER that flows into the sea with him - it is full of yucky, smelly, slimy and poisonous pollution. The pollution can hurt the animals and plants in the river and also hurts the animal and plants that live in the sea.

Danny the Drip is desperate. What can you and your family do to help the rivers and beaches?

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Barossa Bushgardens Excursion

Background

Barossa Bushgardens is a regional native flora centre, situated in the township of Nuriootpa. Ideal for school visits, Barossa Bushgardens offers an introduction to the local flora of the Barossa region on its 7 hectare site, including low water-use front-garden sized display gardens.

Schools are encouraged to book in for tours and/or to play the experimental group game which allows students to discover local flora for themselves. It is best to allow approximately one and a half hours on site for this activity.

The Barossa Bushgardens offers a unique learning experience to students, and gives them the opportunity to learn about one of the most important aspects of catchments, vegetation and its role in the local environment.

Planning and planting for the future: Arianne Sadiwynk of Gawler with a pram full of local Barossa native plants from Barossa Bushgardens regional native flora centre at Nuriootpa"

Things you will need:

☐ Transport to and from the Barossa Bushgardens

☐ Lunch and drinks

☐ Appropriate clothing and sun protection (closed shoes, hats, long pants, sunscreen etc.)

☐ Pens, pencils and clipboards to complete the Barossa Bushgardens Game

☐ Extra parents and staff members if the group is large

Activity outline

The experiential group game below has been developed for primary school students when visiting Barossa Bushgardens (regional native flora centre) at Nuriootpa. It is envisaged that students divide into groups of three or four and after being briefed by a project officer they can then embark in separate groups on the game. The game itself stresses co operative learning and decision-making. Each group has a different set of questions to answer. Allow at least an hour and a half to two hours on site for an introduction to the Bushgardens and the game.

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Barossa Bushgardens Game: The Echidnas / Group A

1. How many people does it take to link arms around the Old Gum Tree?.....

2. How many tree hollows can you see in the Old Gum Tree?……..

3. What creatures live in the tree hollows?.....

4. How old is the Old Gum Tree?.....

5. Give the Old Gum Tree a score between 1 and 10 for health: 10 = very healthy, 5 = sick, 0 = dead……

6. Name two types of climbing plants that grow on a trellis or fence:
   a)
   b)

7. List the birds you have seen:
   ……
   ……
   ……
   ……
   ……
   ……
   ……

8. What is the name of the river? Is it flowing? .....

9. Draw the leaf of a silver banksia

10. Which is your favourite of the four Display gardens? Why?

11. Why is it good to plant local Barossa natives in the Barossa?

12. Can you find the magic ingredient of the Bushgardens? It is hidden in a plastic bottle under the cypress pines in Row …….

13. Write down the magic ingredient……

Barossa Bushgardens Game: The Frogs / Group B

1. How old is the Old Gum Tree?.....
2. Give the Old Gum Tree a score between 1 and 10 for health: 10 = very healthy, 5 = sick, 0 = dead……
3. Name two types of climbing plants that grow on a trellis or fence
   a)
   b)
4. How many people does it take to link arms around the Old Gum Tree?.....
5. How many tree hollows can you see in the Old Gum Tree?.....
6. What creatures live in the tree hollows?.....
7. List the birds you have seen
   …….
   …….
   ……..
   …….
   …….
8. Draw the leaf of a silver banksia
9. Which is your favourite of the four Display gardens? Why?.....
10. Why is it good to plant local Barossa natives in the Barossa?
11. Can you find the magic ingredient of the Bushgardens? It is hidden in a plastic bottle under the cypress pines in Row…….
12. Write down the magic ingredient……
13. What is the name of the river? Is it flowing?.....

Barossa Bushgardens Game: The Kookaburras / Group C

1. List the birds you can see in the Bushgardens

   …….

   …….

   …….

   …….

2. Draw the leaf of a silver banksia

3. Which is your favourite of the four Display gardens? Why?.....

4. Why is it good to plant local Barossa natives in the Barossa?.....

5. Can you find the magic ingredient of the Bushgardens? It is hidden in a plastic bottle under the cypress pines in Row…….

6. Write down the magic ingredient……

7. What is the name of the river? Is it flowing?.....

8. How old is the Old Gum Tree?.....

9. Give the Old Gum Tree a score between 1 and 10 for health: 10 = very healthy, 5 = sick and 0 = dead……..

10. Name two types of climbing plants that grow on a trellis or fence

    a)

    b)

11. How many people does it take to link arms around the Old Gum Tree?.....

12. How many tree hollows can you see in the Old Gum Tree?.....

13. What creatures live in the tree hollow?.....

Barossa Bushgardens Game: The Redgums / Group D

1. Draw the leaf of a silver banksia

2. Which is your favourite of the four Display gardens? Why?.....

3. Why is it good to plant local Barossa natives in the Barossa?.....

4. Can you find the magic ingredient of the Bushgardens? It is hidden in a plastic bottle under the cypress pines in Row……..

5. Write down the magic ingredient……

6. What is the name of the river? Is it flowing?.....

7. List the birds you can see in the Bushgardens
   ……
   ……
   ……
   ……

8. How old is the Old Gum Tree?.....

9. Give the Old Gum Tree a score between 1 and 10 for health: 10 = very healthy, 5 = sick, 0 = dead……

10. Name two types of climbing plants that grow on a trellis or fence
    a)
    b)

11. How many people does it take to link arms around the Old Gum Tree?.....

12. How many tree hollows can you see in the Old Gum Tree?.....

13. What creatures live in the tree hollows?.....

Barossa Bushgardens Game: The Banksias / Group E

1. Name two types of climbing plants that grow on a trellis or fence

   a)

   B)

2. Draw the leaf of a silver banksia

3. Which is your favourite of the four Display gardens? Why?.....

4. Why is it good to plant local Barossa natives in the Barossa?.....

5. Can you find the magic ingredient of the Bushgardens? It is hidden in a plastic bottle under the cypress pines in Row…….

6. Write down the magic ingredient……...

7. What is the name of the river? Is it flowing?.....

8. List the birds you can see in the Bushgardens

   ……

   ……

   ……

   ……

   ……

   ……

9. How old is the Old Gum Tree?.....

10. Give the Old Gum Tree a score between 1 and 10 for health: 10 = very healthy, 5 = sick, 0 =dead

    ……

11. How many people does it take to link arms around the Old Gum Tree?.....

12. How many tree hollows can you see in the Old Gum Tree?.....

13. What creatures live in the tree hollow?.....

Barossa Bushgardens Game: The Wattles / Group F

1. Which is your favourite of the four Display gardens? Why?.....
2. Why is it good to plant local Barossa natives in the Barossa?.....
3. Name two types of climbing plants that grow on a trellis or fence

   a)

   b)
4. Draw the leaf of a silver banksia
5. Can you find the magic ingredient of the Bushgardens? It is hidden in a plastic bottle under the cypress pines in Row……..
6. Write down the magic ingredient……
7. What is the name of the river? Is it flowing?.....
8. List the birds you can see in the Bushgardens

   ……..

   ……..

   ……..

   ……..
9. How old is the Old Gum Tree?
10. Give the Old Gum Tree a score between 1 and 10 for health. 10 = very healthy, 5 = sick, 0 = dead……
11. How many people does it take to link arms around the Old Gum Tree?.....
12. How many tree hollows can you see in the Old Gum Tree?.....
13. What creatures live in the tree hollows?.....

Catchment Crawls in the Central Region

Background

The following information is provided to enable school groups to conduct their own Catchment Crawl. By running it yourself, you can have full flexibility of dates and number of classes. You can also add specific spots of local interest that may not be a part of a suggested tour itinerary. Equipment for activities such as macroinvertebrate sampling or water testing is available for loan to use on your tour.

Things you need:

- Clothes appropriate to the weather and enclosed shoes
- Sun hat and sunscreen
- Recess and lunch
- Macroinvertebrate net (or stocking net instructions included in Topic 8 of this booklet) and a tray for viewing bugs.
- Worksheets (attached, there are more available from www.waterwatchadelaide.net.au)
- A catchment map

Tour outline

Tours are designed to take a full school day, departing at 9am and returning at 3pm. Following are some outlines of suggested tour itineraries currently run by Waterwatch Central Adelaide, but you can change the itinerary depending on your interests. Please visit www.waterwatchadelaide.net.au for tour stop specific information and access.

The basic itinerary is dependent on the location of your school and how long the bus trip to the first stop and from the last stop will take. Work out what time you will need to leave the last stop to get back to school on time and work backwards to calculate timings for each destination.

Discuss the definition of a catchment; the area of land that catches rainfall and directs it into the river. Show school location and tour stops on the catchment map.

Introduce the idea of land uses in the catchment and consider their impacts on the environment.

River Torrens Catchment

Suggested sites include the Mannum-Adelaide pipeline, Kangaroo Creek Reservoir, Third Creek confluence, Torrens Lake Weir, Breakout Creek or Apex Park Wetland and the mouth of the Torrens at Henley Beach.

Patawalonga Catchment

A suggested itinerary is Heathfield Wastewater Treatment Plant, Sturt Gorge Flood Mitigation Dam, Warriparinga Wetland, Barcoo Outlet/Patawalonga Lake and Glenelg.

Port River Catchment

The suggested sites to visit are Barker Inlet Wetlands, Garden Island, Mutton Cove, and a coastal stormwater outlet at Osborne.

River Torrens Catchment Tour

Stop 1: Mannum-Adelaide Pipeline, Houghton or Paracombe

View the Adelaide - Mannum pipeline bringing River Murray water approximately 60 km over land to Adelaide. Observe the modified habitats. This stop is bus friendly however there are no toilet facilities.

Stop 2: Kangaroo Creek Reservoir, Gorge Road

Construction of the Kangaroo Creek dam began in 1967 and was completed in 1969. Water from Kangaroo Creek is released into the River Torrens, as required, to maintain the level in Hope Valley Reservoir, the water being diverted at the Gorge Weir. Reservoir capacity 19,160 ML. Talks can be arranged with SA Water staff - this enables access to areas not accessible to the general public. Contact Waterwatch Central Adelaide for details.

There are a couple of places the bus can park, be

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careful if crossing the road. There are no toilet facilities.

Stop 3: Third Creek Confluence, Drage Reserve, Felixstow.

Observe the highly modified straightened concrete channel of Third Creek, revegetation area, environmental weeds (willows) along the River Torrens. Good opportunity to observe the impacts of such a modified system on the flora and fauna of the area, as well as the role and function of trash racks.

Facilities include interpretive signage, toilets (on Riverside Dr), park, tables, grassed areas, extensive car parking. A good place to have recess.

Stop 4: Torrens Lake Weir, off War Memorial Drive.

The Weir, built in 1881, is a significant site that has greatly influenced the River Torrens. Also view the artificial lake on the River Torrens. The area has a high recreational value. Observe: removal of willows along some sections, reinforced banks, accumulation of floating pollution, aerators to reduce algal blooms, abundant bird life.

Facilities include shady grassed areas. A few toilets are available at the Golf course.

Stop 5: Breakout Creek or Apex Park Wetland

Breakout Creek, Arcoona Ave, Lockleys.

A constructed channel and wetland system, provides the opportunity to discuss urban constructed wetlands and observe flora and fauna. Discuss the horse agistment downstream of the bridge and the impact this may have on the river.

Buses will be required to reverse for a short distance. Interpretive signage by a local school is available to help direct discussion.

Apex Park Wetland, Burbridge Road, West Beach.

A re-constructed wetland with good examples of native aquatic and submerged plants, with some remnant species. Lots of frogs and water birds present. Pumping station located close by to move overflow into the River Torrens. Discuss the history of the Reedbeds and how it has changed since European settlement. A good place to catch and identify macro-invertebrates. Contact Waterwatch Central Adelaide to borrow equipment.

Facilities include toilets, picnic tables, playground, tennis courts and interpretive sign about the wetland.

Stop 6: Torrens Outlet/Mouth, Seaview Road, Henley Beach.

View the constructed river outlet to the sea and the concrete weir, fish ladder (to allow migration between the river and the sea), floating boom, a last effort to remove litter, and recreational fishers. Small interpretive signage and toilets are available. A worksheet for the outlet is available at www.waterwatchadelaide.net.au

Patawalonga Catchment Tour

Stop 1: Heathfield Wastewater Treatment Plant, Brick Kiln Road, Heathfield.

Tours by arrangement only, contact Waterwatch Central Adelaide to arrange a tour guide. See Wastewater Treatment Plant in operation and learn the processes undertaken to clean wastewater. No toilets are available; visit Memorial Park, Stirling or Apex Park, Stirling for toilets and playground.

Stop 2: Sturt Gorge Flood Mitigation Dam, Broadmeadow Drive, Flagstaff Hill

The Sturt flood mitigation dam (40m high) was completed in 1963 for a 1/100 yr flood. Walk along the dam wall to observe the sedimentation pond upstream, which ponds the river for several hundred metres. A good place to consider and discuss the impacts of altered flows regimes on aquatic plants and animals. No toilet facilities available.

Stop 3: Warriparinga Wetland, Warriparinga way, Bedford Park

An urban wetland constructed in 1997 offstream of Sturt River to improve water quality, mitigate floods and provide habitat. A great place to look at riparian and aquatic vegetation, remnant river red gums, and nesting boxes. Just downstream of the Expressway is an open drain lined with rip-rap. Observe the contrast between the natural river and the concrete channel. Facilities include shady lawn areas, trash racks, interpretive signage, limited toilets are available. The Living Kaurna Cultural Centre offers tours/talks with local Kaurna guides for a fee. To book contact The Living Kaurna Cultural Centre (08) 8357 5900.

Stop 4: Barcoo Outlet/Patawalonga Lake, Africaine Road, West Beach

See the floating boom upstream, a last attempt to prevent rubbish from going out to sea. Stormwater is diverted from the Patawalonga to the ocean, via an underground and underwater pipeline. Facilities at this stop include lawn areas, interpretive signage, and toilets at the skate park.

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Stop 5: Glenelg Beach, Jetty Road, Glenelg

This stop features the Glenelg Jetty, metro coastline, stormwater outlets, and urban impacts including pollution and development.

Facilities include interpretive signage, benches, lawn, shade, and toilets (north of the town hall).

Port Catchment Tour

Stop 1: Barker Inlet Wetland, Salisbury Highway, Wingfield

These wetlands can be seen from the viewing platform or access and a tour of the wetlands can be organised with a Waterwatch Central Adelaide Education Officer.

The Barker Inlet Wetlands forms part of the largest constructed wetland in the southern hemisphere and is abundant in birdlife, ideal for sampling aquatic macro invertebrates, home to feral and native fish and a variety of frogs.

An excursion to Statewide Recycling at Wingfield is also available for a small cost per student. Contact Sandy Lea at KESAB on 8234 7255.

Stop 2: Garden Island, off Grand Trunkway, Gillman

Features include a former landfill site now undergoing rehabilitation, views of Torrens Island power station, and mangroves. Facilities include a boardwalk over the intertidal zone, alongside mangroves, as well as toilets, a large car park, lawn, shelter, tables, and a public boat ramp. Visit www.waterwatchadelaide.net.au or contact Waterwatch Central Adelaide on 8234 7255 for resources on mangrove environments.

Stop 3: Mutton Cove, end of Mersey Road Outer Harbor

Historically, dense mangrove forests interweaved by creeks were present at this site. However, construction of the seawall resulted in limited tidal flow to the cove through a single pipe from the river. A few regenerating mangroves on mud flats and samphire communities. Previously, lots of illegal dumping and trail bike riding occurred in the area. Recent fencing, plantings and formation of a management committee are tackling degradation issues and re-establishing the area as a conservation park. There are no toilet facilities at this stop.

Stop 4: Coastal Outlet, Lady Gowrie Drive Osborne

This stop features a stormwater outlet, trash rack, and a revegetation site. The outlet provides for an interesting micro environment, where freshwater reeds, sedges and rushes are growing within sand dunes. Contact Waterwatch Central Adelaide to borrow sand dune plant ID cards, beachcombing ID cards and to access sea grass information. Facilities include toilets, a playground, and carpark (200m north of this site).

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Onkaparinga Catchment Crawl

Background

The following information is provided to enable school groups to conduct their own Catchment Crawl. By running it yourself, you can have full flexibility of dates and number of classes. You can also add specific spots of local interest that aren't included in the regular tours provided by Waterwatch Southern Adelaide. Equipment for activities such as macroinvertebrate sampling or water testing is available for loan for your tour.

Things you need:

- clothes appropriate to the weather
- sun hat and sun-screen
- rubber boots or a change of shoes (preferably old ones)
- recess and lunch
- stocking net (instructions included in Topic 8 of this booklet) and ice-cream container
- worksheets (attached), pencil and clipboard
- a catchment map (available from WSA)

Tour outline

Tours are designed to take a full school day, departing at 9 am and returning at 3 pm. Below is the outline of the current tour run by WSA but you can change the itinerary depending on your interests. Suggested alternatives are included. The basic itinerary is dependent on the location of your school and how long the bus trip to the first stop and from the last stop will take. Work out what time you will need to leave Port Noarlunga (the last stop) to get back to school on time then work backwards to calculate timings.

Discuss the definition of a catchment; the area of land that catches rainfall and directs it into the river. Show school location and tour stops on the catchment map. Introduce the idea of land uses affecting river health and ask students to keep an eye on changing land uses in the catchment and consider their impacts on the environment.
On completion of the worksheet activities, enjoy a 15-20 minute recess break.

Note: Mount Bold is sometimes closed to the public so check before you go. A visit to Mylor is a suitable alternative if Mt Bold is closed. Mylor is a good opportunity for students that live in the southern suburbs to get into the hills and see a completely different face of the Onkaparinga than they're familiar with. At this stop, students observe and describe the appearance of the river as a basis for comparison with the lower catchment.

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Stop 1:Cooper Reserve, Silver Lake Road, Mylor

River sketch

- description of the river (prompts: how fast is the water flowing, how wide, are there lots of plants on the river bed, is there light and shade and shelter in the water?)
- water quality testing: instructions available with equipment if needed. This can be done in 4-5 groups or by a staff member then sharing results.

There are no toilets available at this stop. The nearest public toilets are at Mylor Oval or in Echunga.

OR

Mount Bold Reservoir

A substitute set of questions is provided for Mt Bold Reservoir if it is open. Answer questions from the information panel before walking along the dam wall then down and across the swing bridge.

Stop 2: Clarendon - Riverbend Park, between the oval and the river.

Clarendon is a good place to collect macroinvertebrates because there are usually plenty around and the river is easy to access at several points. Once at Riverbend park, walk upstream (right, if facing the river) towards the path that crosses the river. Macro sampling can be done from this wall and around the surrounding areas, anywhere that looks safe though there will always be at least one that slips in!

Time depending, spend about 30 minutes scooping for macros (see attachment) and 20 minutes examining and identifying what is found to answer the macro question. If you didn't do any water testing at your first stop, do a salinity test and share the results.

Stop 3: Lunch at either Market Square, Old Noarlunga or Adventure Playground Saltfleet Street, Port Noarlunga

Lunch and play time. Before departing do a quick water salinity test and discuss why salt levels are much higher than upstream (because it's the estuary where sea water mixes with river water). Also discuss how land uses have changed since leaving the hills, how are urban land uses likely to affect the river?

Stop 4: End of the line - Onkaparinga River mouth

Stop near the footbridge that leads to the South Port Surf Lifesaving Club. Traffic can be busy on Weatherald Terrace so beware, or have the bus do a loop to drop you on the river-side of the road. Before reaching the footbridge, keep an eye out for signs warning of pollution problems.

Stop halfway across the bridge and discuss how the river looks different to the day's first stop. Can you see fish, crabs etc. in the water?

Estuaries are important habitat and nursery areas for a large diversity of birds, fish and other creatures. The sea's tides have an impact on water chemistry, i.e. when the tide is coming in, the water is much saltier.

If you have enough time (about 20-30 minutes), follow the river down to the mouth where it enters the sea. If time is short, take the boardwalk across the dunes to the lookout adjacent to the Surf Lifesaving Club. Discuss how polluted river water could affect the marine environment such as the reef and sea grass beds.

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The following options could be tailored into the day:

Happy Valley Reservoir: SA Water conducts tours of this facility that supplies drinking water to the southern suburbs.

Noarlunga Wetlands: River Road Noarlunga Downs. Follow the wetland walk (best in Terms 2 & 3, takes about 45 minutes) to observe diverse bird life and wetland vegetation.

Onkaparinga Gorge, Onkaparinga Hills: a steep climb from Sundews campsite - not for the unfit but well worth the effort - to a very spectacular part of the river. Takes about an hour to get down to the river level and back up. Alternatively, walk to the lookout (30 minutes round trip) above the gorge for a bird's eye view.

Woorabinda Lake, Stirling: Walk around the lake to observe bird life and remnant bushland (takes about 20 minutes) and tour the discovery room (about 30 minutes - booking required, 8370 1298).

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Cachment Crawl Excursion Worksheet

STOP 1: COOPER RESERVE, MYLOR

1. Sketch this part of the river and its surrounds.

2. Describe the appearance of the water and the river banks.

3. Record water quality test results:

A) Turbidity

B) pH

C) Salinity

4. What do these results tell you about the water quality here?

STOP 1: MOUNT BOLD RESERVOIR

1. Where does the water in the reservoir come from?

2. Where does the water in the reservoir go?

3. How much water does the reservoir hold?

4. What other interesting things have you seen at Mount Bold?

5. Can you think of ways the reservoir might affect the creatures that live in the water?

STOP 2: RIVERBEND PARK, CLARENDON

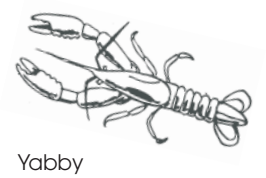
1. Describe the river and its surroundings here. How is it different from the first stop?

2. Do you think this site provides good habitat for aquatic animals?

3. List the macroinvertebrates you saw.

4. What does the variety of macroinvertebrates tell you about how healthy this site is?

5. Did you see or hear anything else living in or near the water?



Yabby

Eastern Banjo frog
Photo courtesy of Steve Walker

STOP 3: OLD NOARLUNGA

1. How have land uses in the catchment changed since the first stop?

2. What impact would this have on the river?

3. Test the water salinity. Has it increased since it was first tested this morning? Why do you think that is?

STOP 4: THE END OF THE RIVER

1. What is an estuary?

2. Why is it important for us to look after our estuaries?

3. Would you expect the water here to have high or low salinity? Why?

IN CONCLUSION.....

1. List 3 things you have learnt about the Onkaparinga River

2. List all the kinds of land use you saw today

3. How do these different types of land use affect the river and the things that live in it

4. Do you think the Onkaparinga is a healthy river, or does it need help? Explain your answer.

5. What can people living in the Onkaparinga Catchment do to improve the health of the river?

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3. Habitats, ecosystems and biodiversity

Concepts

- Definition of habitats and ecosystems.
- We don't understand the full complexity of ecosystems.
- Humans influence most ecosystems.

What is a habitat?

Habitat can be simply defined as the physical location or type of environment in which an organism or biological population lives or occurs. Habitats are generally defined in terms of a particular animal, e.g. the habitat of the Superb fairy-wren or the habitat of the Southern brown bandicoot. Habitats are the homes of particular animals but the term habitat also implicates the resources required by the animal for shelter and nourishment.

While habitats are most often described in terms of individual animals, and indeed there are certain animals which have very specific requirements for their survival, the complete habitat of an animal should not be thought of as being exclusive. It is inevitable that there will be significant overlap between habitats of animals. *Catchment Connections - Folder 2,Topic 1* includes a colour diagram illustrating the overlapping habitats of 3 bird species.

Talking about the habitats of particular animals is a good starting point, but is often insufficient for fostering a full understanding of just how interconnected all living things are.

What is an ecosystem?

An ecosystem (ecological system) is a common concept used to describe a group of plants and animals which are in some way connected by the resources they require for survival. The overlap and interdependency of organisms is best described as ecosystem function.

If we were to consider the ecosystem in which birds coexist, we would have to think about the types of plants they frequent; the soil and nutrients that support those plants; the animals that pollinate them; the herbivores that eat their foliage; flowers and seeds; the animals that disperse their seeds, the frequency of the bushfires which break the dormancy of the seeds; the frequency of the rainfall; the degree of impact on the plants from human wood collection practices. This is just the plants, let alone the insects that the birds also require!

Ecosystems are extremely complex, perhaps more so than the concept suggests. Ecosystems can be considered on many different scales.The main thing to remember is that almost no ecosystem can really be considered completely separate from any other as they all require oxygen and water at some stage which could travel there from any corner of the Earth. It is safest to assume that really the whole Earth is one huge ecosystem.

Lesson ideas

- Have the students draw a picture of a local bird, mammal, reptile or macroinvertebrate. Alternatively issue the *animal cards (Catchment Connections, Folder 2, Topic 3).*
- Have the students prepare an information card about their animal's habitat by researching the answers to the following four questions:
  - What type of animal am I?
  - What do I like to eat?
  - What likes to eat me?

  - Where do I like to live?

- To make this activity more challenging, delete the names of the animals on the cards and ask students to look them up based on appearance only.
- Laminate the information cards to build a lasting set of the biodiversity of the local area. Make more cards as more biodiversity is discovered. Information cards can be used for future games and quizzes, see *Bird Bingo* and *What Bird am I? (Catchment Connections, Folder 2, Topic10)*

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Recommended resources

Menkhorst and Knight (2001) *A Field Guide to the Mammals of Australia*, Oxford University Press

Strahan (1995) *The Mammals of Australia*, Reed Books

Pizzey & Knight (2002) *The Graham Pizzey and Frank Knight Field Guide to the Birds of Australia*, Angus and Robertson

Simpson & Day (1999) *Field Guide to the Birds of Australia:* Sixth Edition, Penguin Books Australia

Cogger (2000) *Reptiles & Amphibians of Australia,* Reed New Holland

Weigel (2000) *Australian Reptile Park's Guide to Snakes of South-east Australia,* Dai Nippon

Any books on birds, mammals, insects and reptiles will provide the information you may need for this activity.

http://www.environment.sa.gov.au/biodiversity/

Website of South Australian Department for Environment and Heritage. Provides some excellent information on individual animals and ecosystems.

http://users.chariot.net.au/~rgrund/bcsa.htm

Excellent website about all of South Australia's butterflies and moths.

http://www.une.edu.au/agss/insects/dbritton/photoin.htm

Website of entomologist and insect enthusiast David Britton. Fantastic insect images which can be downloaded if appropriately acknowledged.

4. What do you need to survive?

Concepts

- Most species are dependent upon other species for their survival.
- Animals closer to the top of the food chain, such as humans, are more dependant on other species than those towards the bottom of the food chain.

Why is biodiversity important?

Biodiversity provides the life systems from which we obtain the essentials for our survival: food, clean water and oxygen.

Where does food come from?

The food plants we eat are grown in healthy soil. The animals that we eat survive by eating the plants which grow in healthy soils.

What is soil made of?

Soil is made from decomposed matter (humus), rocks and billions of micro-organisms. Micro-organisms as well as earthworms, slater beetles and chafer beetles work hard to turn waste into soil.

Where does clean water come from?

The water cycle:

Evaporation> transpiration> condensation> precipitation.

The water that we use comes from rainfall, creeks, rivers and reservoirs. The most effective ways of keeping water clean are natural: Wetland plants filter through the removal of excess nutrients, macroinvertebrates are tiny animals which can eat the potentially harmful algae, keeping it safe for human consumption. Wetlands also slow the water down and so sediments sink to the bottom.

Where does clean air come from?

The Earth's atmosphere is naturally made up of gases such as nitrogen, oxygen and carbon dioxide. We need oxygen to survive. The waste product of our breathing is carbon dioxide, so where does the oxygen come from? Almost all oxygen on Earth comes from the process called *photosynthesis* performed by plants.

Photosynthesis is the process by which plants and some bacteria use the energy from sunlight to produce sugar, which cellular respiration converts into ATP, the 'fuel' used by all living things. The conversion of sunlight energy into usable chemical energy is associated with the actions of the green pigment called chlorophyll. Most of the time, the photosynthetic process uses water and releases the oxygen which we need to survive.

What do animals need to survive?

The resources for survival of local wildlife and humans are basically the same: food, water and oxygen. While the specific foods may differ, the support systems which sustain these resources such as soil and vegetation are the same.

Lesson idea

Activities available in the full set of *Catchment Connections* folders:

- *What do you need to survive worksheet (Folder 2, Topic 2).* Ask students to complete this task. Some of the common requirements will include: water, plant material, fruits and seeds for food and wood, sticks or other vegetation used for building homes.
  - Discuss where these resources come from.
  - Discuss potential impacts and who would be affected if the water supply became polluted or the soil becomes too salty to support plants.

Additional ideas:

- Discuss where air, food and water come from.
- Ask students to imagine that they must live within an isolated biosphere for six months and ask them to consider the following:
  - They have basic sunlight, water, soil and air, but no food or shelter.
  - If they could choose what else they think they would need to survive within that biosphere, what would they choose?
  - What would they NOT want within their biosphere?
  - How will they keep the air and the water supply clean?
  - How would they ensure a food supply?
- Write down answers on a whiteboard.
- Point out variety, some of us need (think we need) resources that other people do not.
- Consider how many resources are needed for human

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survival. Humans are just one species. Consider that every other species on Earth has requirements too!
- Ask how long would we survive without biodiversity?
- Ask students to write a report/ a few sentences/ illustrate their biosphere, and why biodiversity is important to them.

Recommended resources

http://www.indusscitech.net/edu_1.htm

What is photosynthesis? (Technical)

http://www.clw.csiro.au/education/soils/index.html

Some excellent information on Australian soils.

http://www.dnr.state.wi.us/org/caer/ce/eek/earth/groundwater/watercycle.htm

Comprehensive look at the water cycle.

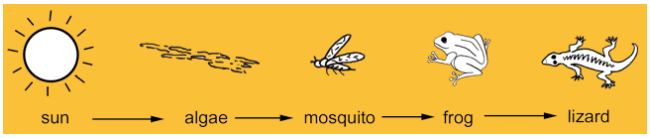
5. Construct a food chain

Concepts

- Food chains in nature can be very simple or very complicated.
- Food chains provide a visual example of how the survival of plants and animals are interconnected.

Following our description of ecosystems in previous topics, the concept of a food chain provides a useful and simple visual tool for demonstrating the interconnectedness of organisms in an ecosystem.

A simple food chain may start with an insect eating a plant, a frog eating an insect and a lizard eating the frog.

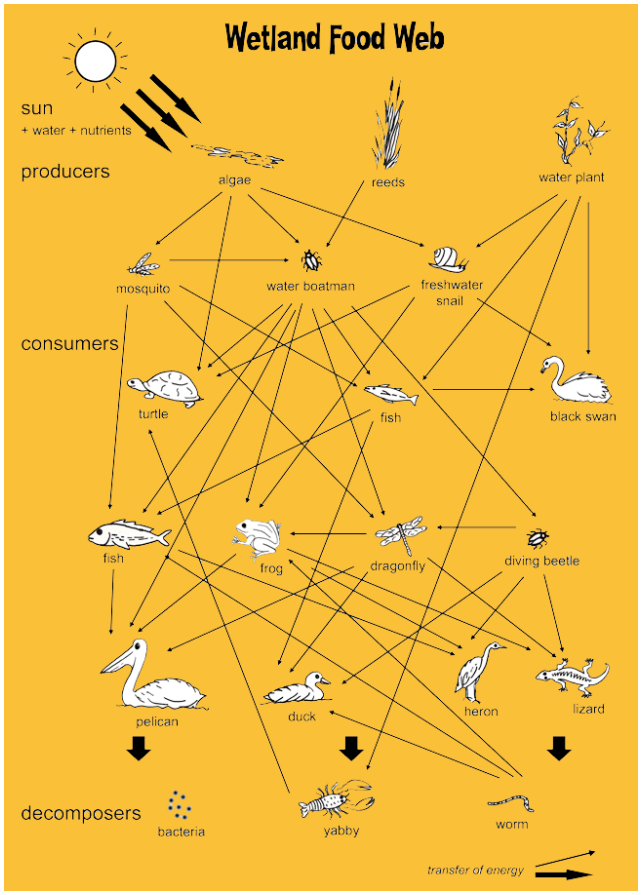


Another combination may be a macroinvertebrate eating an aquatic plant, a tadpole eating the macroinvertebrate, a small fish eating the tadpole, big fish eating the smaller fish and finally a pelican or human eating the larger fish.

Most food chains start with sun, plants and insects and can potentially finish with humans or other predators, such as foxes and cats. In South Australia prior to European settlement, the top predators were dingoes, aborigines, birds of prey, snakes and the Eastern quoll, or native cat as it was sometimes called. Of course food chains do not always end in a top predator because not all insects or fish are eaten. If this was to happen, all species other than top predators would be heading for extinction very quickly! Food chains can be as short as two species.

Food chains are obviously a very simplified representation of what happens in nature. Many animals have extremely varied diets which may include plant matter, insects and small reptiles, not to mention clean water and all the mechanisms that keep the water clean. Furthermore, food is not the only material thing needed for an organism to survive. Many species have extensive habitat requirements which may include hollow logs, fallen leaf litter, clay soils for burrowing in, and stone and timber for building.

Plants also need insects, birds and mammals to pollinate them. This complexity and interdependency of organisms is best described and represented as a web of life.



Lesson ideas

- Give the students names and/or pictures of plants, animals, insects and macroinvertebrates found locally, or use a set of biodiversity cards *(Catchment Connections, Folder 2, Topic 3)*.
- Ask students to think about what the animals eat, what eats them, and ask them to place them in order from the bottom of the food chain to the top. Pictures can be strung together and made into mobiles (food chains) of differing lengths.
- For a more challenging activity, discuss the habitat requirements of each organism and how it links with other organisms. Simple food chains can be laid out on a large piece of paper and lines drawn between them to indicate the connection between them. The end result will show a web of connections (web of life).
- Taking items away from the food web such as plants and insects will show how many other organisms will go hungry or homeless without these important organisms at the bottom of the food chain.

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Recommended resources

See resources provided for Topic 4 for determining food and habitat requirements of individual species.

http://www.yvw.com.au/waterschool/seniors/ecology/freshwatereco/pondfoodweb.html

Excellent diagram of a complex freshwater ecosystem food web.

http://www.gould.edu.au/foodwebs/

This site has some excellent food web diagrams and activities suitable for all ages.

6. Understanding native vegetation

Concepts

- Introduction to the descriptive terminology used for describing natural groupings of plants.
- Vegetation varies across the landscape.
- Some plants will only grow in areas with specific conditions such as rainfall and soil type.

What is a vegetation association?

A vegetation association is a group of plants which occur in association with soil types, rainfall and other climatic conditions along with animals, birds and insects. The plants in these areas are there because they are best at exploiting the conditions available to them. A vegetation association is usually named after the most dominant canopy species occurring in the area, which is most often the Eucalypts, e.g. Grey box grassy woodland or Stringybark forest. The terms woodland and forest refer to the organisational structure of the vegetation, sometimes called the vegetation class. A forest consists of taller trees generally more than 15 metres high which are quite close together, a woodland has fewer large trees and more medium size trees to 5 metres which are a lot further apart, giving a more light and open appearance. Woodlands are often grassy at ground layer.

Vegetation communities can in many instances be correlated with soil types and topography. Over thousands of years the plants and animals living in these associations have started to become dependant on one another for food, pollination, pest control, water supply and habitat provision. There are certain animals which show distinct preferences for particular vegetation associations and individual plants. On the other hand there are a number of species for which a variety of habitats and vegetation associations are essential to their survival. Therefore it is important to consider all types of vegetation associations, when we think about conservation.

We can often easily work out what the vegetation in an area was like, based on what still grows in our National Parks and reserves. Sometimes entire regions have been extensively cleared, leaving little of the original vegetation and making it a lot harder to determine what was once there. In this case we can often work it out from tiny patches of vegetation left on roadsides or single trees left in parks or residential gardens. Combining this information with soils and rainfall data will usually enable us to predict what the vegetation once looked like.

Why is this information important?

Many of the serious environmental issues facing us today e.g. dryland salinity, loss of biodiversity and loss of water quality can be attributed to the clearance of indigenous vegetation from the landscape. In order to address these issues, revegetation is the management tool most often used. To ensure that our revegetation projects are successful, we need to reinstate the plants which once occurred in that area, as they are best suited to the local conditions and provide the best habitat for local indigenous species. Learning about what used to be there (and what shouldn't be there) allows us to make informed decisions when managing these areas.

As is the case in nature, things are rarely black and white. The concept of a vegetation association is based on human observations and used to help us to understand why plants occur in groups and why vegetation changes across the landscape. There will always be plants which 'break the rules' and grow in areas which are seemingly completely unsuitable for their well-being. Lines on a map showing the boundaries between vegetation associations will more often than not represent a very broad, fuzzy line in nature and should not be interpreted as absolute.

About the vegetation associations maps

Please see the Urban Forest Biodiversity Project website for vegetation association maps for the Adelaide region. Www.urbanforest.on.net. The maps are not available on the net but by contacting the Project itself.

As vegetation associations are most often determined by soil type and rainfall, this information is also included for each area. The vegetation class and a description of the typical landscape is also indicated. The vegetation around a creek or river (the riparian zone) is often a little different, so the typical canopy species for these zones is also indicated. Further information about other plants occurring within association can be found on this website.

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Lesson ideas

Activities available in the full set of *Catchment Connections* folders:

- *Pre-European vegetation association map (back section of Folder 2)*: Show students the map and ask them to work out where they live and go to school. As this map has few details of towns and roads, it may be useful to cross-reference with the Onkaparinga catchment map *(back section of Folder 1)*.
- Ask students what the pre-European vegetation community is/was where they live and at school. The correct way of writing this is Grey box and SA blue gum woodland or Rough-barked manna gum +/- River red gum, depending on the region. Where more than one vegetation association is possible, ask students to write down all possibilities. As their plant knowledge improves they may be able to work out which vegetation association they are actually in by looking at the plants in their street. This can be as simple as determining whether these plants have brown, stringy bark or white, smooth bark. Encourage students to also become familiar with Latin names of plants.
- Ask students to write down what the soil type is in their area and the rainfall range. Ask them to research what the specific annual average rainfall is for their closest town.
- Ask students to research and write about five other plant species which occur in their local vegetation association and the types of animals which may use those plants. Names of other local plants can be found on the *vegetation identification charts* located at the back section of *Catchment Connections, Folder 2*.
- Using the *pre-European vegetation association map* located at the back of *Folder 2,* ask students to write down why they think vegetation associations change across the landscape and why there is so much variety in the Onkaparinga catchment area. Do they know what the dominant canopy species of their area looks like, e.g, the Eucalypts? Do they know where there are any patches of bush in their local area?

Additional ideas:

- Encourage students to take note of changes in vegetation as they travel around.

Recommended resources

Woodlands and Shrublands of the Southern Adelaide Region in 1836 and/or

Woodlands and Shrublands of the Adelaide Metropolitan Region in 1836.

These two posters show the vegetation association which once occurred across the Adelaide area. Unfortunately the range of these posters does not extend into the Adelaide Hills. These posters are available for approximately $3 each from the Urban Forest Biodiversity Program, Ph: 8278 0600.

7. Identification of local indigenous plants

Plant identification

The parts of a plant most used in plant identification by the novice plant observer are the size, shape, buds, flowers, fruit, bark and leaves of a plant. The usefulness of these attributes for identification depends greatly on the plant being identified.

The key to identifying different plants is working out which attributes of the plant vary the most between different plants. For example, one of the most defining features of the different local *Acacia* (wattle) species is the size and shape of the leaves. For *Eucalyptus*, the fruits (gum nuts) will often vary greatly between different species, making this the most useful tool for identification. For many of the smaller shrubs and ground layer plants, it is the flowers which tend to be the most noticeable and varied feature.

Despite these distinctions, it is often necessary to look at a combination of plant attributes to make a positive identification. Even then it can still be very challenging, especially if there are many species of the same genus in a particular area.

Thankfully, there are many excellent plant identification resources to aid with plant identification. Many of the plant identification resources available for use base their defining techniques on one or more plant properties. For example Ann Prescott's *It's Blue with Five Petals* uses flower colour as its defining feature.

Many of the resources tend to cover whole of South-eastern Australia, South Australia or the whole of the Mt Lofty Ranges. Opening a book of Australian Eucalypts, to discover that there are more than 500 species, can be quite daunting. However there are only about 90 which are indigenous to South Australia and from these only about twelve which are indigenous to the Onkaparinga catchment area. For this reason it is better to use the most local resources possible to reduce the pool of possibilities.

See the recommended resources for some good local publications. Note that all of the referrals to vegetation in *Catchment Connections - Folder 2, Topic 6* is really only relevant to patches of remnant vegetation most often located on roadsides and in reserves. Many, if not most of the Australian natives historically used in amenity plantings in streetscapes and gardens are not local, but most often indigenous to Western Australia or the East Coast of Australia. Attempting to find a Western Australian native in a book about South Australian plants can be very frustrating! Stick to remnant patches for plant identification activities.

A good starting point for plant identification is to try to identify to genus level, as this is often very distinctive. Once students can confidently identify an *Acacia*, *Eucalyptus, Hakea* or *Banksia*, etc, identifying the species within that genus will seem a lot simpler.

Acacia: *a* widespread genus

Acacias (or Wattles) are the most widespread genus of Australian native plants. The *Acacia* genus is also indigenous to South Africa. Species within the *Acacia* genus are often best recognised by their leaf shape. Generally the *Acacia* genus is very robust and being of the LEGUMINOSAE family (legume), is able to improve soil nitrogen levels. It is used extensively in revegetation projects due to its ability to colonise areas of bare ground and recent disturbance. However, this resilience can also make them a formidable pest plant if they are introduced to areas outside their natural range.

Plants as resources for local wildlife

The buds, flowers, fruits and seed of our local native plants are generally the richest source of food for many of our visible wildlife such as insects, birds and mammals. Many of us have observed Honeyeaters on tubular flowers in suburban gardens, Yellow-tailed black cockatoos eating the seeds of a *Banksia* or groups of Parrots eating the flowers of *Eucalypts* and dropping the leftovers all over the ground. Unfortunately for these animals, plants do not produce the specific resources needed all year round. Many animals must travel to find enough resources.

Historically, animals are probably well-accustomed to travelling for their food but modern times have no doubt made life harder through:

- the loss of large tracts of the right kind of resources (vegetation) and
- barriers in the landscape such as roads, fences and cleared landscapes where smaller animals have little shelter or protection from predators.

While we associate spring with a flush of flowers and life, there are many plants which provide important resources throughout lean times in other seasons. Sometimes the timing and duration of flowering will vary in an area due to seasonal factors such as rainfall, soil fertility and temperature. Learning how our vegetation provides the resources needed for wildlife can teach us a lot about why populations of species decline or explode.

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Lesson ideas

- Split the class into four or five groups and have each group prepare an information card or poster on a local genus of plant. Choose a genus off the plant posters or from a book on South Australian plants. Ask groups to report back to the rest of the class on their findings and show the class actual cuttings from different species within their genus. Ask them to draw one of the species of their plant. The illustration should include some of the typical features of that genus, e.g. the shape and colour of the fruits and flowers, and the shape of the leaves.
- The worksheet included with the activity in *Catchment Connections - Folder 2, Topic 6* and *Eucalyptus* identification charts provided at the back of *Catchment Connections - Folder 2* will show students the structure and function of the vital parts of the *Eucalyptus* genus necessary for positive identification to the species level. Read through the worksheet with the students. Design a quiz based on the information on the worksheet.
- Collect fruits, or take students outside to show the local indigenous *Eucalypt* species appearing on the *Eucalypts* of our local area identification chart included with this activity.
- Encourage students to closely observe the fruits and match them to the picture of the species on the poster.
- Ask students to provide a detailed verbal description of the characteristics of the different *Eucalyptus* species, paying particular attention to the fruits and bark, to see how they differ from one another.
- Read through the worksheet *Accolades to Acacias* included in *Catchment Connections - Folder 2, Topic 6* and have students provide answers to the questions on the reverse side verbally, or in writing.
- Have students research or write a photo essay on one of their local *Acacias* and include a detailed, labelled drawing of the leaf structure of their specific plants. Students may also provide details on the ecology of their plant, e.g. the sorts of animals which use it, how it may benefit/disadvantage other plants.
- Monitor the availability of resources for local wildlife. Go out into your local natural area or school grounds with plant identification sheets and record the plants which are budding, flowering or fruiting. Ideally establish this activity as a monitoring exercise to be performed on a monthly basis.
- Regular monitoring of several different plant species will give a good indication of the times of year when most resources are available. A scoring system, which reflects the volume of resources available to the ecosystem's birds and insects could be adopted.
    - 'buds only' is given a '1'
    - 'buds and flowers' are given a '3'
    - 'buds, flowers and fruit' is given a '5'
    - 'flowers and fruit' are given a '3'
    - 'fruit only' is given a '1'
    - 'buds and flowers are given a '3.'
- Results of the plant or bird survey can be collated in the classroom and ticked on a wall chart with the months and seasons on one axis and the individual plants or birds on the other. Surveys could be performed monthly. Over time students will see changes in the site and will be able to link the changes to months and seasons via the classroom wall chart. Other details may also be recorded such as the presence of water in the creek (flowing or pools), weather, frogs, insects, etc. The wall chart results may be used in other subjects such as maths (graphs).

Recommended resources

Bonney, Neville (2003), *What Seed is That?* Finsbury Press.

Dashorst and Jessop (1990), *Plants of the Adelaide Plains and Hills*. Botanic Gardens of Adelaide and State Herbarium.

DEH (2002), *Common Wildflowers of the Mount Lofty Ranges*. DEH publishing.

Nicolle, Dean (1997), *The Eucalypts of South Australia*. Lane Print Group.

Prescott, Ann (1988), *It's Blue with Five Petals*. Lutheran Publishing House.

http://www.flora.sa.gov.au/factsheets.html

Excellent fact sheets on SA's *Acacia* species. Navigate site to learn about the distribution of individual species.

How does seed travel through the environment?

Sort your seeds into the following seed movement categories and record the seed's plant species name under the headings below.

Hitchhikers: Includes most of the grass seeds, designed to stick to anything passing by, such as birds and animals, and be carried to other locations to propagate. Test seed to see if it hitchhikes by throwing a handful at a piece of felt. If they stick, they are hitchhikers.

.....

.....

Drifters: **Mostly windborne and include Twiggy daisy bush and other members of the daisy family (COMPOSITAE). Some of the Tea-trees, Eucalypts, Sheoaks, grasses, reeds and sedges could also fall into this category. Test by blowing on these seeds, throwing them in the air or in front of a fan. If they appear to float without falling straight to the ground, they are drifters.**

.....

.....

Stayers: **Mostly heavier types of seed such as Wattles, Bush-peas and other members of the pea family (LEGUMINOSAE) . The seeds of many LEGUMINOSAE species have hard coatings, which allow them to persist in the soil for many years even after the parent plant has died. Stayers will not float or stick to felt.**

.....

.....

Food bearers: **Often come packaged within a tasty fruit or with an attachment which is sought after by insect or animal. Native apricot, Native cherry, Saltbush, Emu bush and Ground-berries all fall into this category.**

.....

.....

Seeds are generally very high in fats and proteins and sought after by many birds, therefore most plant species will have their seed eaten at some stage. Most seeds fall into the food bearer category occasionally. Whether consuming the seed actually assists dispersal or kills the seed can be difficult to determine.

On the back of this sheet design, draw and label 'the ideal seed' which may fall into 2 or more categories.

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The ideal seed

Make up a name for the plant your seed comes from

.....

.....

Which categories does your seed fall into?

.....

.....

.....

Please provide some further information on your seed design

.....

.....

.....

.....

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8. Introduction to aquatic macroinvertebrates

Concepts

- Definition and description of aquatic macroinvertebrates.
- Using aquatic macroinvertebrates as pollution indicators.

What are aquatic macroinvertebrates?

The technical term for water bugs is 'aquatic macroinvertebrates.' 'Aquatic' means freshwater, 'macro' means you can see it with your eyes, and an 'invertebrate' is an animal without a backbone.

Where are they found?

Aquatic macroinvertebrates are found in most creeks, rivers, lakes and wetlands. However, you will not find them in estuarine areas, as they generally live in freshwater. At your local waterway you can find them under rocks, in the mud on the bottom, among the reeds, on the water surface and swimming in open water.

Why collect aquatic macroinvertebrates?

They are easy to catch and come in a variety of weird and wonderful shapes. Students of all ages love looking at them, so they are a great way to stimulate student interest in environmental issues.

Aquatic macroinvertebrates are pollution indicators!

You can use aquatic macroinvertebrates to get an estimate of the amount of pollution in a waterway. A very polluted stream will have only a few types of macroinvertebrates living there. A less polluted stream will usually have more invertebrate species.

Sensitive or tolerant to pollution?

Some invertebrates are sensitive to pollution while others are pollution tolerant. In fact, scientists have grouped the macroinvertebrates found in our region into four pollution groups. These are "very sensitive," "sensitive", "tolerant" and "very tolerant." Refer to the 'Aquatic macroinvertebrate Identification Key' included in this topic.

Imagine a healthy stream with many macroinvertebrates living in it. If we add a small amount of pollutant, for example detergent, then the first group of invertebrates to disappear would be those in the "very sensitive" category. Add some more detergent, and the pollution sensitive ones will be wiped out. If we keep adding pollution, eventually even the "very tolerant" ones will die. So if you find no invertebrates at your site, this may be a sign of a very polluted waterway. Sometimes you will find a mixture of pollution tolerant and pollution sensitive invertebrates in a waterway. This means that the pollution level in the waterway is low.

Why else might the aquatic macroinvertebrates disappear?

Heavy rainfall can cause many creek animals to be flushed downstream. So if you sample after heavy rain, you may find fewer macroinvertebrates present in your sample. During cooler months, the breeding activity of some animals is lower, and fewer kinds of invertebrates may be found. However, if you sample the same site over a year, you will get to know what types of invertebrates should be there at different times of the year. So, if you expect to find ten different types of invertebrates, but only find a few types of very tolerant ones, then it is a fair bet that the site has been polluted.

Lesson ideas

- Make a waterbug sample net (instructions included with this topic).
- Complete the reading comprehension exercise: *The Great Waterbug Hunt* (included in *Catchment Connections - Folder 2*).
- Complete the *Waterbug Match-up* worksheet (included in *Catchment Connections - Folder 2*).
- Complete the *Sensitive or tolerant* cut and paste worksheet (included in *Catchment Connections - Folder 2*).
- Complete the *Healthy habitats* worksheets (included with this topic).
- Carry out a research project on one type of macroinvertebrate.
- Visit your local waterway, and carry out the *Scrape, jiggle and sweep* program (refer to the *Scrape, jiggle and sweep - excursion notes* with this topic). Students can develop a presentation of their macroinvertebrate sampling excursion and present this to other classes.

Recommended resources

The Aquatic Macroinvertebrate Identification key (two versions included in this activity).
Freshwater Invertebrates of the Onkaparinga Drainage Basin, (included at the back of *Catchment Connections - folder 2*).

Colour Guide to Invertebrates of Australian Inland Waters. Hawking and Smith, Co-operative Research Centre for Freshwater Ecology (1997)

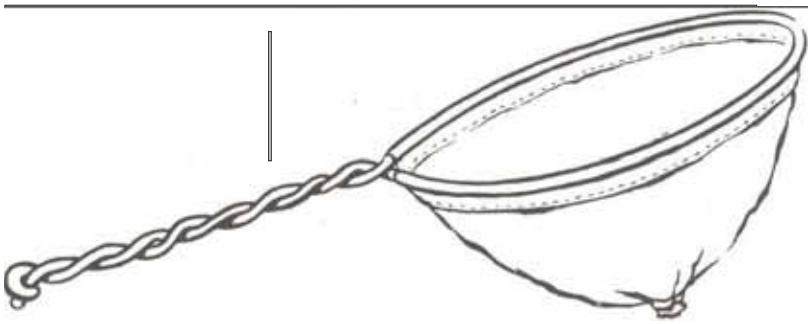
The Waterbug Book. Gooderham and Tsyrlin, CSIRO Publishing (2002)

Catching water bugs

How to make a stocking net

To make a stocking net you will need:

- A pair of pantyhose (or a stocking)
- A wire coat hanger (or strong wire)
- A pair of pliers (or strong hands)



How to make it:

1. Unbend the wire coat hanger and form a circular shape.

2. Thread wire through waistband of pantyhose.

3. Rewind the coat hanger to form a handle and tie a knot in the pantyhose.

OR

1. Cut part of the leg (the widest part) and stitch around the wire coat hanger (bent into circular shape).

2. Place a knot at the bottom.

For both cases, wind masking tape around the handle to provide a more comfortable grip.

Name: _____

Healthy habitats

Choose the habitats and animals from the cut-outs below and paste them into the correct habitat found on the back of this worksheet.

(1) Which habitat do you think is healthy and which is polluted?

Polluted

Healthy

(2) Cut out these habitat features and glue them in either the polluted or healthy environment.

(1) Native trees, shrubs and reeds growing along the edge.

(1) No trees and few plants growing along the edge.

(2) Water polluted by oil, detergents and other chemicals.

(2) Places for animals to hide and find food. Very little pollution.

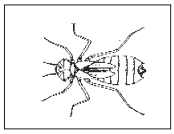
(3) You will find pollution sensitive animals here.

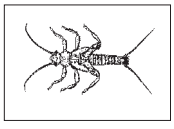
(3) You will only find pollution tolerant animals here.

(3) The Flatheaded Gudgeon is a native fish that doesn't like pollution.

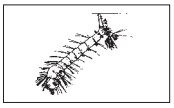
(4) The Gambusia is a pest fish that can survive pollution.

(5) These animals hate pollution.

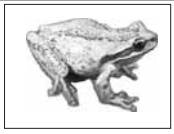




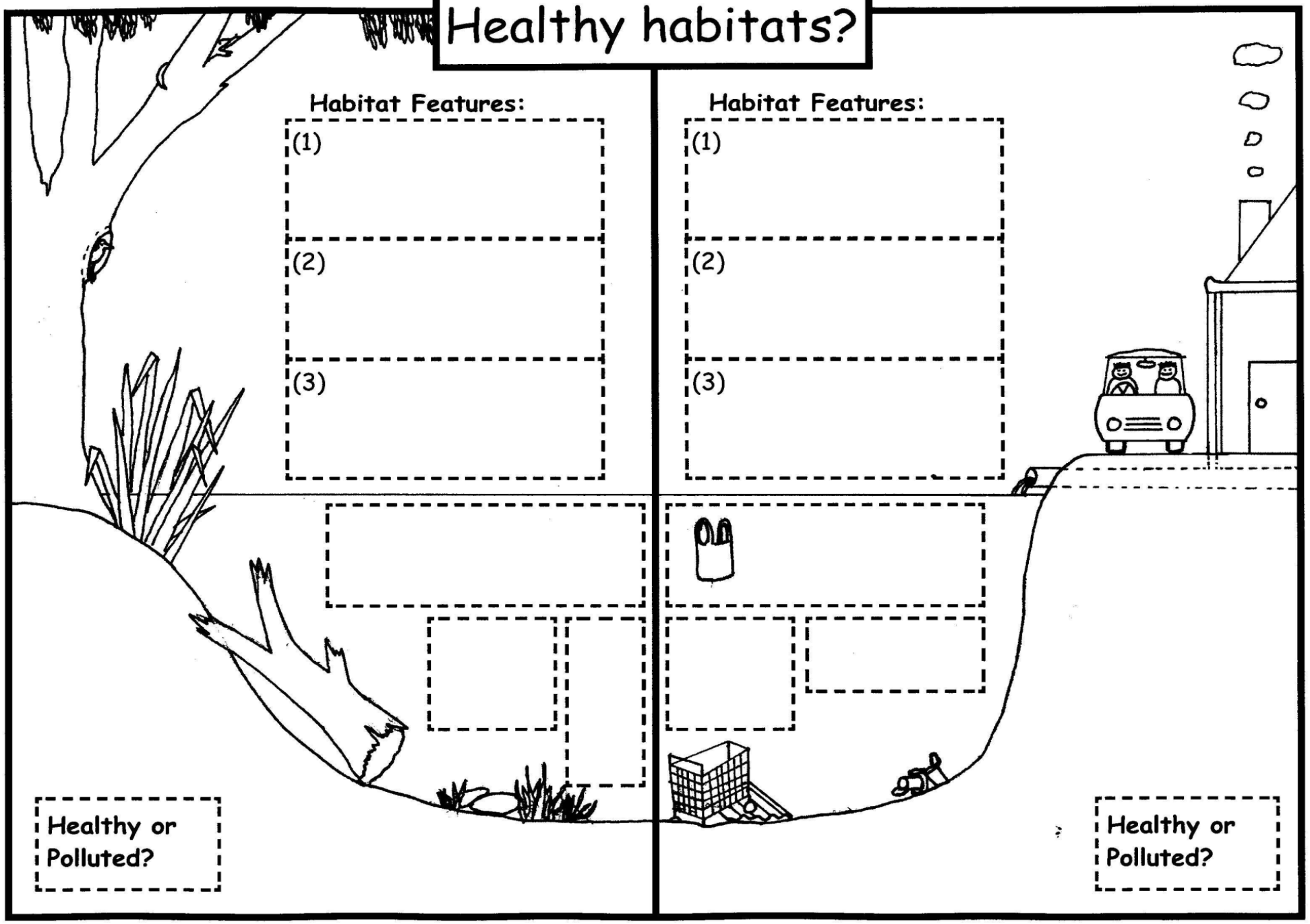
(6) These animals can survive pollution.



(7) Which habitat would the frog choose?



Healthy habitats?



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Scrape, jiggle and sweep: catching macroinvertebrates

Select your site:

Find a site that has easy access for a large group and is SAFE for all involved. It needs to have at least 5 m of watery edge, riffle, pool or drain. It should provide potential habitat like aquatic vegetation, snags, rocks, riffles, algae, etc, for the animals you hope to catch. The site you select does not have to be one of your regular Waterwatch sites. If however, your regular site is suitable, it would be preferable as you have prior knowledge of water quality, habitat, etc. For comparison, you may like to pick two contrasting sites, sample them both and keep the samples separate.

Equipment required:

- Nets. School groups should take plenty of their own fun-to-make stocking nets down to the sampling site. A more advanced sampling net (standard benthic net) can be borrowed from your local Waterwatch Adelaide organisation by arrangement.
- Aquatic Invertebrate Record & Identification Sheets. These sheets (included with this activity) can be used to record animals as you catch them, but most identification work is best done back at your base!
- Suitable containers for catching and travel. Take containers to the creek that are large enough to empty the nets into. White four litre ice-cream containers are great because they are a good size and you can see the animals easily. Make sure you have one large container with a good lid that is deep enough to put your final sample in for travel back to your base.
- Hand Lenses. Useful for examining surfaces of rocks, sticks, etc, for attached invertebrates.

What to do at the creek:

- Fill catching container with 5-10 cm of fresh water from your sampling site.
- Now catch those bugs! At last it is the time to get everybody involved. Scrape, jiggle and sweep the nets through the water. Be reasonably vigorous as many animals will be hanging on for dear life (they just don't understand that it is sampling day).
- Scrape the frame of the nets along solid objects such as rocks, branches, gravel and amongst leaf litter on the bottom but don't get too much mud as you will not be able to see any of your 'catch'.
- Jiggle the nets amongst the vegetation and scrape along the stems and leaves to dislodge any invertebrates. Take care, though, that you don't break or uproot the plants.
- Sweep the net through the water to catch the free living critters. Do several rapid U-turns with the net to catch animals that could get swept aside as you move the net through the water.
- Leave no stone unturned. Pick up stones, small rocks and other objects and examine the surface. You might be surprised at what is clinging to them. Replace them carefully to avoid crushing invertebrates on the object or on the stream bed.
- Empty the nets. Turn the nets inside out in the collection container. Jiggle the net sideways in the water in the container to wash debris and animals into the water.
- Watch as you go. Record any animals you see during the collection. Mark these off on the Freshwater Invertebrate Record Sheet.
- Condense the sample. Holding the net over the sampling site, pour the contents of the container(s) into the net. If the sample is muddy, pour slowly down the side of the net to try to catch and remove some of the mud. Empty contents back into tub containing about 10 cm of fresh water from the sampling site, (repeating the process of turning the net inside-out and jiggling it in the water).

Back at Base:

- Sort the sample: When back from your site, let the sample settle properly. Closely observe the sample for at least 30 minutes and record any animals seen. Gently move debris and cover to expose the shy ones. If possible, leave the sample where it can be observed intermittently over a long period of time. It is amazing what crawls out from a dark corner. Some animals can be gently lifted from the sample for closer examination with hand lenses or microscopes.
- Leave plenty of time to marvel at the normally unseen underwater life!
- Be sure to return your macroinvertebrates, along with the water in which they were collected, back to the collection spot.

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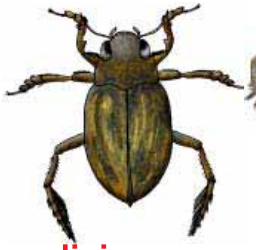
Which critter did you catch?

Swims fast


shrimp 3


back swimmer 1


diving beetle 2


scud 3


water boatman 2

Wriggles


worm 2


mosquito pupa 1


mosquito larvae 1

Tiny


seed shrimp NR

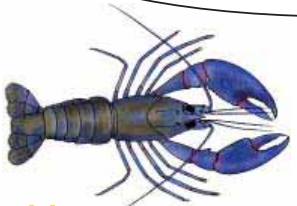

copepod NR

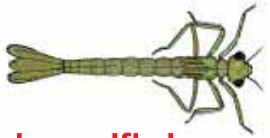

water flea NR



water mites 7

Legs, tails or feelers


yabby 4


damselfly larvae 3


caddisfly larvae 8


biting midge larvae 4


mayfly larvae 9


dragonfly larvae 3


stonefly larvae 10


non-biting midge larvae 3

Slides


flatworm 2


leech 1


freshwater snail 1

Very tolerant 1 – 3 | Tolerant 4 – 5 | Sensitive 6 – 7 | Very sensitive 8 – 10 | Not rated NR

Sensitivity ratings from SIGNAL2 system in "New sensitivity grades for Australian river macroinvertebrates. Bruce C. Chessman. Marine and Freshwater Research, 2003, 54, 95-103."

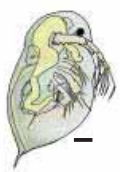
Waterwatch Adelaide

AQUATIC MACROINVERTEBRATE IDENTIFICATION KEY

1

Microscopic →

Bigger than microscopic — go to 2

Green, white or black	Teardrop shape, jerking movement	Swims with a jerk using antennae
		
Seed Shrimp (NR)	**Copepod** (NR)	**Water Flea** (NR)

2

Shell → OR

No shell — go to 3

Single shell

Flattened shell with small hump	Spiral shell, opening on left	Spiral shell, opening on right
		
Freshwater limpet 4	**Pouch Snail** 1	**Gilled Snail** 1

Double shell

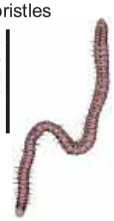
Small, pale delicate shell	Small, darker shell with ridges
	
Pea shell 5	**Little basket shell** 4

3

Legs — go to 4 over page

No legs → OR

Worm-like

Green to red, twisting	Segmented, no suckers, +/- bristles	Long, very thin, swims in 'S' shape, can't coil	Suckers, expands and contracts	Hair-like, swims in "S" shape	Slides along bottom
					
Non-biting midge larvae 3	**Segmented worm** 2	**Biting midge larvae** 4	**Leech** 1	**Roundworm** 3	**Flatworm** 2

Tentacles, brushes or tails

Six fleshy lobes at end of body	Breathing tube at rear	Large head, wriggles	Grub-like with no obvious head	Sucker on end of body, waves head	Slender, with tentacles, attached to solid surface	Hangs from surface by ring of hairs
						
Cranefly larvae 5	**Mosquito larvae** 1	**Mosquito pupae** 1	**March fly larvae** 3	**Blackfly larvae** 5	**Hydra** 2	**Soldier fly larvae** 2

Sensitivity ratings from SIGNAL2 system in "New sensitivity grades for Australian river macroinvertebrates. Bruce C. Chessman. Marine and Freshwater Research, 2003, 54, 95-103."

Government of South Australia
Adelaide and Mount Lofty Ranges Natural Resources Management Board

WATERWATCH South Australia

KESAB environmental solutions

Invertebrate Size (—)
Average actual size unless stated otherwise.

Pollution Sensitivity*:

(NR)	Not rated
10 — 8	Very sensitive
7 — 6	Sensitive
5 — 4	Tolerant
3 — 1	Very tolerant

Acknowledgements
- This key was designed by Ron Simms and Amy Blaylock, 2002.
- Adapted by Steve Walker, November 2006.
- Assistance was kindly provided by the following staff members of the South Australian Musuem: Dr. Errol Matthews, Dr. Chris Watts and Mr Robert Hamilton-Bruce.

Invertebrate Size (—)
Average actual size unless stated otherwise.

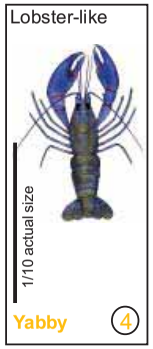
Pollution Sensitivity*: (10)–(8) Very sensitive (7)–(6) Sensitive (5)–(4) Tolerant (3)–(1) Very tolerant

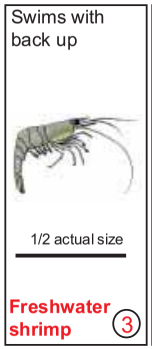
4

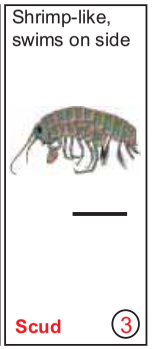
>3 pairs legs → OR

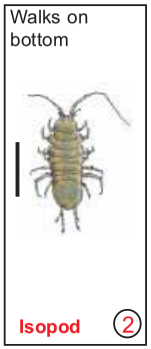
3 pairs legs — go to 5

10+ pairs legs

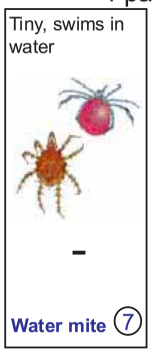








4 pairs legs

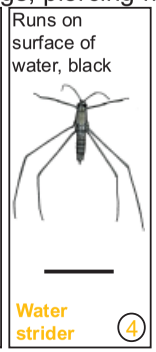


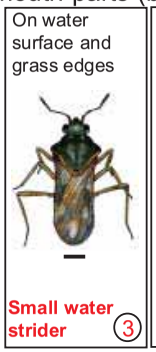
5

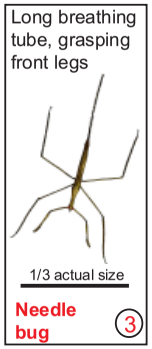
Wings → OR

No wings — go to 6

Soft wings, piercing mouth parts (bug)







Hard wings, jaws (beetle)

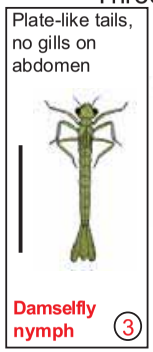
6

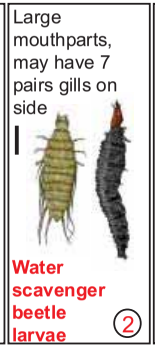
No obvious tail

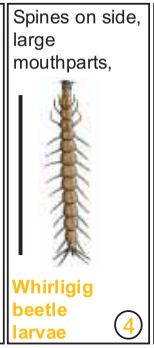
Tails → OR

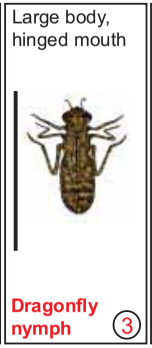
Two tails

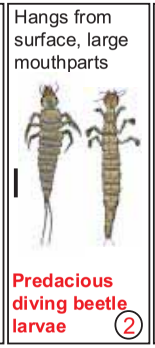
Three tails

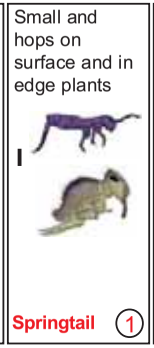












All images on this ID Key are adapted by Steve Walker from 'Critter Catalogue: a guide to the aquatic invertebrates of South Australian inland waters (2004 EPA)' except for the crawling water beetle (Steve Walker 2006).

Sensitivity ratings from SIGNAL2 system in "New sensitivity grades for Australian river macroinvertebrates. Bruce C. Chessman. Marine and Freshwater Research, 2003, 54, 95-103."

Waterwatch Adelaide AQUATIC MACROINVERTEBRATE RECORD SHEET

Group: _____ Date: _____ Site Code: _____

Waterway: _____ Weather: _____

	Common Name	Pollution Sensitivity	Tick if present	Sensitivity Number
Very Sensitive	Stonefly Nymph	10		
	Mayfly Nymph	9		
	Caddisfly Larvae	8		
Sensitive	Riffle Beetle Larvae	7		
	Water Mite	7		
	Marsh Beetle Larvae	6		
Tolerant	Black Fly Larvae	5		
	Crane Fly Larvae	5		
	Pea Shell	5		
	Biting Midge Larvae	4		
	Freshwater Limpet	4		
	Freshwater Prawn	4		
	Little Basket Shell	4		
	Water Strider	4		
	Whirligig Beetle Adult	4		
	Whirligig Beetle Larvae	4		
	Yabby	4		
Very Tolerant	Crawling Water Beetle	3		
	Damselfly Nymph	3		
	Dragonfly Nymph	3		
	Freshwater Shrimp	3		
	March Fly Larvae	3		
	Needle Bug	3		
	Non-biting midge Larvae	3		
	Scud	3		
	Small Water Strider	3		
	Round Worm	3		
	Water Measurer	3		
	Water Scorpion	3		
	Flatworm	2		
	Fishing Spider	2		
	Isopod	2		
	Hydra	2		
	Predacious Diving Beetle Adult	2		
	Predacious Diving Beetle Larvae	2		
	Segmented Worm	2		
	Soldier Fly Larvae	2		
	Water Boatman	2		
	Water Scavenger Beetle Adult	2		
	Water Scavenger Beetle Larvae	2		
	Backswimmer	1		
	Gilled Snail	1		
	Leech	1		
	Mosquito Larvae/Pupae	1		
	Pouch Snail	1		
	Springtail	1		
Not Rated	Seed Shrimp	NR		
	Copepod	NR		
	Waterflea	NR		
	Totals			

Add up the number of ticks (ie count the number of macroinvertebrate types found). This is the TAXA RICHNESS.

Add up all the sensitivity numbers to calculate the POLLUTION INDEX.

Interpreting your results:

Step 1

Calculate the Signal Score for your site:

Signal Score = ☐ POLLUTION INDEX / ☐ TAXA RICHNESS

SIGNAL SCORE = ☐

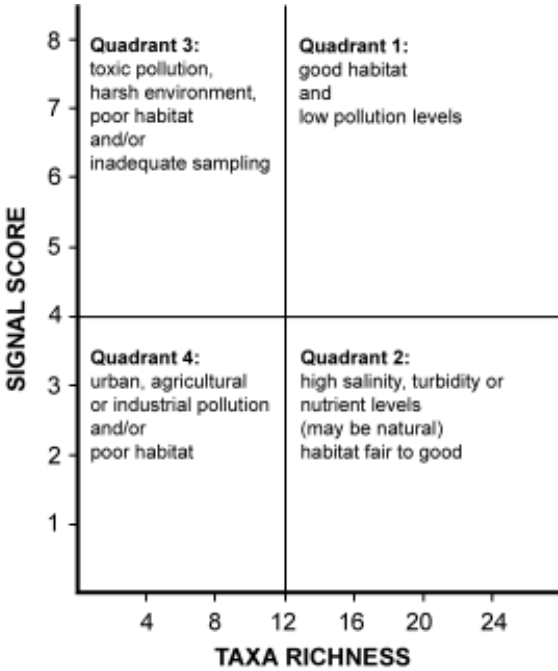
Step 2

Use the signal score to determine the pollution rating of your sampling site.

SIGNAL SCORE	Pollution Rating
Higher than 5	Healthy Waterway
Between 4 and 5	Mild Pollution
Between 3 and 4	Moderate Pollution
Less than 3	Severe Pollution

Step 3

The pollution indicator graph can suggest possible sources of pollution. Use your SIGNAL SCORE and TAXA RICHNESS to plot on a point on the graph. In which quadrant does your plot fall?



9. Introduction to frogs of Adelaide and the Mount Lofty Ranges

Concepts

- Features and facts about frogs found in the Adelaide region.
- Frogs are biological indicators.

What is a frog?

Frogs are amphibians. Amphibians are cold-blooded vertebrate animals which live in water and on land. They differ from reptiles in that they lack scales and generally return to water to breed.

Frog characteristics

Each frog species has differing features which have been adapted for their habitat. However, most frogs share certain characteristics which include:

- drinking and absorbing water through their skin
- having mucous glands to keep their skin moist
- the females are usually bigger than the males (except for the Painted frog).

Frogs eat by extending their tongue and catching their prey. When swallowing its prey, the frog's eyeballs will close and go down into their head to assist in pushing their prey down their throat. Frogs usually only eat live prey including crickets, flies, snails and smaller frogs.

Frogs of the Adelaide Region

There are seven frogs believed to exist in the Adelaide region. These are:

Common froglet - *Crinia signifera*

Brown tree frog - *Litoria ewingi*

Eastern banjo frog - *Limnodynastes dumerili*

Spotted grass frog - *Limnodynastes tasmaniensis*

Bibron's toadlet - *Pseudophryne bibroni*

Painted frog - *Neobatrachus pictus*

Southern bell frog - *Litoria raniformis**

*The Southern bell frog (*Litoria raniformis)* was previously found in the region but it is believed to be an introduced species and not indigenous to the region. However, this species has not been heard in the catchment since the early 1980s.

Why are frogs bio-indicators?

A bio-indicator is a living organism that is able to tell us whether our environment is healthy or unhealthy.

Frogs are well known for their sensitivity to pollution and habitat degradation. They need a healthy environment, both on land and in water, to complete their life cycle from egg to tadpole to adult. Polluted water which may contain chemicals such as fertilizers or detergents can significantly impact on frog populations. It is believed that a healthy habitat can be determined by the diversity of frogs calling in the area. Therefore unhealthy habitats have reduced frog populations.

The eggs and tadpoles are the most sensitive to pollution or environmental change because they are permanently in the water. The eggs are covered in a soft jelly-like substance that does not protect the embryo from pollutants in the water. Pollutants commonly result in the death of the egg or tadpole, but may result in the production of abnormalities of soft and/or skeletal tissues which can later be seen in the adult frog as an abnormality.

Abnormalities are seen in every population of animals. It is only when you find an unusually high number of frogs with crooked spines and extra legs or arms that you know there is something wrong in the environment.

There are many factors affecting frog habitat including land clearance, stormwater and increased urbanisation.

Froggy facts

- The smallest frog in the world is found in Brazil and is named the Golden frog (*Psyllophryne didactyla*). The adult grows to a length of only 9.8 mm. The smallest frog in the AMLR Region is the Common froglet which is twice as big!
- South Australia's smallest frog is the Desert froglet (*Crinia deserticola*) at a length of between 13-20 mm. This frog is not found in the Adelaide region.
- South Australia's largest frog is the Green tree frog (*Litoria caerulea)* which can reach a length of 11cm or more. This frog is not found in the Adelaide region.
- West Africa has the largest frog, named the Goliath frog. It grows to a length of about 37 cm and can weigh as much as 3.7 kg. This is as much as a cat!
- The Cane toad can reach a length of 26 cm and weigh up to 2.7 kg.

Special froggy features

- Although frogs are excellent swimmers, most will

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eventually drown if they don't have access to land.
- The bulging eyes of frogs can see in almost any direction.
- Frogs may be hypnotised by placing them on their back and gently stroking their stomach.
- Frogs that have very bright colours are usually poisonous.
- A good way to know if any Banjo frogs are living near you is to look for the footsteps they leave behind. They aren't really footsteps though, they're more like belly and toe marks. Look out for them next time you are down at your creek. (Banjos live in the AMLR Region).
- Frogs hear by using big round ears on the sides of their heads called a tympanum. Tympanum means drum (ear drum). Look carefully because on some frogs the ear is very hard to see.
- Frogs are one of the best leapers on the planet! Frogs can launch themselves over 20 times their own length. The longest frog jump on record comes from the South African Sharped nosed frog with a staggering 5.3m for a single jump!
- Ten frog species have disappeared from Australia. There may be several factors why including habitat destruction, land clearance and urbanization.

Lesson ideas

- Complete the frog life cycle worksheet included with *Catchment Connections - Folder 2, Topic 9*.
- Visit your local waterway and look at the habitat, human impacts and water quality at the site. Listen and make a recording of any frogs you hear.
- Visit your local waterway to listen and record the frog calls over the term/year. Are frogs present or absent from the site? Get students to look at the habitat and surrounding area to determine what factors may be affecting frog abundance.
- Participate in the EPA Frog Census program held annually in September. (www.epa.sa.gov.au/frogcensus)
- Discuss with the class some pollutants that may affect egg and tadpole health.
- Create a habitat. Get students to draw a creek or wetland on a large sheet (at least A3) and divide the drawing into half. Half becomes an example of a good frog habitat and the other side a poor habitat. Students can use magazine cutouts, rubbish found in the school yard, fallen leaves or their own drawings to create the scene.
- Play 'celebrity frog'. Write down the six frogs of the AMLR Region on cardboard. Select six students to be the celebrity frogs and provide them with their identity. Each of these students must then ask the rest of the class a question to try and guess which frog they are.
- Research the Cane toad. What would happen if they were introduced to SA? Look at what factors are affecting frogs in your catchment.

Recommended resources

http://www.asxfrogfocus.com
Extensive information about Australian frogs.

10. Introduction to birds

Concepts

- Introduction to bird identification.
- Birds are biological indicators.
- There are many local bird species which are considered to be 'threatened.'

Basic bird identification

Birds are present in most environments and can provide an interesting and valuable insight into the health of ecosystems. They fulfil many important roles in the ecology of natural areas, from hunters and scavengers of carrion to pollinators of rare plants. Best of all, they are mostly present during the day, providing a magnificent opportunity for learners to observe their habits close up.

The common name (non-scientific name) of a bird is occasionally named after a prominent bodily feature or marking. In some cases this might help to tell us a bit about the bird we are looking at. Examples include Black-chinned honeyeaters, White-naped honeyeaters, Yellow-tailed black cockatoos and Sulphur-crested cockatoos.

Bird names which reflect a bodily feature, are often the most easily remembered. Even if the bird's name does not tell us anything about its physical appearance, being able to visualise and describe the appearance of a bird is one of the most important techniques of identification.

Knowing the different parts of a bird can help us to make accurate descriptions when we are looking at them in the field. For example saying that the bird has a blue crest, white brow and red breast will make it a lot easier to look up in a book than if we say it had a 'blue mohawk, white eyebrow wrinkle and red front bit'.

Field guides are the most common means by which interested people can discover and learn more about Australian birds. They are generally simple to use, with most having common name indexes and excellent paintings or photographs of the birds for easy identification. They are a good first port-of-call for any research project as they provide good basic information on each bird pertaining to identification, distribution, habitat types, breeding seasons, nest and egg appearance.

Birds as biological indicators

Birds help to look after the bush. They are vital to the pollination processes of many local indigenous plants. They also help in the control of insects and other plant parasites, thus helping to keep native vegetation healthy. Birds of prey and other scavenging species help to 'clean up' carcasses and keep feral mice and rats under control.

Frogs and macroinvertebrates are a common indicator of the health of rivers and creeks. On land, the number and types of birds can help to indicate how healthy our ecosystems are. A large diversity of birds with only a few feral bird species will tell us that our system is quite healthy, especially if they are visited by threatened or declining species.

A threatened species is any species which is listed as either *rare, vulnerable* or *endangered* under Schedules 7, 8 and 9 of the *National Parks and Wildlife Act 1972*. Birds referred to as 'declining' have not yet become so reduced in numbers that they require listing as a threatened species, but their survival is of great concern to bird experts who are keeping a close watch on their numbers.

Why have these species become 'threatened' or considered to be declining in numbers?

Loss of habitat and food supply due to land clearance and weed invasion (only 2.7% of Adelaide's original vegetation cover remains), are the most significant factors leading to the decline of our local bird species. This problem is compounded by competition for reduced resources with feral and aggressive native species such as Noisy miners and Rainbow lorikeets.

Despite being native, these species are naturally more aggressive and do well from the decline of other birds as they generally have broader dietary and habitat requirements. It is often the case that these more aggressive species have actually managed to grow in numbers and expand their natural home range since European settlement, displacing other smaller birds. For this reason, these species are often referred to as increaser species.

Other factors contributing to the decline of bird species include nest predation by rats, Brushtail possums and cats and deterrence from food supply by cats, dogs and humans.

What can we do to help these bird species?

Helping stop the decline of local native species requires finding out what these animals need to survive, identifying their threats and managing them accordingly. Researching their habits, restoring food source and habitat, controlling feral and aggressive species are some of the techniques often employed. See the recommended resources for weblinks to current threatened species recovery programs.

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Lesson ideas

- Indoor classroom: Discuss information sheet *More than just pretty feathers* included with this topic and use it as the front cover of a bird surveying booklet. Bird surveying booklets consist of plenty of sketch paper and lines for writing down bird features, names, dates and locations.
- Using field guides or other bird books complete the *What Bird am I?, Field Guide Frenzy* and *Invent-a-bird* worksheets included in *Catchment Connections - Folder 2 Topic 10*.
- Bird cards included with that topic can be used in games to increase bird knowledge.
- Each Bird card has:
  1. common and scientific names;
  2. colour picture of the bird;
  3. maximum bird height in centimetres;
  4. habitat description;
  5. breeding season;
  6. local conservation status.
- *Bird bingo*: Issue a set of bird cards to the students and keep a set so that you can select clues. Ask all students to stand up and read out clues such as: "I like wetland habitat". Students with birds from other habitats sit down. The next clue might be "I have a long bill' students with cards such as ducks with short bills sit down. "I have a white face and long legs". This will probably leave one student standing with the white-faced heron card. The student reads out the information on that card to the rest of the class.
- *What Bird am I*: As above, issue the cards to students and similarly read out clues, but allow all students to put their hand up and guess what the bird might be at any time. If they guess incorrectly they are automatically disqualified. If they guess correctly but do not have the card, they receive two points; one for knowing the bird and a bonus point for knowing it without the card. If they have the card, they receive one point.
- Play *What Bird Am I?* for a few minutes each day and keep a class point tally and reward students at the end of the week with 'Bird Expert of the Week' certificate or similar.
- Make your own set of bird cards based on the birds you see locally or add to the set already provided.
- Outdoor classroom: Take students equipped with bird monitoring charts (located at the back of *Catchment Connections - Folder 2*) and/or bird surveying booklets, to a natural area to survey the birds present. Split them into groups of three or four and have them sit quietly for ten minutes and watch and listen to the area around them. Encourage students to employ bird identification techniques outlined on the '*More than just pretty feathers*' information sheet.
- See the techniques outlined on the '*More than just pretty feathers*' information sheet.
- Encourage extreme quietness and minimal movements, so that students also learn to identify birds by their calls. Allow students to change stations once for an opportunity to see different birds.
- For an extra challenge, consider not taking out bird charts so that students use more thorough observation skills. Look up the birds based on descriptions and sketches after returning to the classroom.
- As identification and monitoring skills improve, try to count the number of birds appearing in an area, the number of feral birds or the number of smaller birds over time. This type of data will provide some meaningful, visual patterns over time.
- Bird surveying lessons could be accompanied by a plant monitoring activity, (see *Native vegetation*, *Catchment Connections - Folder 2, Topic 2*). Similarly any outdoor activity can be accompanied by a bird survey whereby birds are ticked off the chart checklist after they have been sighted.
- Results of the birds and plant survey can be ticked on a large wall chart with the months and seasons on one axis and the individual birds and plants on the other. Perform surveys monthly. Over time students may observe changes in the patch and will be able to link the changes to months and seasons via the classroom wall chart. Other details may also be recorded such as presence of water in the creek (flowing or pools), weather, frogs, insects, etc.
- The wall chart results may be used in other subjects such as maths (graphs), see example below.
- Have students perform a research activity e.g. web search, bird guide search, on their favourite bird or on any of the threatened or declining bird species on the bird chart and answer:
  1. What does the bird eat?
  2. Where type of habitat does it need?
  3. Where does it currently live?
  4. What are the threats contributing to its decline?
  5. What can we do to stop this species' decline in the future?

Recommended resources

Pizzey and Knight 2001. *The Graham Pizzey and Frank Knight Field Guide to the Birds of Australia*, Harper Collins Publishers Australia.

Prescott, Ann 2002. *Common Bush Birds of the Mt Lofty Ranges,* SA Dept for Environment and Heritage.

Rowland, Peter 1998. *Green Guide: Birds of Australia,* New Holland Publishers Australia.

Simpson and Day 1999. *Field Guide to the Birds of Australia,* Sixth Edition, Penguin Books Australia.

Slater, Peter 2001. *The Slater Field Guide to Australian Birds, Revised Edition,* New Holland Publishers Australia.

Winters, Bob 1999. *Australian Guide to Birds,* Gould League of Victoria.

Http://www.environment.gov.au/biodiversity/threatened/recovery.html

Links to current threatened species recovery programs

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More than just pretty feathers...

Good bird identification skills can be extremely useful for discovering which species are visiting our local areas. Remember that birds are very important for keeping our plants and native bushland healthy. If we know which species are visiting our area we can start to discover how healthy (or degraded) our ecosystems are.

The bright colours of a Rainbow lorikeet actually help to camouflage it in the tree tops

Over 750 bird species call Australia home! Thankfully for our memories' sake there are only about 200 species indigenous to the Onkaparinga catchment. One of the best ways of identifying birds is by their colours and markings. Colours and markings on birds do not happen by accident, but actually serve the very important functions of:

- **camouflage or advertisement**
- **allowing birds to recognise one another**
- **indicating males and females**
- **indicating age**
- **indicating readiness for breeding**

The male Superb fairy-wren adopts bright blue plumage during the breeding season in late winter, spring and early summer before moulting.

The vivid markings on a Black-bellied storm petrel act as traffic signals to other birds in rough ocean

Bird plumage can also act as traffic signals. Bright white bars on the wings of migratory birds can help others in the flock maintain visual contact in poor weather or darkness and helps them avoid collisions. As most humans also have good colour eyesight, we can employ the same visual tactics as the birds and use their markings to enable us to easily recognise species.

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More than just pretty feathers...

When observing birds in the wild, there are a few key aspects to look out for.

Shape and Colours: Colours and shape of the bird, note particularly its bill size, shape and colour. Check colour markings on the face, throat, breast, belly and rump.

Size: Knowing that a bird is about 60 cm tall, with a long bill, grey over most of its body with a white face, may be all you need to know, in order to successfully look it up in a field guide.

Habitat: Finally, check what sort of habitat you are observing the bird in. If you are near a creek or wetland, your bird will probably be in the 'Water Birds' section of a Field guide.

When bird watching, follow these simple steps:

1. Focus on your bird.

2. Look for distinctive features and make a mental or physical sketch, or write down a list of features you see such as black throat, red brow, white nape.

3. Note habitat type.

Look up your bird in a Field Guide or on the Bird Chart.

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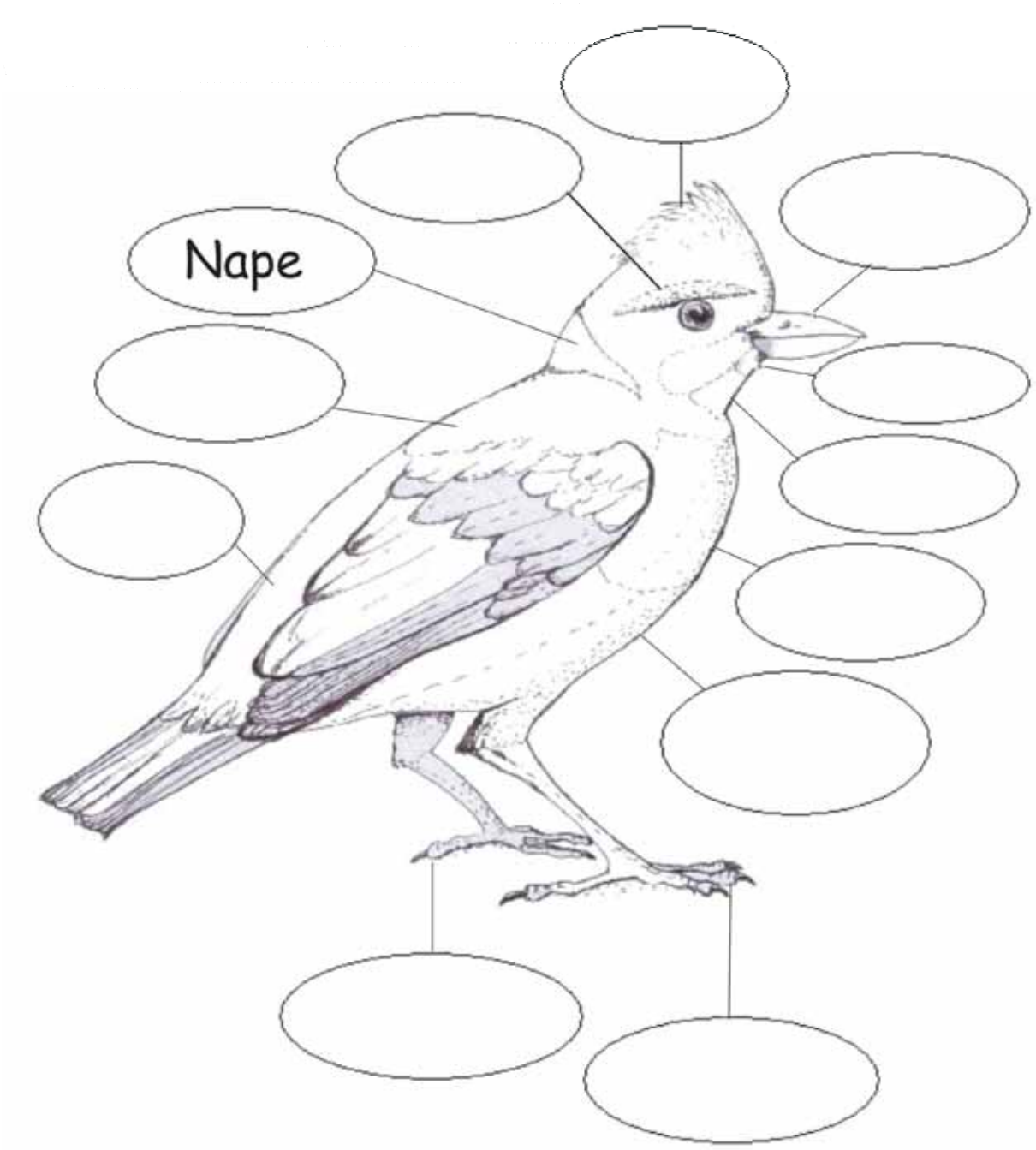
Invent-a-bird

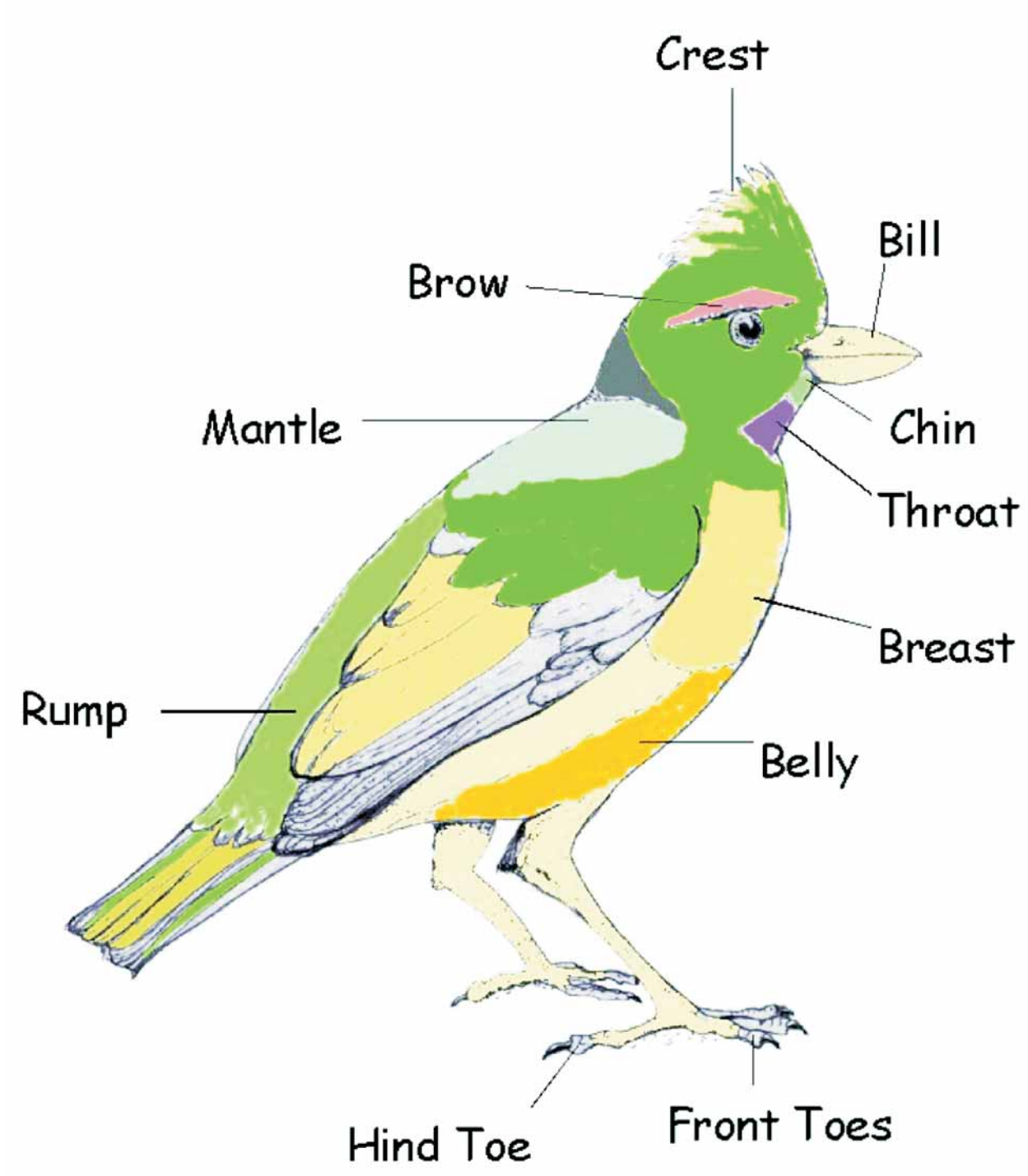
- **Write the names of the bird's body parts in the egg-labels**
- **Colour in the bird**
- **Invent a name for the bird which tells something about the way the bird looks**



Teacher Cheat Sheet

Invent-a-bird

- **Write the names of the bird's body parts in the egg-labels**
- **Colour in the bird**
- **Invent a name for the bird which tells something about the way the bird looks**



11. Introduction to fish of Adelaide and the Mount Lofty Ranges

Concepts

- Native and introduced fish live in the AMLR region.
- Many species of native fish are disappearing from local waterways

Native or introduced?

In our local catchments we have a mixture of native and introduced fish. This chapter focuses on types of fish that spend most of their lives living in freshwater parts of rivers. There are many types of ocean going fish that also visit the estuarine parts of rivers. The fish in our region that live most of their lives in freshwater include six species of native fish and five species of introduced fish. Two species of native fish have become extinct. All introduced fish in our catchment eat native fish.

A disappearing act

The native fish in our region are becoming less common, and their range is decreasing. Reasons for the disappearance of native fish include:

Reservoirs prevent migratory native fish like the Climbing galaxias from travelling downstream to the estuary to breed.

Removal of snags (fallen trees) from the river reduces the habitat available to native fish.

Removal of streamside vegetation reduces the food supply available to fish species as well as their habitat.

Trout are released into the some of our catchments, such as the Onkaparinga for fishing. Trout compete with native fish. Natives such as the Mountain galaxia can only be found where trout are not living.

The introduced Redfin carry a disease that can kill native fish.

Poor water quality due to chemical pollution or erosion will kill native fish.

Why are native fish important?

Native fish are unique animals that are becoming rarer all the time. They are a sign of a healthy environment. If the native fish are present, then we know the environment is fairly healthy. Also, we like variety in our lives. If all the different kinds of native fish in Australia were replaced by Trout, Redfin, Carp and Gambusia then our world would be a much less interesting place.

What can be done?

We can help native fish by ensuring that the health of their habitat is maintained. Introduced fish numbers should be reduced so that they do not compete with native fish.

To summarise, here are seven tips to help native fish:

- Leave fallen branches and trees in waterways to provide fish habitat.
- Plant native trees along creeks to provide shading of the creek and increase the availability of food (bugs, leaves and bark falling into the water).
- Fence off creeks and encourage native reeds, grasses and shrubs to grow along the banks. Reeds provide native fish with a food source, a place to breed and a shelter from predators.
- Reduce pollution entering the waterway. Use all those tips provided in Folder 1 - *Understanding Catchments*.
- If you catch pest fish such as Carp or Gambusia, do not put them back into the river.
- Write to fisheries organisations and the government encouraging them to stop releasing trout into our local rivers.
- Participate on a Friends group working bee to help restore parts of the river.

Lesson ideas

- Carry out a student research project on one of the fish of the Adelaide region
- Make a board game of the life of a native fish. Students can use the fish facts sheets to research the pitfalls of life as a native fish. Be as creative as possible. Send your good game ideas in to Waterwatch Adelaide to be included in our website
- Complete the worksheet *Can you name the fish body parts* included with this topic.
- Complete the *Can you bring back the native fish?* activity included in this chapter. This can be extended into a group activity where each group has to come up with creative ways to complete the management tasks. They can draw their ideas on a piece of butcher's paper and present the ideas to the class.
- Complete the *Where's Congoli Now?* literacy exercise. Students could turn these sentences into a story book. They could write a story about one of the other types of native fish.

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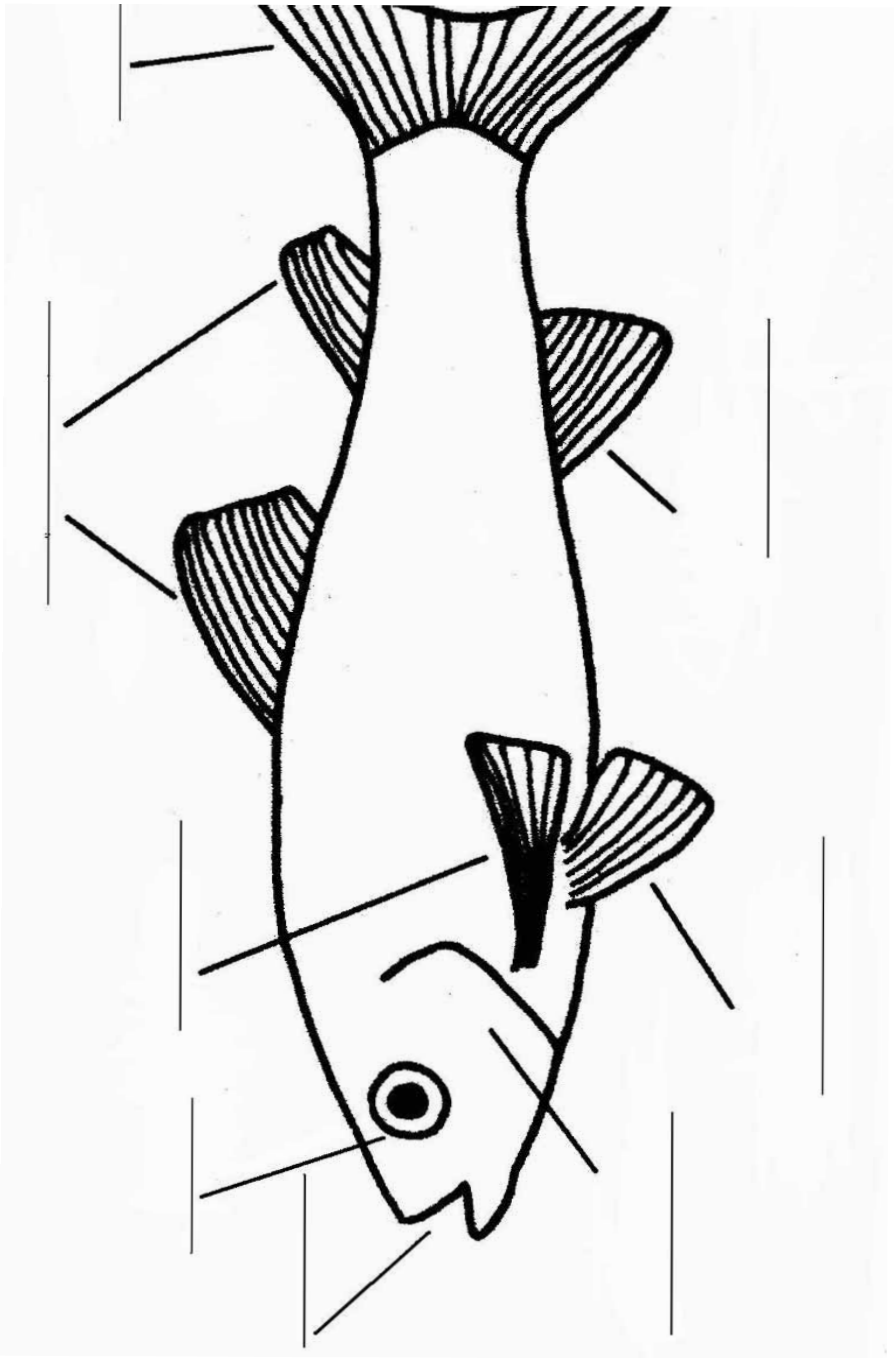
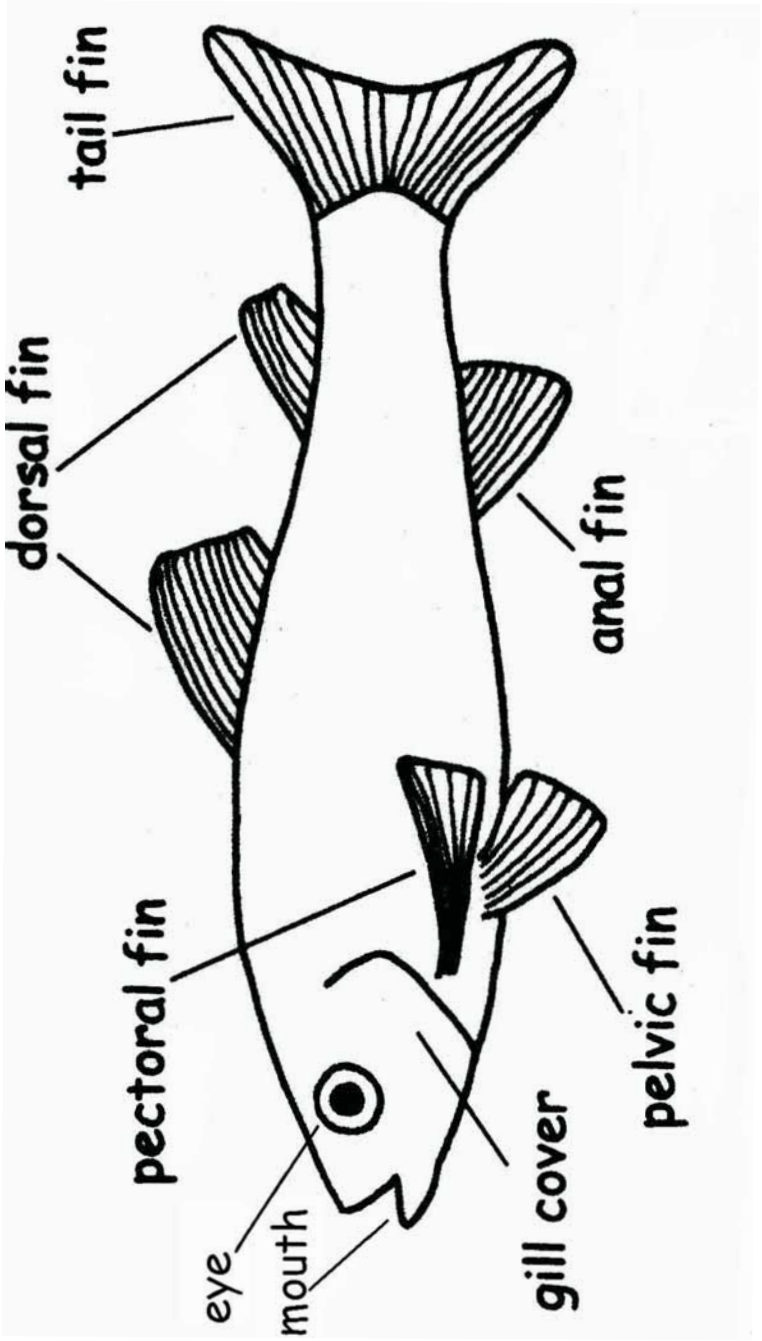
Can you name the body parts of the fish?

Try to correctly label each of the body parts of the fish shown below.



Can you name the body parts of the fish?

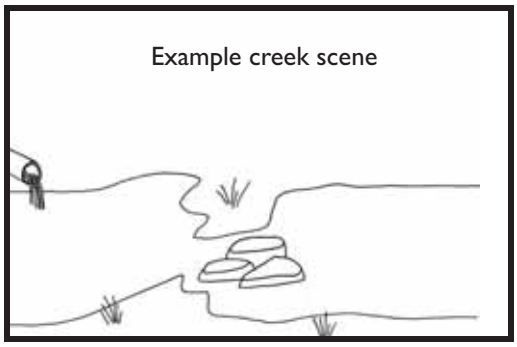
Try to correctly label each of the body parts of the fish shown below



Can you save the native fish?

What's the problem?

Native fish are in trouble. Their habitat is under threat, and introduced fish are taking over. Your job is to save the native fish from extinction.



Start here!

On a large sheet of poster paper draw a creek habitat. Use this creek scene as a guide or make up your own scene.

Cut out the native and introduced fish pictures and paste them onto your poster.

Time to get creative:

Read each management task and think carefully how you would complete the task in real life. Then draw your creative answers on the poster. For management task 1 you could draw students planting trees, or perhaps something different?

Management Tasks

You need to:

(1) Plant river red gums as they shade the water from the hot summer sun. Insects will fall out of the trees into the water and become fish food.

(2) Add snags (dead branches and trees). These are important places for adult fish to hide from predators.

(3) Plant reeds in the water along the edge of the creek. They are important places for baby fish to hide and find their food.

(4) Clean-up the stormwater that's running into the creek. Stormwater pollution can cause native fish to be killed.

Remove these introduced fish!

(5) Gambusia are a pest fish which eat native fish eggs and babies.

(6) Trout eat native fish. Some types of native fish disappear if trout are in the area.

(7) Redfin carry a disease that kills native fish. It is harmless to humans so you can catch them and eat them.

Summing Up:

Answer the following questions in your book.

(1) Introduced fish are overtaking our local rivers and native fish numbers are declining. Why and how does this happen?

(2) A healthy habitat is <u>not</u> important to maintain a river full of animals. Agree/disagree? Explain your answer.

(3) Provide two reasons why fish such as the Purple Spotted Gudgeon are no longer found in some catchments, like the Onkaparinga.

(4) Fish can no longer swim from sea to the start of some rivers, such as the Onkaparinga in the Hills. Why? What can be done to help the fish swim up the river?

(5) List five things that you can do to help save the native fish. Which of these helpful things can you do?

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Can you save the native fish?

Here are some pictures to help you complete you task:

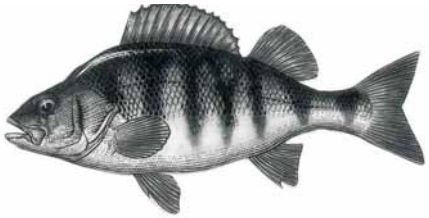
These are the **native fish** we are trying to save!

Congoli **(Native)**

Mountain Galaxias **(Native)**

These are the **introduced** fish that kill the natives:

Brown Trout **(Introduced)**



Redfin **(Introduced)**

Gambusia **(Introduced)**

Can you save the native fish?

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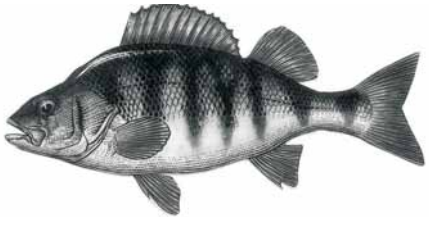

Redfin **(Introduced)**

Gambusia **(Introduced)**

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Where's Congoli now?

Congoli is a native fish. She likes to live in creeks or rivers.
What adventures will she have today?

Fill in the missing words using the word list. Then complete the pictures of Congoli's busy day. The first picture is almost finished!

hollow	burrows	chased	reeds	net	yabby

1. Congoli is hiding in the _____ by the edge of the water.

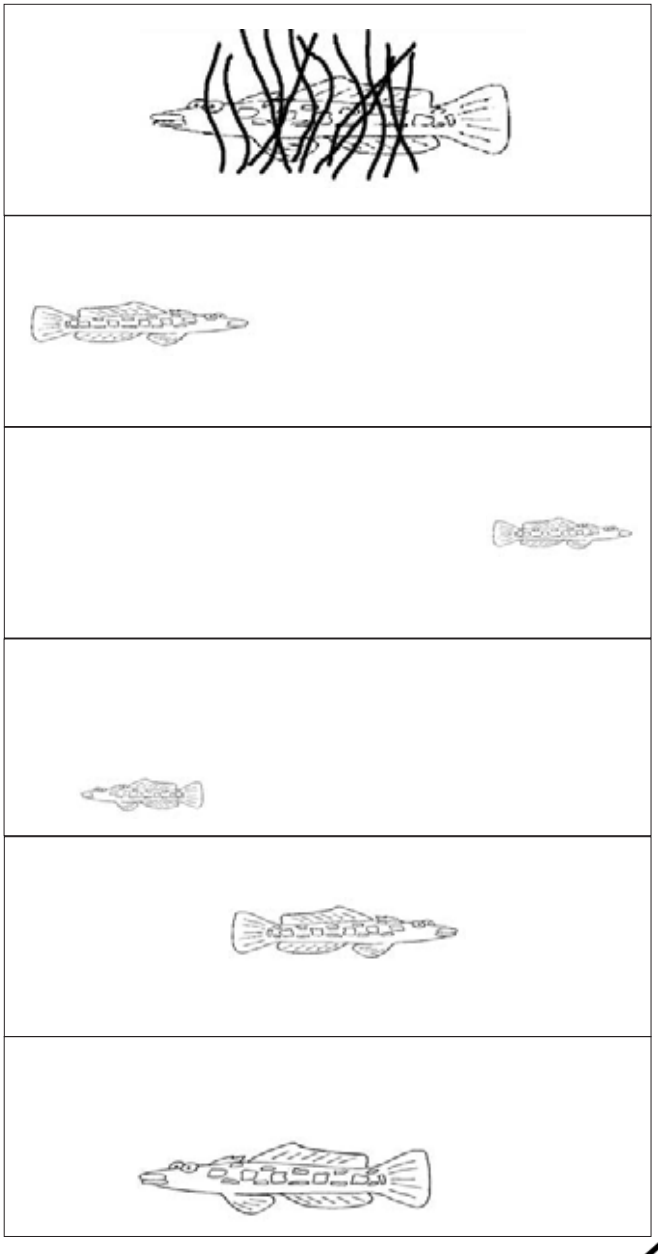
2. She is trying to catch a _____. It's her favourite food.

3. Congoli is being _____ by a trout that wants to eat her.

4. She hides from the trout in a _____ log.

5. She almost gets caught in the fisherman's _____ .

6. It's time for a rest. Congoli _____ into the sand on the bottom of the creek and falls to sleep.



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Native fish of Adelaide and the Mount Lofty Ranges

Mountain Galaxias

Scientfic name: *Galaxias olidus*
Status: Restricted range no longer found in certain areas
Size: 6-8 cm but can grow up to 12 cm
Habitat: Prefers cooler streams with good water quality mostly in the upper parts of the catchment. Usually located over gravel or rocky substrates. Only found where Gambusia or trout are not living.
Diet: Carnivore, feeding on invertebrates and terrestrial insects.
Something special: They can withstand living in water temperatures up to 32°C with substantial daily variations.

Climbing Galaxias

Scientific name: *Galaxias brevipinnis*
Status: Restricted range
Size: 8-12cm but can grow up to 22 cm
Habitat: Prefers to live in the upper catchment in cooler areas. They can have a marine larval stage and then migrate upstream into freshwater. However this migration is restricted by weirs and reservoirs. This also means that fish living upstream can not enter the estuary to breed.
Diet: Prefers aquatic and terrestrial insects.
Something special: They have the ability to climb vertical rock surfaces, metres high.

Photos courtesy of Michael Hammer.

Text generated from Freshwater Fishes of the Mount Lofty Ranges produced by the Upper River Torrens Landcare Group Inc. and the Native Fish Society Website www.nativefish.asn.au

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Congoli

Scientific name: *Pseudaphritis urvilli*
Status: Common
Size: Usually between 10-15 cm but can grow up to 34cm
Colour: Blotchy, checkered pattern on body
Habitat: Estuaries and lower reaches of rivers but can migrate large distances. Prefers sandy and muddy substrates to live in.
Diet: Carnivore, eating aquatic insects, worms, yabbies and shrimps. They like to bury themselves under sand with only their eyes protruding to ambush their prey.

Common Galaxias

Scientific name: *Galaxias maculatus*
Status: Common
Size: Usually between 6-10cm but can grow up to 19cm
Colour: Faintly spotted body. Juveniles can be translucent
Habitat: Able to live in fresh and salt water. Tolerates a range of habitats but prefers still or slow moving waters.
Diet: Carnivore, will feed on any insects (including some terrestrial), molluscs and crustaceans. Will feed on any small animals located on the surface, mid water or bottom.
Something special: Have been reported to feed on Gambusia

Photos courtesy of Michael Hammer.

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Flathead Gudgeon

Scientific name: *Phylipnodon grandiceps*
Status: Common
Size: Usually between 5-6cm but can grow upto 12cm
Colour: varies in colour
Habitat: Likes to live on the bottom but will live in a range of environments including: estuarine, freshwater, wetlands and fast flowing and still waters.
Diet: Carnivore, feeding on small fish, insects, worms, yabbies and shrimps.
Something Special: Male is very protective of the eggs and will go very dark and puffs out his gills.

Purple Spotted Gudgeon

Scientific name: *Mogurnda adspersa*
Status: No longer found in the catchment
Reason for extinction: Not known but may be caused through decline in healthy habitats, pest fish species and increased turbidity of the water due to erosion.
Size: 5-8cm but can grow up to 12cm
Habitat: Likes to live on the bottom and prefers to live in rocky areas with good habitat and clear water.
Diet: Likes to eat worms, aquatic insects, shrimps and small fish.
Special something: Very attractive fish with coloured spots on its side. Maybe a bio-indicator species.

Photos courtesy of Michael Hammer.

Text generated from Freshwater Fishes of the Mount Lofty Ranges produced by the Upper River Torrens Landcare Group Inc. and the Native Fish Society Website www.nativefish.asn.au

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River Blackfish

Scientific name: *Gadopsis marmoratus*

Totally protected species

Status: No longer found in our area.

Reason for extinction: Believed to be caused through habitat removal, exotic fish introductions and alterations to natural river flows.

Size: 15-20cm but can grow up to 35cm.

Habitat: Likes to live on the bottom and prefers good quality water with lots of habitat such as snags and reeds.

Diet: Likes to feed on small crustaceans such as shrimps and yabbies, insects, worms and small fish.

Something special: Nocturnal and they have unique pelvic fins which are believed to detect prey.

Blue Spot Goby

Scientific name: *Pseudogobius olorum*

Status: decrease in range

Size: 3-5cm but can grow up to 8cm

Habitat: Likes to live in rocky and muddy habitats on the bottom of the river beds. Usually found in the lower reaches of the catchment and in the estuary.

Diet: carnivore, feeding on copepods, midge larvae and other macroinvertebrates.

Something special: They have an iridescent blue spot on their first dorsal fin.

Photos courtesy of Michael Hammer.

Text generated from Freshwater Fishes of the Mount Lofty Ranges produced by the Upper River Torrens Landcare Group Inc. and the Native Fish Society Website www.nativefish.asn.au

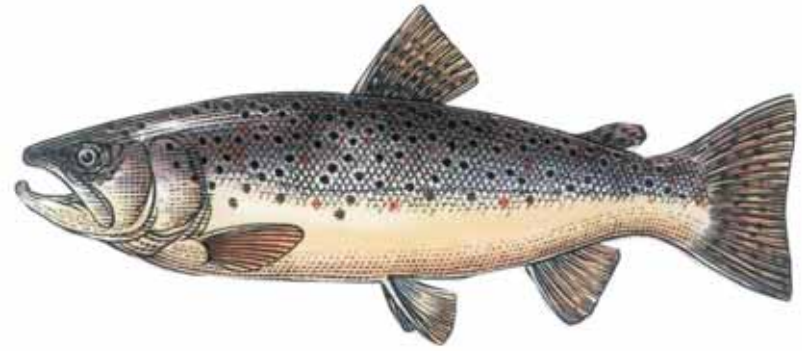
Exotic fish of the Adelaide Region

Rainbow Trout

Scientific name: *Oncorhynchus mykiss*
How introduced: Native to North America. Introduced into the catchment from local Trout hatcheries under a permit gained under the Fisheries Act 1982
Impacts on the Environment:

- Actively prey on local native fish, tadpoles and invertebrates
- They are much larger in size than natives
- Well suited to the cooler water temperatures of creeks within the our catchments.

Brown Trout



Scientific name: *Salmo trutta*
How introduced: Native to Europe but are regularly introduced to the creeks throughout the region from local hatcheries under a permit gained through the Fisheries Act 1982.
Impacts on the Environment:

- Predators of local native fish especially Galaxias and also tadpoles.
- Much larger in size than natives
- Well suited to water conditions in our catchments.

Pictures used with permission from the Freshwater Fishes of Souther Australian Gulf Division.

Text generated from Freshwater Fishes of the Mount Lofty Ranges produced by the Upper River Torrens Landcare Group Inc. and the Native Fish Society Website www.nativefish.asn.au

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Gambusia

Scientific name: *Gambusia holbrooki*
Other names: Mosquito fish and plague minnow
How introduced: native to Mexico but introduced to control mosquitos. However they are no better at reducing mosquito numbers than native fish.
Impacts on environment:

- They are aggressive towards other fish species, tadpoles and invertebrates.
- They compete for food and feed on native hatchlings.
- They reproduce very quickly as they give birth to live young.
- They can tolerate poor water and habitat conditions.

Redfin

Scientific name: *Perca fluviatilis*
Other names: European Perch
How introduced: originally from Europe and is now widely established.
Impacts on the environment:

- Redfin carry a virus which is harmful to natives.
- The female can also produce a large number of eggs which native fish will not eat.
- They are also rather large in size compared to other fish.
- Active predator of other fish

Photos courtesy of Michael Hammer.

Text generated from Freshwater Fishes of the Mount Lofty Ranges produced by the Upper River Torrens Landcare Group Inc. and the Native Fish Society Website www.nativefish.asn.au

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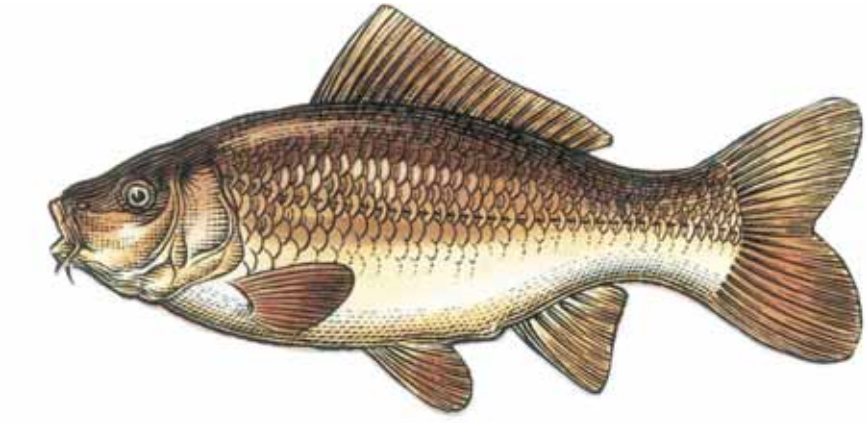
Carp



Scientific name: *Cyprinus carpio*
Other names: European Carp
How introduced: Originates from Asia, spread into Europe.
Impacts on the environment:

- They can produce up to 1 million eggs which grow quickly, even in poor conditions.
- They have a very destructive eating method. They sift through sediment to find invertebrates which causes the sediment to become disturbed and increases the turbidity, whilst also damaging aquatic vegetation.
- They can also tolerate very poor habitat and water quality and thus can be used to determine degraded environments.
- They also carry diseases and parasites.

Photos courtesy of Michael Hammer.

Text generated from Freshwater Fishes of the Mount Lofty Ranges produced by the Upper River Torrens Landcare Group Inc. and the Native Fish Society Website www.nativefish.asn.au

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12. Introduction to wetlands

Concepts

- There are several different types of wetland.
- Wetlands perform many important functions.
- Wetland ecosystems

What is a wetland?

Wetlands are usually an area of fresh, brackish or salty water that are typically shallow, slow moving or static. Wetlands can be temporary, seasonal or permanent and are generally well vegetated. They are also both naturally occurring and human-made.

Types of wetlands

There are three main types of wetlands which are:

1) Coastal and marine

These include:

- Permanent shallow marine waters e.g. Streaky Bay
- Estuarine waters e.g. Onkaparinga estuary
- Intertidal mud, sand or salt flats e.g. Coffin Bay coastal wetland system
- Coastal brackish/saline lagoons e.g. The Coorong

2) Inland wetlands

These include:

- Freshwater marshes e.g. Swan Reach Wetland complex
- Freshwater springs e.g. Great Artesian Basin
- Subterranean karst wetlands e.g. Ewens Ponds and Picanninie ponds
- Seasonal/intermittent saline lakes e.g. Lake Eyre
- Seasonal/intermittent freshwater lakes e.g. Banrock Station wetland
- Permanent Freshwater lakes e.g. Lake Bonney, Lakes Alexandrina and Albert

3) Human-made wetlands

These include:

- Water storage areas e.g. Mount Bold Reservoir
- Wastewater treatment areas e.g. Greenfield wetlands
- Stormwater treatment areas e.g. Morphettville Racecourse wetland
- Conservational value e.g. Woorabinda dam

Wetlands in the Northern Adelaide & Barossa region

There are over 30 wetlands that occur along stormwater paths in the City of Salisbury alone, covering more than 260 hectares. There are many more wetlands throughout the Northern Adelaide and Barossa region.

In the Northern Adelaide and Barossa region, wetlands such as the Greenfields Wetlands act as stormwater retention basins, helping to clean water by allowing sediment to settle and micro-organisms to be killed through exposure to sunlight. Greenfields Wetlands are human constructed, as are the Paddocks wetlands, Andrews Farm wetlands and those located near Parafield Airport. Most wetlands in this region have been constructed by humans. Human made wetlands in the Northern Adelaide and Barossa region all contribute to cleaning of stormwater and the water from some can be harvested via an Aquifer Storage and Recovery Scheme. Many wetlands provide significant habitat to the animals that live there.

Wetlands in the Central region

There are many natural and manmade wetlands in the Central area of metropolitan Adelaide. These include:

- Port Catchment:
- Barker Inlet Wetlands* - listed in migratory bird conventions
- Barker Inlet Mangroves . Listed in migratory bird conventions
- Range Wetlands*
- Magazine Wetlands*

Torrens Catchment:

- Breakout Creek Wetland*
- Apex Park Wetland*
- St Peters Billabong
- Roy Amer Reserve *
- Northgate Reserve *
- Pitman Park/Lagonda Drive*

- Patawalonga Catchment:
- Morphettville Racecourse Wetland*
- Warriparinga Wetland*
- Urrbrae Wetlands*
- Frank Smith Park Wetland*
- Osmond Wetland, Heathfield
- Cooper Wetland, Heathfield
- Brownhill Creek, Sheoak Rd Upper Sturt
- HK Fry Reserve, Crafers

* Urban constructed wetlands

Wetlands in the Southern Region

There are at least 24 wetlands in the Southern area of varying types and conservational significance. Some of these include:

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- Englebrook reserve
- Mount George wetland
- Rubida grove
- Woorabinda lake
- Aldinga Scrub wetland
- Silky tree swamp
- Onkaparinga estuary
- Washpool lagoon
- Eurilla bog

Wetlands of International Importance

Australia is fortunate to have 64 wetlands which are listed as Wetlands of International Importance. South Australia has five of these areas: The Coorong and Lakes Alexandrina and Albert wetland; 'Riverland'; Bool and Hacks Lagoon; Coongie Lakes and Banrock Station wetland complex.

To be listed as a Wetland of International Importance there is a range of criteria which the wetland must meet including: supporting endangered or vulnerable species; supporting 20,000 or more water birds; providing a source of food for fishes or being a spawning ground or nursery area for fishes.

The importance of wetlands

Wetlands provide a variety of functions and benefits to the community and the surrounding environment. Some of the benefits are as follows:

Water purification

The plants, animals and soils in wetlands play a significant role in cleaning the water, removing excessive nutrients associated with stormwater and agricultural runoff. Human-made wetlands such as the Port Noarlunga wetland system have been developed to help reduce stormwater, nutrient loading and other pollutants entering the Onkaparinga River and heading out to sea. Since these wetlands have been introduced pollutant levels have declined.

Groundwater replenishment

Many wetlands help to recharge underground aquifers and this is vital for maintaining these water supplies.

Flood prevention

Wetlands help to act as water storage devices, reducing the potential for floods.

Biodiversity

Freshwater wetlands hold more than 40% of the world's species! This means they are as productive as coral reefs and rainforests. Coastal wetlands, such as the Port Noarlunga wetlands provide homes and breeding grounds for hundreds of migratory birds. Macroinvertebrates are usually also very diverse in wetlands, as well as frogs and other animal species.

Recreation/tourism/economy

Wetlands also provide significant recreational and tourism value. Tidal wetlands and mangrove swamps provide a breeding ground and nursery area for many commercial fish species. Fishing, boating, birdwatching and camping are just a few of the recreational pursuits for which wetlands are used.

Cultural significance

Many wetlands and their immediate surrounds provide great spiritual or cultural significance to indigenous Australians. These can include burial places, former campsites, or places where traditional hunts once took place.

Education, science and research

Wetlands provide a unique habitat for raising awareness and educating the community and schools. They also offer a way in which pollution levels in a catchment area can be minimised through careful research, planning and design.

Threats to wetlands

Since European settlement, more than 50% of Australian wetlands have been exploited for uses such as agriculture and urban development. There are a range of activities which can impact on wetland health. These can include such things as: poor agricultural practices, construction, introducing non-native species (both flora and fauna), stream channelisation, land clearance adjacent to the wetland, and increased nutrient loading.

Wetland inhabitants

Wetlands are home to a variety of flora and fauna species. Plants are an important feature of wetlands, as they tolerate both flooding and short periods of drought in any one year. Plants provide valuable functions in the wetlands including helping to maintain water quality by acting as nutrient filters; preventing erosion, and providing valuable shelter and food for many animals. However, wetland plants are threatened by changes in water levels which can occur through human intervention. For example, removing groundwater for public and private use can lower the water table level and affect the normal amount of water available to plants. This can result in plant dieback and the introduction of non native plant species into the area.

Many waterbirds use wetlands as a breeding ground. For example in the Port Noarlunga Estuary wetlands, more than 120 species of birds have been sighted, some of which are migratory.

Macroinvertebrates and fish are also common inhabitants of wetlands. Many fish use coastal wetlands for breeding and nursery areas.

Reference: Department for Environment and Heritage & Department of Water, Land and Biodiversity Conservation (2003). Wetlands

Strategy for South Australia. Department for Environment and Heritage, South Australia.

Lesson ideas

- Take part in a wetlands field trip with an education officer or run it yourself! Worksheet provided with this topic.
- Create a large wetlands mural in your classroom to show some of the wetland features. Get students to illustrate the different flora and fauna you might find at a nearby wetland.
- Develop a wetland food web.
- Complete the Wetland Ecotour planning worksheet included in Catchment Connections - Folder 2 online.

Junior primary

Why wetlands?

Wetland visit

1. Write six words that describe the wetland.

1 _____ 2. _____ 3..... _____

4. _____ 5. _____ 6. _____

2. How many different kinds of birds did you see? _____

3. Do you know their names? Try to name some of them.

_____ _____ _____

_____ _____ _____

4. How many different types of macroinvertebrates (water bugs) did you see? _____

5. Do you know their names? Try to name some of them.

_____ _____ _____

_____ _____ _____

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6. Draw two of the macroinvertebrates (water bugs) that you saw today. Remember to label them.

7. Did you see anything else living in or near the wetland? *What did you see?*

If you <u>didn't see</u> any other animals, what do you think might like to live in the wetland?

8. Did you see any pollution or rubbish in or near the wetland? _____

If you did, where do you think it came from?

It came from:

9. Why do <u>you</u> think that pollution and rubbish is bad for the wetland?

10. Can you think of ways to stop rubbish from ending up in the wetland? Write your ideas below.

11. Draw a picture of the wetland and some of the animals living in it.

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Upper primary

Why wetlands?

Wetland visit

1. Sketch a wetland pond, labeling the parts. (Remember to include parts such as the water, edge, reeds, shrubs and macro invertebrates.)

2. What are the land uses around the wetlands? How might these affect water quality?

Land use	Effect on water quality

Birds

3. List the birds you see around the wetland. (If you don't know their names, ask a teacher or write a description so you can look it up later).

_____ _____ _____

_____ _____ _____

_____ _____ _____

4. Different bird species have different feet shapes and sizes. Why?

_____

_____

5. How many birds did you see <u>on</u> the water? _____

6. How many birds did you see near or around the water? _____

Macroinvertebrates

7. How many different species of macroinvertebrates did you collect? _____

8. List the three most common macroinvertebrates that you saw. Include if they were *sensitive* or *tolerant* to pollution in the water.

name of Macroinvertebrate	Sensitive or tolerant?

9. Do you think this wetland is healthy? Explain your answer.

10. Have you seen/heard anything else living in or around the wetlands?

11. Draw a wetland food chain which includes plants, macros, fish and waterbirds.

Wetland food chain

12. Why are wetlands important and what can we do to look after them? Provide two reasons.

They are important because:

1. _____

2. _____

We can look after them by:

1. _____

2. _____

13. Draw your favourite thing (bird, plant or macroinvertebrate) that you saw at the wetland today. Remember to include its name.

Watershed Sustainability Centre

Background

The Watershed Sustainability Centre located at Greenfields Wetlands is an ideal base location for your venture into the world of wetlands. Tours around the wetlands can be organized with one of our Education Officers, and other activities can be conducted within the centre itself.

Things you need:

☐ Transport to Greenfields Wetlands

☐ Lunch and water

☐ Suitable clothing, footwear and hats

☐ Clip boards and pencils

☐ First aid kit and sunscreen

☐ Optional: sporting equipment like a few footballs etc.

☐ Extra staff members or parents would help!

☐ Nets. School groups should take plenty of their own fun-to-make stocking nets down to the sampling site. A more advanced sampling net (standard benthic net) can be borrowed from the Northern Adelaide and Barossa Waterwatch team by arrangement.

About the wetlands:

The Greenfields Wetlands system connects the Dry Creek Catchment with Gulf St. Vincent. Greenfields Wetlands were constructed between 1990 and 1995 with the intention of capturing stormwater and cleaning it before it was washed, untreated, into Barker Inlet, carrying excess nutrients and pollution. The Greenfields Wetlands are divided into three stages, from 1 to 3. Stage 1 is furthest from Barker Inlet, while Stage 3 is closest to Barker Inlet. The salinity of the Greenfields Wetland system increases as it gets closer to the saltwater environment of Barker Inlet.

Greenfields Wetland system provides valuable habitat to over 160 bird species, with some migrating from as far away as Siberia every year. Greenfields also provides reptiles, macroinvertebrates, fish and frogs with habitat. As well as providing habitat to wildlife, the stormwater that is collected in the Greenfields Wetland system is used to provide recycled water to some homes and industry, adding more sustainability to water usage in the Northern Adelaide and Barossa region.

Tour Outline

Tours around Greenfields Wetlands follow a loop around the Watershed Sustainability Centre. During your tour, you will encounter wildlife such as birds and macroinvertebrates, and the aquatic and terrestrial habitats they use in the wetlands. You will also learn about the role of Greenfields Wetlands in stormwater regulation and stormwater harvesting. During your visit, we hope that you develop an appreciation for the issues that affect Greenfields Wetlands like pollution, urban water usage and the importance of urban habitat in conserving and promoting biodiversity.

Activity Outline

Greenfields Wetlands provide a habitat to a variety of species so when you visit the Watershed Sustainability Centre you'll be able to participate in activity sessions that deal with macroinvertebrates, frogs and fish, as well as bird-watching, drawing and viewing videos. Our Education Officers will guide the tours and activity sessions with your help.

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Watershed Excursion Worksheet

1. What does macroinvertebrate mean?

……
……

2. How many species of macroinvertebrates did you see?

……

3. Did you find mostly sensitive species or tolerant species?

……

4. What does the presence of these macroinvertebrates in your water sample tell you about the quality of the water in Greenfields Wetlands?

……
……
……

5. What role do macroinvertebrates play in the food chain of wetlands?

……
……
……

6. Draw your favourite macroinvertebrate and describe its features.

Froggy Frenzy and Funky Fish

1. What is a bioindicator?

……
……
……
……

2. Why is it good if sensitive bioindicators are found in an area of the environment?

……
……
……

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3. What happens if the environments that bioindicators are found in become polluted or degraded?

……
……
……
……

4. Draw your favourite frog on a separate page and describe its features. What colour is it? How large is it? Make sure you label your diagram and include a measurement scale.

5. What role do fish play in the food chain of a wetland?

……
……
……
……

6. What happens if a water body containing fish becomes polluted or degraded?

……
……
……

7. List the native fish you saw today. Draw your favourite one on a separate page.

8. Why are invasive species bad for an environment like Greenfields Wetlands? What effects do they have on native species?

……
……
……
……
……
……
……

9. Name one invasive species of fish that occurs in Greenfields Wetlands.

……

Eastern Banjo frog
Photo courtesy of Steve Walker

Yabby

Watershed Sustainability Centre Worksheet

Wetland Tour

1.Why are wetlands so important to our catchments?

……

2.What animals live in wetlands?

……

3.Sketch your favourite part of Greenfields Wetlands.

4.Why is this part your favourite?

……

5.Does the wetland look healthy to you?

……

6.Why does it look healthy?

……

Macro Madness

1. What does macroinvertebrate mean?

.....

2. How many species of macroinvertebrates did you see?

.....

3. Did you find mostly sensitive species or tolerant species?

.....

4. What does the presence of these macroinvertebrates in your water sample tell you about the quality of the water in Greenfields Wetlands?

.....

5. What role do macroinvertebrates play in the food chain of wetlands?

.....

6. Draw your favourite macroinvertebrate and describe its features.

Froggy Frenzy and Funky Fish

1. What is a bioindicator?

.....

2. Why is it good if sensitive bioindicators are found in an area of the environment?

.....

3. What happens if the environments that bioindicators are found in become polluted or degraded?

.....

4. Draw your favourite frog on a separate page and describe its features. What colour is it? How large is it? Make sure you label your diagram and include a measurement scale.

5. What role do fish play in the food chain of a wetland?

.....

6. What happens if a water body containing fish becomes polluted or degraded?

.....

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7.List the native fish you saw today. Draw your favourite one below.

8.Why are invasive species bad for an environment like Greenfields Wetlands? What effects do they have on native species?

.....

.....

.....

.....

9.Name one invasive species of fish that occurs in Greenfields Wetlands.

.....

13. Estuaries in the Adelaide and Mount Lofty Ranges Region

Concepts

- Introduction to estuaries
- Facts about estuaries in our region
- Geographical features and ecosystems of our estuaries.

What is an estuary?

An estuary is where a river or creek meets the sea, where the fresh river water and the salty sea water mix.

A more comprehensive definition of estuaries provided in the State Water Plan are:

"semi enclosed water bodies at the downstream end of freshwater systems that are subject to marine, freshwater and terrestrial influences and that experience periodic fluctuations and gradients in salinity. Collectively the estuaries of SA have significant environmental, social and economic value".

The Onkaparinga Estuary

The Onkaparinga Estuary is located approximately 30 km south of Adelaide and begins at the ford at Old Noarlunga and extends to the river mouth at Port Noarlunga.

Long: 138.47 Lat: -35.165. Refer to the aerial photo of the estuary in *Catchment Connections - Folder 2* for more information.

Facts

- Length: 11.02 km
- Water area: 1.14 km2
- Perimeter: 22.87 km
- Water depth: varies, but mostly less than 2 metres
- Tides: The river is tidal up to Old Noarlunga
- Best access points: Weatherald Terrace footbridge at Port Noarlunga, River Bend Park boardwalk on River Road, Noarlunga.

Why is it special?

The Onkaparinga Estuary and the adjacent reef system was proclaimed as an Aquatic Reserve in 1971 due to its significant recreational, educational and conservational value. The Onkaparinga Estuary provides the link between the catchment and the sea. Its health is vital for the preservation of South Australia's coastline. It provides valuable habitat and nursery areas for many fish, birds and crustaceans.

Human uses

- Fishing
- Walking
- Canoeing
- Education
- Research

Activities permitted in the Onkaparinga Aquatic Reserve

- Boating (row boats only in the estuary)
- Swimming
- Walking
- Line fishing (not within 25m of the reef)
- Canoeing

Activities NOT permitted in the Onkaparinga Aquatic Reserve

- Collecting or removing marine organisms other than gathering shrimp for bait
- Fishing within 25 m of the reef
- Digging for bait
- Fishing in the wetlands

How salty is your estuary?

Salinity values in the estuary can fluctuate considerably, and are affected by the seasons, weather and the tides. The Onkaparinga Estuary's salinity levels generally range between 20-35 grams of salt per litre. However in the saltmarshes or when the river mouth closes over in summer, salinity levels can reach up to 70 g/L. This is very high considering seawater salt levels are usually around 35 g/L and freshwater is 0 g/L.

Habitats of the Onkaparinga Estuary

There are four main habitats within the Onkaparinga Estuary which are:

- The river mouth and sand dune system
- Floodplain, lagoon in the lower reaches
- Wetland systems
- Upper tidal reaches of the river

The river mouth

The mouth of the River is located at Port Noarlunga, adjacent to the South Port beach. The mouth is dominated by a sand barrier which has built up over time as sediment from both the river and the sea accumulates. During summer, when water flow is reduced, the mouth can close

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over causing a lagoon to form in the entrance of the mouth. This can cause increased salinity levels upstream.

The sand dunes

The sand dune system is located at the mouth of the river at Port Noarlunga and is now considered to be an area of high biodiversity and conservation significance. However, originally this dune system was not considered unique. Only after the significant loss of most of the coastal sand dunes in metropolitan Adelaide has this system become so important.

How do the dunes replenish?

Different sand dune systems replenish their sand levels in different ways. The Noarlunga sand dunes are believed to be replenished through a cyclic action. That is, sand is blown off the dunes to the east and into the Onkaparinga River. The sand is then flushed out to the coastal bay into which the river flows, where some of the sand gets trapped. The sand is finally returned to the beach and dunes and the cycle repeats.

How can dunes be stabilised?

The dune system is threatened by human use and the dunes have been reduced in height in recent years. To stabilise the dune system, vegetation is required. Many original vegetation species still remain and local community groups have been helping the stabilisation process by planting in the area.

The dune system provides a valuable habitat for many species of flora and fauna. Look at the '*Plants of the Onkaparinga Sand Dunes*' identification sheet (*Catchment Connections - Folder 2*) for further information on what is commonly found in the sand dune system.

Floodplain/samphire flats

The Samphire flats are a major component of any estuary. Most of the Samphire or saltmarsh area is now only found in the lower estuary, some of which is now severely degraded. The floodplain or saltmarsh area of the estuary is characterised by salt tolerant Samphire vegetation, an area of sandy marine and estuarine mudflats, which are partly colonised by seagrass.

The mud-flats along the estuary were formed through the accumulation of sediment washed down the river. The sediment is added to the flats during high tides and when the mud-flats are inundated with water during flood events.

The salt tolerant plants of the mud-flats assist in stabilising the sediment and creating an important habitat for macroinvertebrates, reptiles and birds.

Wetlands

A wetland is generally an aquatic or marine environment that can hold temporary or permanent freshwater, brackish or saline water. The total wetland area consists of the water body and the surrounding vegetation.

The Onkaparinga Estuary wetlands area was human-made in the early 1990s to help reduce the amount of nutrients, stormwater and other pollutants entering the river and going out to sea. The wetland system is made up of a series of five wetlands constructed in the floodplain of the estuary.

Each of the five wetlands has a different combination of soil types, landform, size and salinity. These ponds act as a natural filtration system controlling the amount of bacteria, nutrients, suspended solids and heavy metal concentrations from urban areas entering the river estuary. Since their introduction there has been a significant reduction in the amount of heavy metals, faecal coliforms levels and suspended solids in the river.

Wetlands such as these provide valuable habitat for a variety of indigenous flora and fauna such as the Common froglet *Crinia signifera*, the Big headed gudgeon *Phylipnodon grandiceps* and the Common reed *Phragmites australis*.

Visit the previous topic, *Inland freshwater ecosystems* and this topic in *Catchment Connections- Folder 2* for more information on wetlands.

Upper tidal reaches

The estuary is tidal for approximately 2.5 km upstream, near the town of Old Noarlunga. Therefore the water remains relatively salty up to this point. The upper reaches of the estuary are the beginning of the Onkaparinga National Park.

This area comprises riparian (riverside) habitat compared to the lower reaches of the estuary which is comprised of coastal flora and fauna.

Inhabitants of the estuary

The estuary provides a home for a variety of species of birds, fish and macroinvertebrates (such as zooplankton and crustaceans).

Friends of Onkaparinga Park have recorded 198 bird species in the area (from Bakers Gully down to the estuary). The estuary provides an important feeding ground for birds, although most of the larger ones such as the White-faced heron, Egrets and Spoonbills leave the area to breed. The shallow, swampy and muddy Samphire areas of the estuary provide valuable habitat for many of the main food sources for the birds. These include mud-dwelling worms, crustaceans (crabs), insects and plankton.

Some of the rare species found are the Pacific heron, Intermediate Egret and White-bellied sea eagle. The estuary also provides a home for the Singing honeyeater, which is a threatened coastal subspecies. It has a regular presence in the sand dunes.

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There are three major fish species which live in the estuary. These are the Yellow-eye mullet, Jumping mullet and Black bream. Some other 20 species have been recorded within the entirety of the estuary including Congoli, Big-headed gudgeon and the Small-mouthed hardyhead.

In the upper estuary the Jumping mullet and Black bream spawn during spring and summer. The lower parts of the estuary form the nursery area for these fish and also two species of Whiting.

Macroinvertebrates

There are many macroinvertebrates that live in the estuary. These include:

Gastropods (limpets, periwinkles and dog whelks) Crustaceans (mud crabs and sentinal crabs) and bivalves (cockles) and Echinoderms (Seastars)

View the *Macroinvertebrates of the Onkaparinga Estuary identification sheet* in *Catchment Connections - Folder 2*.

Microinvertebrates, such as plankton, are also present in the water.

The Port River-Barker Inlet Estuary

The Port River-Barker Inlet estuary consists of the Port River, North Arm, Outer Harbor and the Angas and Barker Inlets. The estuary is located approximately 12 km north west of Adelaide and begins where the Port River drains West Lakes, extending to connect with the Barker Inlet and Gulf St Vincent via North Arm and Angas Inlet.

Long: 138.31.00 E Lat: 34.46.00 S. Refer to the aerial photo of the estuary in *Catchment Connections Folder 2* for more information.

Tides: The estuary is a naturally marine-dominated environment and is subject to saltwater influence, from West Lakes through to the Barker Inlet. Two tides are recorded daily, with the morning tide having the greatest range in summer and the evening tide the greatest range in winter.

Why is it special?

The estuary is an important natural asset and has a critical role in maintaining coastal and marine biological diversity, the stability of Gulf St Vincent, and economically important commercial and recreational fisheries. As a working port it is also of great ecological and economic significance to South Australia.

The waters of the Port River-Barker Inlet estuary are the largest coastal wetland ecosystem in Gulf St Vincent, consisting of wide tidal mudflats and an extensive belt of mangroves fringing the samphire saltmarsh flats and low-lying dunes of the coastal plain.

The waters are protected by two aquatic reserves and a conservation park: the St Kilda Chapman Creek aquatic reserve, the Barker Inlet-St Kilda aquatic reserve, and the Torrens Island Conservation Park. In addition to these aquatic reserves, the Adelaide Dolphin Sanctuary proclaimed in June 2005, spanning from North Haven to Port Gawler, aims to protect the dolphins and their habitat while accommodating other estuary users.

The Barker Inlet Wetlands supports the world's largest southern-most stand of grey mangrove *(Avicennia marina var resinifera*), provides nursery, feeding and habitat areas for a diversity of commercial and recreational fish and crustacea, and is also of international significance for waterbirds, shorebirds and seabirds. Despite its proximity to Adelaide, the estuary is also home to a population of bottle-nosed dolphins (Turiops truncatus), the presence of which is thought to be internationally unique. The estuary and wetlands system manages to function even with 95% of South Australia's population living at its back door.

Port River a modified environment

Urbanisation and industrialization have modified the Port River environment considerably since European settlement, with the building of port facilities, sewage disposal, stormwater runoff, industrial development, land reclamation, recreational use and litter.

Associated with this development are significant industrial effluent discharges into the Port River. The Torrens Island, Osborne and Pelican Point power stations all use estuary water for cooling which adds to thermal pollution in the estuary. Major licensed discharges include the SA Water Wastewater Treatment Plants at Bolivar and the Penrice Soda Products plant at Osborne. Industry also discharges pollutants into the air which are deposited to the ground and washed into the river during rainfall periods. In addition, a highly urbanized catchment is a major source of road runoff contaminated with lead, copper, zinc and oil.

The Adelaide City Council landfill at Wingfield and the Garden Island landfill sites are in close proximity to the river and are a possible source of pollution. Landfills can leach pollutants into the marine environment through groundwater flows.

The impacts on the Port River-Barker Inlet estuary include poor water quality, nutrient and sediment related loss of seagrass and mangrove communities, heavy metal contamination of sediments, algal blooms and fish kills.

Human uses

- Fishing recreational and commercial
- Recreation: small boating, kayaking, yachting, speedboat racing, jet skiing.
- Commercial shipping, transport and industry including: loading and unloading of manufactured goods, agricultural produce, livestock, petrochemicals, fertilisers and other chemicals

- Education
- Research

Activities permitted in the aquatic reserves

Barker Inlet St Kilda Aquatic Reserve

- Boating
- Removal of fish by rod and line or hand-line
- Collecting of blood worms for bait by use of a hand net

St Kilda Chapman Creek Aquatic Reserve

- Boating
- Swimming
- Taking of blue swimmer crab (*Portunus pelagicus*) by hand, crab rake or hoop net only

Activities NOT permitted in the aquatic reserves

Barker Inlet St Kilda Aquatic Reserve

- Collecting or removing any other marine organisms, except by rod and line or handline,
- Collecting blood worms by any means other than a hand net.

St Kilda Chapman Creek Aquatic Reserve

- Bait digging, fishing and collecting or removing any marine organism (other than blue swimmer crabs).

How salty is your estuary?

The Port River-Barker Inlet estuary is an ancient marine-dominated estuarine system that is naturally saline, but salinity values within estuaries can vary considerably and are affected by the seasons, weather and tides. Salinity values taken between 1995-2000 show small variability in conductivity ranging from 37.3 g/L to 38.1 g/L. However, salinity levels have been as low as 0.66 g/L.

The Port River-Barker Inlet estuary is a 'reverse estuary' because it is more saline at the landward end and less saline at the seaward end. This situation occurs when more dense saline water brought in by the tide slides under the freshwater (freshwater inputs are low in the Gulf), the evaporation rate is high and water circulation is limited. Thus the stratification of freshwater above saline waters leads to evaporation of the top freshwater layer, leaving behind a more saline layer closer to the land.

Habitats of the Port River Estuary

Coastal wetlands

Mangrove forest communities

Intertidal mudflats

Samphire shrublands

Sand dunes and coastal plains

Coastal wetlands

A wetland is generally an aquatic or marine environment that can hold temporary or permanent fresh, brackish or saline water. The total wetland area consists of the water body and the surrounding vegetation.

The Barker Inlet coastal wetlands consist of many habitats including low-lying dunes, samphire flats, intertidal mangrove forests, intertidal mud flats, tidal channels, subtidal seagrass meadows and the adjoining saltfields from St Kilda to Outer Harbor.

The Barker Inlet coastal wetlands have been identified as being of national importance as they provide sanctuary for many migratory birds and waterbirds. Nearly 60 species of waterbird have been observed in the wetlands, 12 of which are listed under the Japanese-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA). The wetlands are home to a number of threatened bird species, such as the little egret, white-bellied sea eagle and the slender-billed thornbill, and provide a valuable breeding and nursery area for 18 species of waterbird and eight commercially exploited species of marine prawn, fish and crab.

Mangroves

Mangroves in Australia are commonly associated with the sheltered waters of sub-tropical and tropical coastlines, with 95% of mangrove forests and the vast majority of the 30 species, occurring north of New South Wales. South Australia is home to one species of mangrove, the grey mangrove (*Avicennia marina var resinifera*), which occurs in the sheltered intertidal zone of Spencer Gulf and Gulf St Vincent. The mangroves have colonised almost the entire shoreline of Barker Inlet, including the eastern sides of Torrens and Garden Islands. These areas comprise some of

the largest temperate mangrove forests in Australia and are considered one of the state's most important wetland ecosystems.

Due to the high salinity and poor aeration of the coastal muds, mangroves have developed special adaptations to survive, such as the pencil-thin 'air-breathing' roots called pneumatophores. These aerial roots sit above the water during low tide, collecting oxygen for the root system. Pneumatophores also stabilise the sediments within and around the mangrove forest.

The intertidal nature of mangroves and extensive root systems provides a unique and valuable coastal habitat for a variety of marine life including the mud crab (*Helograpsus haswellianus*) and gastropod snails (*bembicium auratum*), which feed primarily from the organic detritus produced by the forests. Mangroves are also essential breeding grounds, nurseries and feeding grounds for many marine fishes, crustaceans and dolphins.

Intertidal mudflats

Seawards from mangroves are extensive areas of mudflats. These flats may be several hundred metres wide. Near the low tide level there are zones, first of eel grass beds (*Heterozostera*), then subtidal sea grasses (*Posidonia*), between 0.5m and 12m below low tide level. These sea grasses support an extensive epiflora, which grow on them. While many fish move across the mudflats with the tides, most organisms live above or within the sediments. Surface sediments support an abundance of microscopic life, particularly diatoms and cyanobacteria (blue-green algae). Other benthic life includes numerous species of annelid worms and bivalve molluscs and the gastropod snail (*Bembicium*).

Samphire shrublands

The samphire is the first of the truly estuarine communities and occurs on regularly-inundated, low-lying highly saline areas often associated with coastal areas. Samphire have long suffered from poor public perception and maligned as saline waste lands. Unfortunately, these areas are commonly used for rubbish dumping, land reclamation and industrial development. However, samphire provides important habitat for a number of threatened migratory bird species including the little egret (*Egretta garzetta*) and slender-billed thornbill (*Acanthiza iredalei*). True samphire species are those that occur in frequently flooded, low-lying and highly saline areas and include the shrubby samphire (*Sclerostegia* sp.) and the samphires (*Halosaarcia* sp. and *Sarcocornia* sp.). By comparison, species that are included in the plant association but are not true samphire, occur in less saline, rarely flooded areas, marking the transition into adjacent shrublands.

Sand dunes and coastal plains

The white sand dunes that run along the coast of Le Fevre Peninsula define the western boundary of the Port River-Barker Inlet estuary. The species composition of the dunes is a result of the poor and saline soils and exposed conditions. The community consists of salt tolerant shrubs and low-growing, often fleshy-leaved, ground covers. In places, the dunes harbour groves of drooping sheoak (*Allocasuarina verticillata*) and native pine (*Callitris gracilis*). Singing honeyeaters (*Lichenostomas virescens*) are a prominent bird in these dunes, as are Peron's skinks (*Hemiergis peroni*), sleepy lizards (*Tiliqua rugosa*), eastern bluetongues (*Tiliqua scincoides*), brown snakes (*Pseudonaja textilus*) and the bush rat (*Rattus fuscipes greyii*). The dunes systems are now recognised as having a high biodiversity value and conservation significance. However, this dune system was not originally considered unique. Only after significant loss of most of the coastal sand dunes in metropolitan Adelaide has this system become so important.

Inhabitants of the estuary

The estuary provides a home for a variety of species of birds, fish, and macro-invertebrates including: king george and yellow fin whiting, western king prawns, mullet, jumping bream, blue swimmer crabs, dolphins and pelicans. The estuary is an important breeding ground, on a national scale, for pelicans as they disperse throughout south east Australia.

Some rare species can be found inhabiting the estuary and include the little egret, white-bellied sea eagle and slender-billed thornbill. The Port River-Barker Inlet estuary is the only known breeding ground in South Australia for the little egret and also provides a home for the singing honeyeater, which is a threatened coastal sub-species, but has a regular presence in the coastal sand dunes.

Lesson ideas

- Visit the a local estuary with your class.
- Get students to research other estuaries and/or aquatic reserves in the State.
- Organise a class role play and debate. 'The estuary is now becoming a National Park where the only activities permitted are walking, birdwatching and educational activities.' Students can become: dog walkers, bird watchers, mountain bike riders, water watchers, fishermen, developers, swimmers, convervationists. Students can work in groups. One of the interest groups can discuss why their activity is important to them, the impact of the estuary changing to a National Park on their group and whether they will be supporting it or not. They can present their points of view to the class, with each of the other groups allowed to ask questions.
- Complete the *Be a beach detective* activity included with this topic.
- Set up five water containers, each with different amounts of salt added. The first having no salt added and the last being very salty. This represents the variety of salt levels of the Onkaparinga River from the hills to the sea. Students can taste test the different water. Discuss the variation of salinity in the catchment, the reasons for it and look at why being salty isn't always bad (ie, high salt levels in an estuary

are a normal thing). Get students to think about why some animals and plants can tolerate salt and others can't. Complete the *Salinity in a day* worksheet included with this topic.

- Use the identification sheets provided at the back of this folder to select ten animals and plants that occur in the estuary. Have students complete the *Creatures of the Estuary* worksheet included with this topic or design a food web.
- Collect a water sample and look at it under a microscope. Research some of the microscopic creatures of the estuary.

Recommended resources

Onkaparinga Estuary bird, plant and macroinvertebrate identification charts provided in *Catchment Connections - Folder 2*.

http://www.deh.sa.gov.au/coasts/estuaries.html is the Estuaries Management and Planning page for the Department for Environment and Heritage, South Australia and is full of background information on our local estuarine systems.

http://www.waterwatchadelaide.net.au

Includes an interactive look at mangroves of the Port River Estuary, worksheets and other activities.

Investigate the Port River and Barker Inlet Estuary Environment (Part 3)

http://www.environment.sa.gov.au/coasts/dolphin_sanctuary/pdfs/dolphin_part3.pdf

For educators to help students develop an understanding of the whole Port Adelaide River and Barker Inlet Estuary ecological system and the surrounding catchment area.

References:

Ambient Water Quality Monitoring of the Port River Estuary 1995-2000, EPA

Where River meets the Sea: Exploring Australia's Estuaries, 2004, Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management

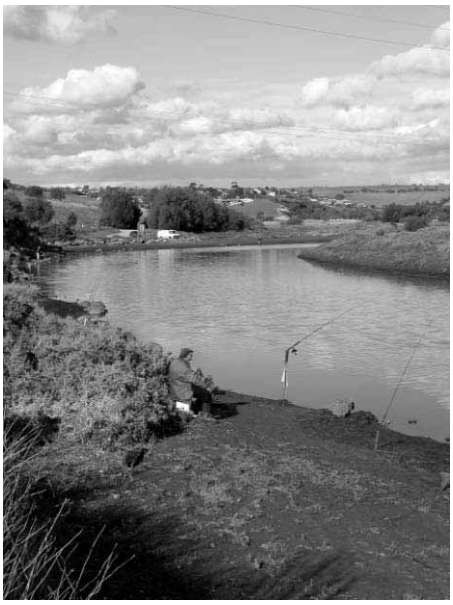
Onkaparinga Estuary field trip

Time taken: 1.5 hours - half a day

Location: Weatherald Terrace, Port Noarlunga

Resources required:

- bird, plant and macro-invertebrate identification charts
- estuary worksheet (clipboards and pencils)
- estuary monitoring kit (if required)



Onkaparinga Estuary upstream

Session outcomes

Students will:

- discuss tides, salinity fluctuations and water quality of the estuary.
- use identification charts to identify birds and plants.
- consider the importance of the estuary as a fish breeding area.
- discuss how the health of the estuary affects the marine environment.

Stop 1: The footbridge

Get the bus to drop you off at the footbridge on Weatherald Terrace Port Noarlunga. Alternatively you may like to visit the adventure playground on Saltfleet Road before walking down to the estuary.

Things to talk about with your class (using the notes provided):

- What is an estuary?
- What is a tide and how does salt water enter a freshwater river?
- Salinity variations.
- Diversity of flora & fauna.
- Human impacts affecting the area.
- The importance of maintaining healthy water upstream.

Onkaparinga Estuary showing the Weatherald Terrace footbridge

Students can complete the questions for 'Stop 1: at the footbridge'.

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Stop 2: the dunes

Walk across the footbridge and on the right hand side will be the start of the dune system. Stop here and discuss the following:

- How are sand dunes created? (I.e. movement of sand)
- Why are sand dunes important? (Include the importance of the Port Noarlunga sand dune system)
- What would happen if there was no vegetation on the dunes?

Use the *Plants of the Onkaparinga Sand Dunes identification sheet* to assist in identifying local and introduced plants.

Stop 3: the lookout

Keep walking along the boardwalk until you reach the South Port Surf Life Saving Club. You should see two lookouts behind the building. Stand on a lookout. You should have a good view of the river mouth and Port Noarlunga reef.

Onkaparinga estuary - river mouth

Discuss the following:

- Implications of poor catchment health on the reef and marine environment.
- Land use in the area.
- What is an aquatic reserve?
- Why are they important?
- What is special about it?

Students can complete the questions for 'Stop 3: the lookout'.

Stop 4: Your choice!

If you would like to extend your stay at the estuary there are a few activities that you can complete:

- Head to the beach and complete the *Treasure Hunt* activity.
- Walk along the sand to the jetty. Go to the end of the jetty to obtain a closer look at the reef environment.
- Contact the Port Noarlunga Aquatic Centre for a 'walk on the reef' activity.
- Walk or drive from the estuary mouth to the wetlands on River Road and complete the *Why Wetlands?* excursion.
- Complete a full estuary tour beginning at the start of the estuary at Old Noarlunga via the wetlands and finish at the estuary mouth at Port Noarlunga.

Port Noarlunga reef from the jetty

Onkaparinga Estuary field trip

Name:_____

Stop 1: The footbridge

1. Look carefully at the river water flowing under the footbridge.

   (a) Is the water flowing to or from the sea? _____

   (b) Explain what is causing this river flow.

   _____

   _____

(c) Water testing results

	Freshwater	Saltwater
Turbidity Clear or dirty (NTU)		
Salinity Amount of salt (mS/cm)		

(d) Do you think the water is salty or fresh? Explain using your water test results as evidence.

_____

_____

_____

2. Using the bird identification chart work out the names of any birds you see.

   Write their names.

3. List any other living things that you can see

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Stop 2: The dunes

Adelaide's dunes are disappearing!
We must look after the special areas we have left.

Fact: Plants help stop the sand dunes from being blown away.

List human activities that:

(a) help sand dunes

(b) harm sand dunes

2. What are the different ways that the **wind** and the **rain** can cause dune erosion?

Rain causes dune erosion by.....

Wind causes dune erosion by.....

3. Choose one of the plants growing on the dunes and complete a plant profile (use your *Plants of the Onkaparinga Sand Dunes* ID sheet to help.

(a) Common name: _____

(b) Scientific name:_____

(c) Flower colour: _____

(d) Words to describe the leaves:

_____ _____ _____

(e) Common names of nearby plants:

(f) Draw your plant (show its root holding the sand dune together.)

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Stop 3: The lookout

1. Pollution left on the street ends up on the beach! Explain how this is possible.

2. The estuary is an important place for birds, fish, native plants and for people doing activities like swimming and fishing. How does pollution affect them?

Pollution	Who is affected?	How are they affected?
Car oil Detergent Dirt (floating in the water) Dog poo		

4. Draw the most interesting thing you can see from the lookout.

5. Look at the jetty and the reef. The reef is a protected area.

(a) What activities can you do at the reef?

(B) What can't you do?

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Onkaparinga Estuary worksheet

Name:_____

Stop 1: The footbridge

1. Look carefully at the river water flowing under the footbridge.

   (a) Is the water flowing to or from the sea? ***To*** or ***from*** _____

   (b) Explain what is causing this river flow?

   The flow in and out of the estuary is caused by the high and low tides. As the tide comes in, water flows upstream and as the tide goes out the river water flows towards the sea.

(d) Do you think the water is salty or fresh?
Explain using your water test results as evidence.

Usually the water in the estuary is very salty. However, after heavy rain, the water flowing to the sea may be a mix of fresh and salt water.

(C) Water testing results

	Freshwater	**Saltwater**
Turbidity Clear or dirty (NTU)		
Salinity Amount of salt (mS/cm)		

2. Using the bird identification chart work out the names of any birds you see.

Write their names.

Various

3. List any other living things that you can see 

Various

Various

Stop 2: The dunes

Adelaide's dunes are disappearing!
We must look after the special areas we have left.

Fact: plants help stop the sand dunes from being blown away.

List human activities that:

(a) help sand dunes

- *planting native plants*
- *keeping to the paths*
- *telling other people about the importance of the sand dunes*

(b) harm sand dunes

- *Use the dunes as a slide*
- *walk and play on the dunes*
- *pull out the native plants*
- *litter*

2. What are the different ways that the **wind** and the **rain** can cause dune erosion?

Rain causes dune erosion by.....

As the rainwater washes across the sand dunes, it picks up the particles of sand and washes them down the sides of the sand dune.

Wind causes dune erosion by.....

Blowing particles of sand from off the dune to the surrounding areas.

3. Choose one of the plants growing on the dunes and complete a plant profile (use your *Plants of the Onkaparinga Sand Dunes* ID sheet to help.

(a) Common name: *Various*

(b) Scientific name:_____

(c) Flower colour: _____

(d) Words to describe the leaves:

_____ _____ _____

(e) Common names of nearby plants:

(f) Draw your plant (show its root holding the sand dune together.)

Stop 3: The lookout

1. Pollution left on the street ends up on the beach! Explain how this is possible.

Rain washes anything left lying on the ground into the streets, then gutters, then into the stormwater drains. The stormwater drains carry this pollution to a river or creek and eventually to the sea.

2. The estuary is an important place for birds, fish, native plants and for people doing activities like swimming and fishing. How does pollution affect them?

Pollution	Who is affected?	How are they affected?
Car oil	*Birds*	*Oil gets caught in their feathers and they die.*
Detergent	*People*	*Detergents cause smelly and toxic algae to grow. This is unsafe for swimmers.*
Dirt (floating in the water)	*Fish*	*Their gills can get clogged and they may not be able to feed properly.*
Dog poo	*People*	*Swimming is unsafe as people may get sick by swallowing bacteria from the water.*
Plastic bags	*Fish and birds*	*They may become tangled in bags*

4. Draw the most interesting thing you can see from the lookout.

5. Look at the jetty and the reef. The reef is a protected area.

(a) What activities can you do at the reef?

Snorkelling
Swimming
Scuba diving

(b) What can't you do?

Spear fish
Fish past the blue line on the jetty
Collect anything

Be a beach detective

You are a detective looking closely at the beach.
You are looking for (but don't collect) the items described below. Sketch the items you find.

A living thing that is growing

Something that has undergone change

Something that is impossible to count

Something that is brightly coloured

Something that shouldn't be At the beach/estuary

A natural item which could be used as a tool

Something that might be food for plants and animals

Something that you think is under threat

Something that won't be here in 100 years

The best thing that you saw today

Modified from a resource sheet produced by the Middle Beach Centre.

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Creatures of the estuary

What have you seen at the estuary today?
Look around and see if you can draw.....

Something brightly coloured

Something slimy

Something that smells

Your favourite creature

14. Water needs in Adelaide

Concepts

- Water from our local catchments have many uses.
- The water drawn by people in the catchment comes from different places.
- Water is a limited resource but human demand is growing.
- More water is drawn from our catchments than they collect.

Water, our most precious resource

All living things need moisture to survive and since water is in short supply, it is arguably the most precious commodity on Earth. South Australia is the driest state in Australia and its supply of water is both finite and limited, yet our water needs continue to grow. A river's ecological system needs water in order to survive thus, by drawing more water from our rivers than the catchments can collect, people are jeopardising the survival of the river as a source of clean fresh water even for the present generation.

Water for many uses

Water is used not only in the home, but by farmers, small businesses, councils and almost every industry large or small. By far the biggest users of water in South Australia are irrigators who use water to grow crops or pasture. Graph 1 shows the percentage of water consumed by each sector in South Australia.

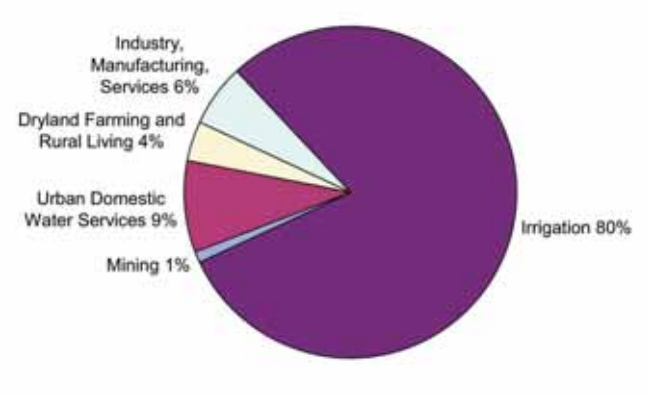
In the home

The average household uses 300 kilolitres (thousand litres) of water per year, mostly for drinking, cooking, washing and cleaning, but almost half of the water is used to water the garden. Graph 2 shows the percentage of water used in the home for each task. Note that 2% of water supplied to the average home is lost due to leaking pipes and fittings!

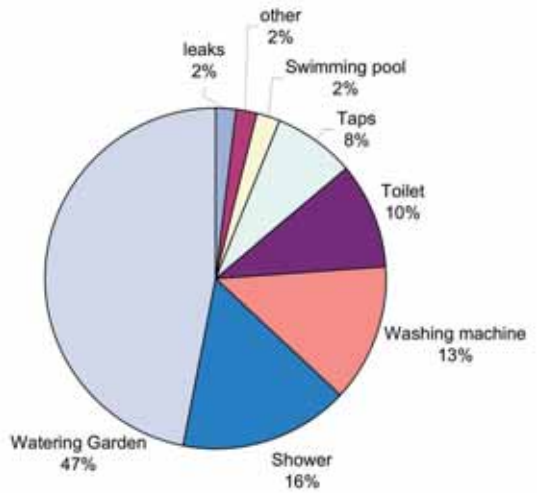
Rural

Farmers use water to grow crops such as apples, wine grapes, almonds, olives, and vegetables. Water is also used to grow pasture for dairy cattle and to make hay. People living in rural parts require water for the house, for watering their gardens and for watering livestock such as sheep, cattle, goats, chickens, pigs and deer. Although some farmers pump water directly from the river, for example, most of the 2,700 dams in the Onkaparinga catchment have been built by farmers to store water for use during dry spells. All of the dams and pumping, taken together, have had a significant impact on flows throughout our catchments.

Industry, manufacturing and services



Graph 1: Water use by sector in South Australia



Graph 2: Water use in different areas of the home

Almost every industry uses water, for example, in:

- manufacture of goods such as soft drinks
- production of steam used for energy
- cooling and cleaning factory machinery

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Where does our water come from?

Initially all of the water used in the catchment area falls as rain which either soaks into the ground and may eventually permeate into the waterways or else drains more directly into the waterways as surface run-off. The water used in the Onkaparinga catchment is sourced from different places.

Groundwater

This is an important source of water for many farmers who pump the groundwater from underground bores or wells for use in watering stock or for irrigation. Groundwater is also often used by manufacturers as a cheap source of water.

Since groundwater influences both the moisture level in the soil and the water levels in the waterways, depleting it more quickly than it can be replenished by rainfall, even just in one small area, can impact on the entire catchment.

The use of groundwater for irrigation of wineries in McLaren Vale/Willunga is today controlled by the government because groundwater levels had become seriously depleted. Treated wastewater effluent from Christies Beach is also pumped down a pipeline to supplement irrigation water.

Rain water tanks

Many homes use water tanks to store rain water collected from the roofs of houses and sheds. Water tanks provide free and clean drinking water for use in the home or garden.

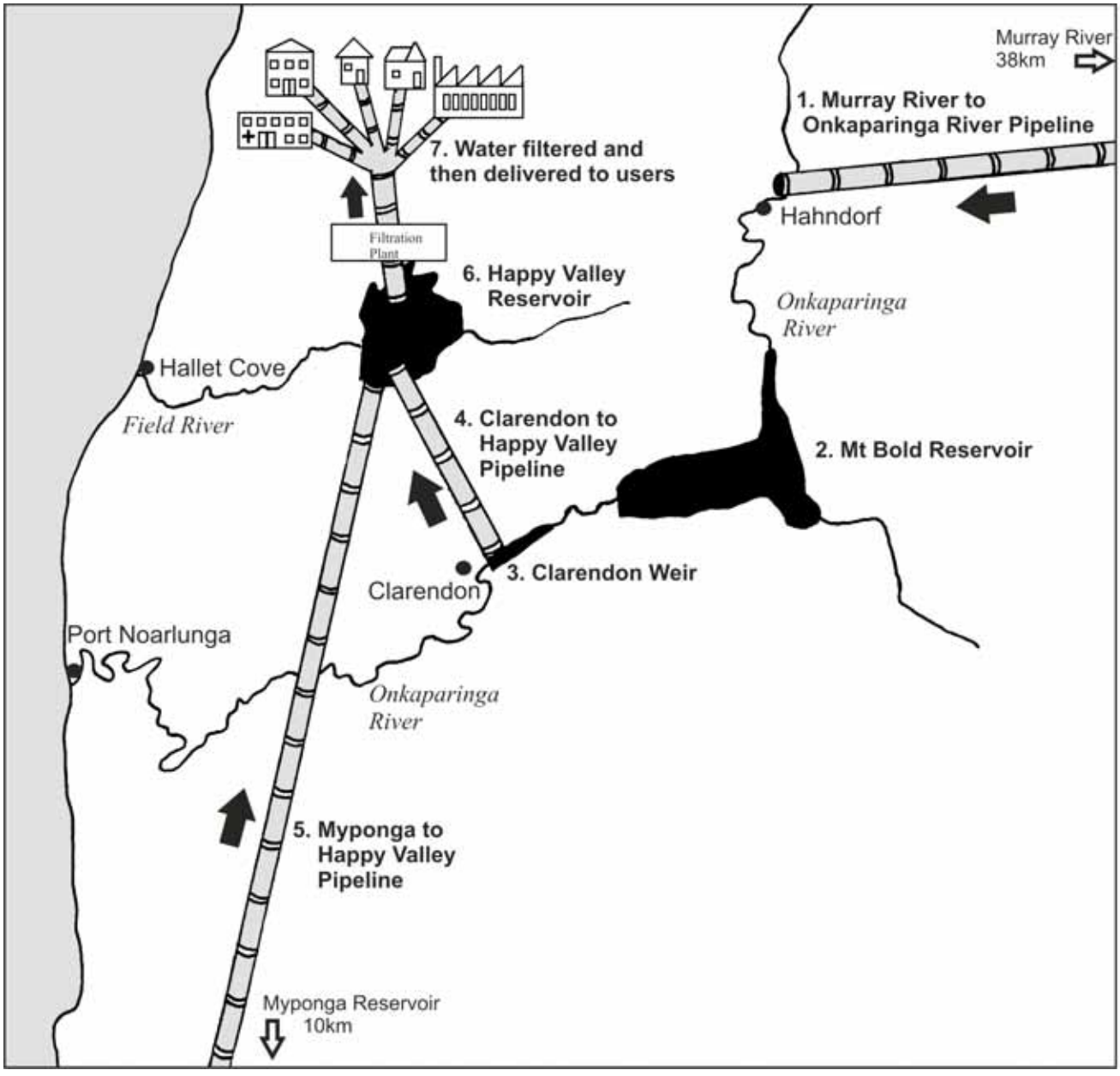

Diagram 1: The Happy Valley Reservoir system

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Domestic and indusrtial uses of water throughout the AMLR region are fairly similar. However, in the rural areas there are some differences in terms of water use.

Farmers in the Torrens catchment use water primarily for the production of pasture for livestock, horticulture and rural living lifestyles (hobby farms), but there has been a trend away from pasture towards increased annual and perennial horticulture, in particular viticulture, as a result of economic drivers. In the Patawalonga catchment, the rural portions of the Sturt River contain significant areas of native vegetation and primary production and rural Brown Hill Creek contains Brown Hill Recreation Park and primary production areas. The Port catchment is made up of a series of small urban and industrial catchments from which stormwater runoff is collected; the catchment contains no rural areas.

Although some farmers pump water directly from the Torrens River, most of the 1200 dams in the Torrens catchment have been built to capture water before it reaches the river. Farm dams represent a total usage volume of 9,360 ML/year. Over the last ten years, farm dam growth has resulted in 143 new dams of a capacity around 730 ML. Half of these are for irrigation purposes. All of the dams and pumping, combined with farm dam growth (due to the trend away from pasture to horticulture), have had a significant impact on flows throughout the Torrens catchment.

Farm dams within the Patawalonga catchment are estimated to have a total of 570 ML, which is small compared with the 8,550 ML average annual stream flow from the rural part of the catchment. Therefore very little water is being harvested from the catchment.

In areas of the Mount Lofty Ranges there is a requirement for farm dams to be sized on the basis of the 50/50 rule. The rule affectively allows the landowner to harvest 50% of the runoff from their land and leave 50% for downstream uses. The rationale is based on ensuring runoff into river systems for public water supply e.g. Torrens catchment, and is also supported for supplying environmental needs i.e. Patawalonga catchment.

Horticulturalists and grape growers, market gardeners and farmers in the Northern Adelaide and Barossa catchments all use water to grow products like grapes, vegetables and cereal crops, and is also used for animals. Groundwater resources in particular have been used heavily in the past in the Northern Adelaide and Barossa region, leading to cones of depression being formed around where bores are located.

Dams and reservoirs

A dam is any body of water confined by some kind of barrier, usually a dam wall built by humans. Often some considerable earthwork is required during the construction of a dam such as removing natural vegetation and the excavation of soil and rock, especially if there is a need to enlarge its capacity by deepening or widening the storage area. In places that are porous, a special kind of clay may be brought in to line the reservoir to reduce seepage.

In the Onkaparinga catchment area there are more than 2,700 dams, most of them constructed by farmers to store water for use in irrigation of gardens and crops, for watering stock, domestic use and some cleaning jobs around the farm.

The largest dams are those that have been constructed by the government to create reservoirs (artificial lakes in which a body of water is held in storage and from which water may be pumped or released when it is needed).

The Happy Valley Reservoir system which provides Adelaide with up to 40% of its water supply is the largest reservoir in the Onkaparinga catchment and comprises a complex system of reservoirs and pipelines. Diagram 1 shows the layout of this reservoir system:

(1) Water pumped from the River Murray enters the Onkaparinga River at Hahndorf.

(2) Water from the Onkaparinga River and River Murray collects in Mt. Bold Reservoir. In an average year, 40% of Adelaide's drinking water comes from the River Murray, although this figure can rise to 85% during a very dry year. Graph 3 shows the variation in amounts of water obtained from the River Murray and Adelaide Hills over the last 24 years.

(3) The water from Mt. Bold Reservoir escapes in a controlled release to Clarendon Weir where it is diverted into a pipeline.

(4) This pipeline transports the water from Clarendon Weir to Happy Valley Reservoir.

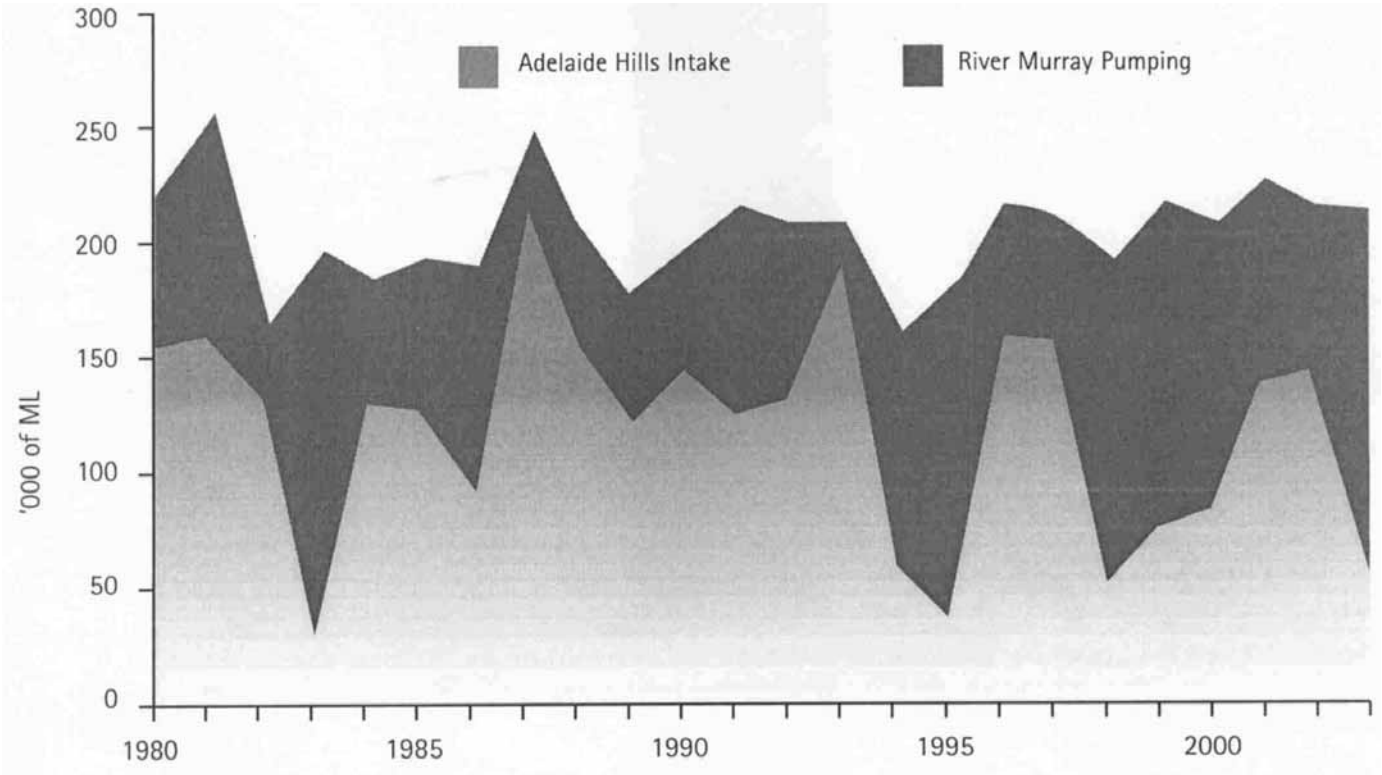
(5) Additional water is brought to Happy Valley from Myponga reservoir (not in the Onkaparinga catchment).

(6) Happy Valley Reservoir stores water ready for filtration.

(7) The water from Happy Valley is filtered and transported to mains water users throughout the Adelaide metropolitan and hills regions (including many homes in the Onkaparinga catchment).

We are using too much water

The availability of fresh water is finite because it depends on the limited amount that falls from the sky. Rainfall in the Onkaparinga catchment can fluctuate a great deal, but in an average year it may vary from 1100 mm over the Adelaide Hills to 400 mm near the coast. Allowing for evaporation and other natural losses, this has been estimated to allow a maximum sustainable yield, in an average year, of 44 gigalitres (44,000,000,000 litres). Currently, people in the Adelaide Hills region alone consume an estimated 120 gigalitres each year, nearly three times the level of sustainability.



Graph 3: Adeliade's drinking water supply sources (from *Water Proofing Adelaide*, 2004, Government of South Australia)

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Water for the Onkaparinga River

The health of the Onkaparinga River is deteriorating because too much water is being removed from it. The section of river below the Clarendon Weir, for instance, has very little flow for much of the year. River water is thought of by many simply as a resource, without consideration being given to the needs of the river itself. A river is, in fact, a "water user" since, without adequate flow throughout the year, it ceases to exist. The action of water flowing along a waterway removes pollution and silt.

Pollution, if allowed to accumulate, can become highly concentrated causing harm to organisms that rely on the river for their survival, including fish, frogs, invertebrates, plants, stock and humans.

The Onkaparinga River needs a great deal of water to flush silt from the estuary out to sea. Accumulated silt can impact on the fishing industry because plants and micro-organisms die off when subjected to heavy silt. This affects the spawning ground and habitat of the fish that feed on them. But silt can also block the river mouth restricting the access of fish that would normally enter for spawning.

The future

The effect of using too much water will become more serious as the human population increases in the Onkaparinga catchment. If people were made aware of the impact of their actions perhaps they would waste less water.

Another way in which the consumption of water could be reduced is by recycling waste water. Currently we recover and re-use only 15% of our storm water and 15% of our treated wastewater effluent. The remainder is released into rivers or the ocean. One way of reducing the amount of catchment water consumed would be to recover and use more of this wastewater.

Lesson ideas

The following activities available in the *Catchment Connections -Folder 3, Topic 5*:

- *Where our water comes from*. A Waterwise worksheet for lower primary that describes the water cycle.
- *The water cycle*. A Waterwise worksheet for middle and upper primary exploring the concepts of evaporation, precipitation and condensation.
- *How much water do we use at home?* A series of four Waterwise worksheets that directs students through a survey of the amount of water that they use at home over a day, weekend and an entire week.
- *Leak check*. This set of five Waterwise worksheets directs students to survey water using appliances at home and school to detect leaks (topic 5, folder 3).

Additional ideas:

- *Water use research task*. This worksheet for lower primary requires students to survey water use in their homes and to survey their friends to find out how water is used in the home.
- *Not enough water?* Students are asked to consider what would happen if the River Murray water supply became too salty for us to use. Currently we top up the Onkaparinga River with large amounts of River Murray water.
- The average household uses 300 kilolitres (1 kilolitre = 1000 litres) of water per year. Given that 5 kilolitres of water weighs 5,000 kilograms (5 tonnes) and that your school bus might struggle under such a load, estimate how many bus-loads you might need to move enough water to supply a household for a year.
- Water use in the Adelaide Hills has been estimated at 120 gigalitres (1 gigalitre = 1 000 000 000 litres), but the sustainable limit is thought to be around 44 gigalitres per year. Try to work out what this statement means. What do we mean by sustainable? What happens if we keep using water at an unsustainable level?
- Debate: Environmental flows. "The river needs more water otherwise it will die" cry the environmentalists. The scientists at the Catchment Board agree. But farmers have put in new grape vines and need more water to irrigate them. The dairy farmer needs the water to irrigate pasture and to wash down the milking shed. What can you tell them?
- In what ways do people use water? Research your area and list all the uses for water that you can find. Find out about factories and farms.
- Graph water use. Ask students to create pie charts and graphs that depict the amount of water used for each task in the home. Discuss the significance of any anomalies.

Recommended resources

http://www.environment.sa.gov.au/reporting/education/pdfs/fact_sheets/06_water_use.pdf

Up to date information about water use in South Australia

http://www.sawater.com.au/SAWater/Education/ourwatersystems

Overview on water use in South Australia. Information and lesson ideas.

http://www.savethemurray.com/pdfs/waterwise_household.pdf

Information on household water use and tips for saving water.

http://www.murrayusers.sa.gov.au

School Water Audit Kit, River Murray Urban Users Committee.

A copy of this Waterwise resource folder should be available in the library of every school in the Onkaparinga catchment. Alternatively electronic copies of the resource are available online.

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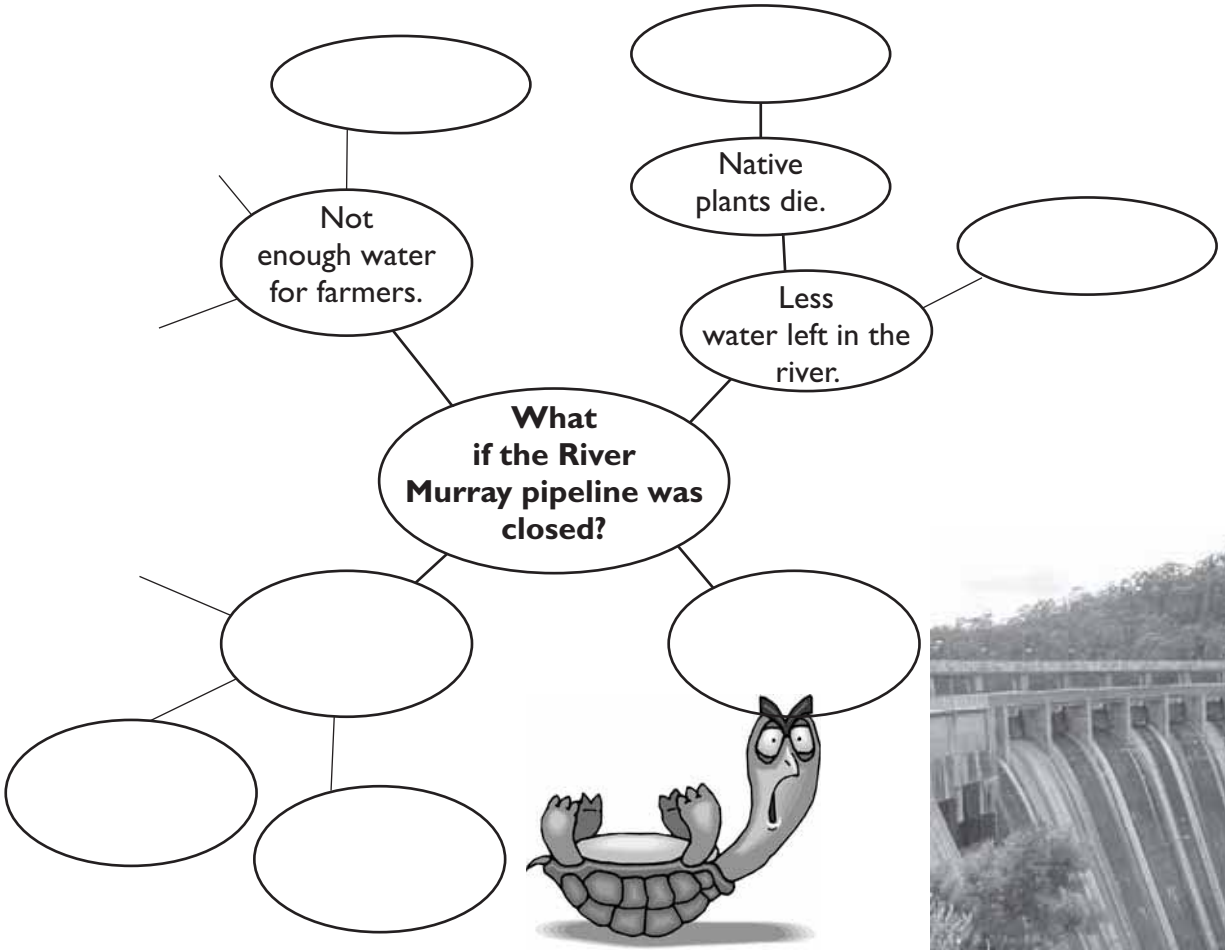
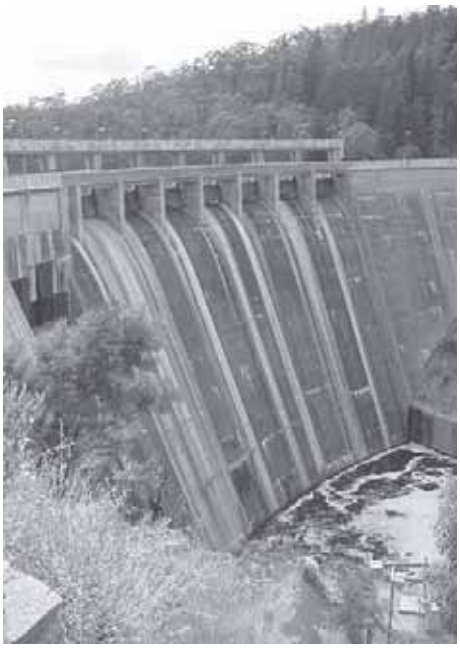
Not enough water?

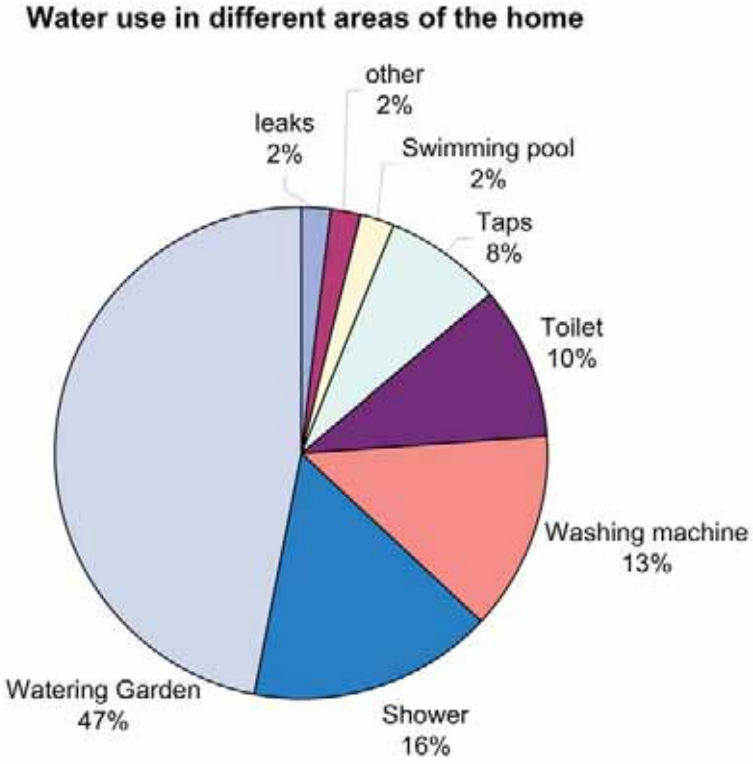
In the Onkaparinga catchment we use a lot of water. In fact, if we did not pump water from the River Murray we would not have enough to go around. On average 40% of Adelaide's drinking water comes from the River Murray. What would happen in the Onkaparinga catchment if the River Murray Pipeline was closed because the River Murray became too polluted?

Task 1: You are to create a consequence wheel that describes some of the problems that could occur if the River Murray Pipeline was closed. Copy and complete the consequence wheel on a separate piece of paper by adding your creative ideas.





Water use in the home



Use the pie chart above to answer the questions below

1. The shower uses less water than the washing machine.
TRUE/FALSE

2. Compared to the swimming pool, the toilet does not use as much water.
TRUE/FALSE

3. The shower uses twice the amount of water as the taps.
TRUE/FALSE

4. The three smallest water users in the home are the taps, toilet and swimming pool.
TRUE/FALSE

5. What are the three biggest users of water in the house?

_____ _____

_____

6. Suggest some ways to reduce the amount of water used in the house.

_____

_____

_____

7. Do you think this water use chart represents water use in summer or winter? Explain your answer.

_____

_____

_____

8. Watering the garden takes the most amount of water. Think of ways to reduce the amount of water use in the garden.

_____

_____

_____

9. What water uses could be recorded in the 'other' section?

10. On a separate sheet of paper draw a pie chart to show water usage in your home.

Water use survey

Survey your friends and fill in 'yes' or 'no' for each water use.

Today I used water to.....

Name	brush my teeth	have a shower	drink	water the garden	wash the dishes

Think! Which task uses the most water? Draw it in a picture.

List the tasks that use water in your house.

_____

_____

_____

_____

_____

15. Stormwater

Concepts

- Stormwater carries many types of pollutants into waterways.
- More stormwater runs off urban areas than rural areas.
- Stormwater flows untreated into waterways unlike wastewater which is treated.
- Stormwater could be collected and re-used to increase water supplies.

What is stormwater?

Stormwater is any water that falls as rain and which then runs off along waterways or collects on the ground as surface water. Stormwater is a normal part of the water cycle and helps to maintain the flow of waterways and to recharge groundwater and aquifers.

In urban areas stormwater is found collecting on paved or concrete areas or falling off roofs of buildings, flowing from gutters into drains. It is usually conveyed from there into the stormwater system by a system of pipes separate to that which conveys sewage and wastewater.

When stormwater enters rivers or reservoirs it can contaminate drinking water, with serious consequences for humans. For example, urban stormwater originating in the hills towns such as Birdwood, Gumeracha or Cudlee Creek, can end up flowing into the Torrens River and then Kangaroo Creek Reservoir. From here it is diverted to Hope Valley Reservoir and treated before being distributed. High levels of pollution entering the Torrens River water supply will increase the cost of its treatment. Some industrial chemicals are so toxic that, were they to enter a river system, no treatment would be possible.

In many areas some stormwater is captured and stored in tanks or dams.

Pollution, sources and effects

As stormwater flows across the ground it picks up or absorbs many kinds of pollutants and carries them into the waterways. Humans leave a large amount of polluting materials in places where it can be collected by the stormwater and, as more people move into our catchments, the amount of stormwater pollution is increasing.

Stormwater pollution is derived from many sources, including:

- animal and human waste
- oil and grease
- sediment
- litter
- salts
- heavy metals
- nutrients

Table 1 provides a summary of the sources and effects of these pollutants.

Where is the worst stormwater pollution?

The way in which the surrounding land is used often dictates what kind of pollutants will contaminate a waterway at any one location. In undisturbed bush land stormwater pollution may be limited to leaves and some animal droppings.

A waterway flowing through an urban area will become highly polluted after rain, due to the large amount of pollutants that accumulates on hard surfaces and in gutters, including litter, grease and oils that have leaked from cars onto the road, cleaning chemicals used outside the home including detergents, industrial chemicals, and insecticides, fertilisers or weed killers washed from garden surfaces.

The effects of pollution in urban areas are made even worse because of increased run-off. In natural bush land most rainfall soaks into the ground, leaving only about 2% to become stormwater (run-off). In a built up area where there are lots of hard surfaces, more run-off is created because less rainwater soaks into the ground. Up to 95% of the rain that falls in suburban areas becomes stormwater. After rain in urban areas, many river animals are killed by large flows of polluted stormwater.

Stormwater is different than wastewater

The system of pipes draining stormwater to waterways is different than the wastewater and sewage system that removes domestic wastewater (sink, toilet, washing machine, and shower) or industrial effluent from factories.

Diagram 1 shows sources of wastewater and stormwater in and around the home.

Wastewater contains very high levels of nutrients and disease-causing bacteria, so it would be correct to say that wastewater is more dangerous than stormwater. However, most wastewater goes through an extensive treatment process before it is released into natural waterways. Stormwater, by comparison, flows directly into waterways without any treatment causing a potentially bigger impact on waterways than treated wastewater.

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Issue	Probable Source	Environmental Impact
Animal & human waste	Leaking septic tanks, run-off from animal holding yards, and dog droppings.	Increased nutrient levels in stormwater which lead to an increase in toxic algal blooms.
Salts	Primarily groundwater. Possibly also from air-conditioning and cooling systems.	Alters the chemical balance of our waterways, which may kill some aquatic plants and animals.
Heavy metals (e.g. cadmium, chromium, copper, zinc and lead)	Run-off from roads and car parks, deterioration of building surfaces (e.g. Roofs), swimming pool water, air conditioning coolants, pesticides, batteries and electroplating.	Have toxic effects on aquatic plants and animals. Can build up in aquatic species, such as mussels, and have a dangerous impact on the food chain.
Litter	Littering (e.g. bottles, cigarette butts, and plastic bags), overflowing rubbish bins, tree litter and vegetation, uncovered truck and trailer loads.	Visual pollution. Toxins in the litter can kill fish, dolphins, and birds. Decaying litter can reduce water oxygen levels and kill aquatic animals and plants.
Nutrients (nitrogen and phosphorus)	Decaying vegetation (e.g. leaves & lawn clippings), treated wastewater, excess fertilisers, biodegradable detergents , animal droppings, wash down water from cars, leaky sewage systems and irrigated lawns.	Promotes toxic and non-toxic algal blooms which reduce the amount of light and oxygen in the water, disadvantaging other plants and animals. Also promotes unwanted weed growth.
Oil and grease	Run-off from roadways or car parks, poor storage and/ or illegal dumping of waste lubricating oils.	Form a film over water and make it difficult for aquatic animals and plants to breathe. Can be toxic to plants and animals.
Sediment (e.g. soil, sand, clay, and dust)	Erosion from building sites and bare earth (e.g. unsealed roads), soil stockpiles on footpaths, roads and driveways, washing cars in the street.	Smothering of plants and animals that live on the bottom of rivers, creeks and the sea. Increase in sedimentation of the water. Heavy metals and other pollutants attach to the sediment particles allowing them to enter waterways and cause harm.

Table 1: Environmental impacts of stormwater pollution
(from *Stormwater Pollution* EPA South Australia)

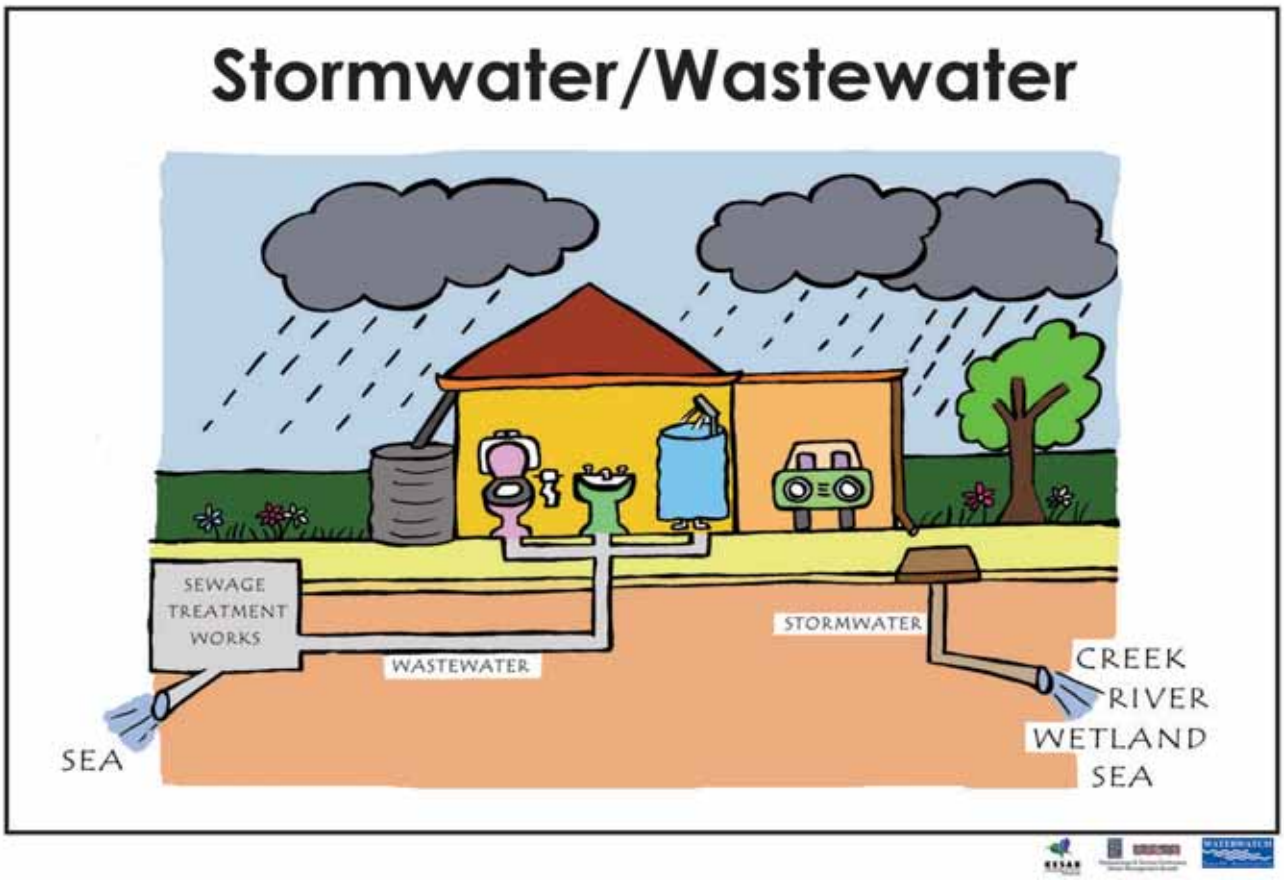

Diagram 1: Stormwater and wastewater sources in and around the home. Source: Waterwatch Central Adelaide

Tips for reducing stormwater pollution

Consider the following points regarding the use of these chemicals :

- Don't overuse herbicide and pesticides, as they may tend to accumulate in the soil and can then be transported via run-off water into the stormwater system when you water your lawn (refer to *Catchment Connections - Folder 4 Topic 17* for tips on appropriate herbicide use).
- Don't use spray applicators on windy days or if rain is forecast.
- Try not to use pesticides on hard surfaces such as paved, concreted, tiled and bitumised areas. Rain will wash any chemicals on these areas directly into the stormwater system.
- Consider alternatives to the use of chemicals for pest and weed control. Some plants have natural pest control properties. These essential oils in a spray water bottle will eliminate the following pests.

(Adapted from **Stormwater** by the City of Port Adelaide and Enfield).

Pest	Essential oil
Ants	Citronella, peppermint, garlic
Mosquitos	Citronella, lavender, mint, rosemary, sage
Slugs	Garlic, chives
Snails	Garlic

Table 1: Natural pest control alternatives

Tips specifically for schools

Schools are generally much larger than residential property and may contain a number of on site stormwater drain entrances. There is a risk that these drain entrances are used to dispose of art room paint clean-up water or wastewater from cleaner activities. Litter can easily enter these drain entrances. This means that schools have the potential to be large polluters of stormwater.

- Ensure that your school has a strong litter control program in place. Students should be made aware of the environmental problems caused when litter enters the stormwater system.
- Ensure that stormwater drain entrances are not used to dispose of wastewater, such as paint brush rinse water.
- Ensure that staff and students are well aware of the location of on site stormwater drains so that pollution problems are quickly recognised and remedied. All school staff including grounds people, cleaners and other contractors must be made aware that wastewater must not be disposed of in a drain.

The most important thing to remember is that **the drain is just for rain**.

What happens to stormwater pollutants?

After mixing with the water in creeks, wetlands and rivers, most stormwater eventually makes its way into the sea

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where many of the pollutants it contains have a profound impact on many life forms. This is described in more detail in *Topic 17 Ocean pollution*.

A fuure resource?

As the demand for clean water increases with our expanding population in the Adelaide region, new water sources may have to be used to cope with this demand. Stormwater is being used in the Northern Adelaide and Barossa region as a viable water resource, alleviating pressure from mains water usage by providing a more sustainable alternative. Stormwater is collected in wetlands where it is allowed to settle to remove excess pollution and nutrients. Once the water has been cleaned in wetlands, like Greenfields Wetlands, it can be harvested and stored in aquifers until it is needed in times of low rainfall.

Our current water use is not sustainable. If water supplies are to be maintained, each resident must learn how to use less water and new sources of water must be found. Some water managers are looking to use stormwater to help meet the future demand for water in our region. Where will it be stored? For what will it be used? Will it need to be treated? These are questions that are currently under investigation.

Lesson ideas

- The *Stormwater* worksheet asks students to justify their opinions about several stormwater issues. Students investigate a single pollutant by drawing it, describing it, and designing a street sign to stop people creating this pollutant in the future.
- *Inventors wanted.* Students design a robot that can fix up our most polluted waterways.
- *Stormwater words.* Students complete the fishbone diagram by adding stormwater pollution words associated with the home, school and the park.
- *City of the future.* Students design a city of the future that has no stormwater pollution problems.
- Visit Port Noarlunga wetlands and investigate how they limit the amount of stormwater pollution entering the Onkaparinga estuary. Stormwater pollutants such as litter can be seen collecting in a litter trap. Run the excursion yourself (instructions available from *Catchment Connections* folder 2 or online) or request an education officer to attend.
- Visit wetlands in other parts of Adelaide.
- Participate or run your own *Stormwater solutions* hands-on activity in which students suggest pollutants that are likely to contaminate a given catchment model. After a 'rainstorm' washes pollutants into the model's waterway, students see first hand how pollutants can contaminate waterways. The model is available for loan from the Waterwatch Southern Adelaide.
- Book a *Stormwater Solutions Session* and have a Waterwatch education officer visit your class.
- Participate in the gutter guardians program. This program is conducted in autumn to reduce the amount of leaves and litter that are washed into stormwater drains
- Involve students in stenciling the drains around the school. You can order stencils and obtain instructions by contacting Waterwatch Adelaide Drain stencil messages such as "the drain is just for rain" are an effective way to remind staff, students and school visitors about stormwater pollution environmental issues.
- Assist students to develop playground rules to reduce stormwater pollution. Post these rules up around the school.
- Order the stormwater picture series from *Catchment Connections - Folder 3* from OWN at the Woorabinda Environment Centre 8370 1298. Students can work in groups to develop solutions to these stormwater problems. Students can also visit their local creek to see if they can observe any other stormwater problems. An action plan can be developed and implemented by students to solve these stormwater problems.
- Conduct a litter survey at the school and present the findings at a school assembly. Alternatively your class could survey the attitudes of students to the local environment. Identify areas of concern or misunderstanding and launch an education program around the school designed by your class.
- Develop advertising posters to put up around the school warning other students of the problems caused by stormwater pollution.

Recommended resources

Http://www.environment.sa.gov.au/epa/pdfs/soaps_detergents.pdf

Information pamphlet concerning the use and disposal of detergents.

http://www.environment.sa.gov.au/epa/pdfs/water_general.pdf

A fact sheet on stormwater pollution in South Australia.

http://www.environment.sa.gov.au/epa/pub_water.html#water

For a list of fact sheets discussing stormwater issues for a range of industries including car yards, garden shops, and mobile vehicle mechanics.

A stormwater environmental education resource is available on CD (2003 edition) from North Central Catchment Management Authority, Ph 03 5448 7124. Cost $16.60. Although some activities listed are specific to northern Victoria, most are relevant to all catchments.

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Stormwater

1. You should pick up your dog's poo when you are walking your dog.

Agree/ Disagree

JUSTIFICATION

_____

_____

2. Chemicals sprayed in the garden can poison a river.

Agree/ Disagree

JUSTIFICATION

_____

_____

3. Dead leaves can cause stormwater pollution.

Agree/ Disagree

JUSTIFICATION

_____

_____

4. Stormwater is more harmful than wastewater.

Agree/ Disagree

JUSTIFICATION

_____

_____

5. City areas cause more stormwater pollution than country areas.

Agree/ Disagree

JUSTIFICATION

_____

_____

Pollution

Task 1: Choose a type of pollution that could end up in a waterway. Explain what the pollution does to the environment and draw it in the box below.

Name of Pollution	Drawing
What it does	
_____	
_____	
_____	
_____	

Task 2: Design and draw a street sign to stop people making this type of pollution.

16. Wastewater

Concepts

- Wastewater originates in many ways.
- Wastewater is usually treated before it enters a waterway.
- Occasionally wastewater systems fail allowing untreated wastewater to enter the environment.
- There are different wastewater treatment systems in the Adelaide and Mount Lofty Ranges region.
- The treatment process creates sludge and effluent which needs to be disposed of in our environment.
- Sludge and effluent are often highly saline and contain high levels of nutrients and so must be disposed of carefully.

Where does wastewater originate?

Whenever we flush the toilet, have a shower or wash our hands, we create wastewater. Wastewater originates in many ways:

Domestic
- laundry waste (grey water)
- water used for cleaning
- sewage.

Industrial
- factory effluent
- hospital effluent

Commercial
- stores and markets.
- services, restaurants, etc.

Where does this water go?
In most urban areas wastewater is either collected or piped to a site where it undergoes a number of treatment processes.

Why does wastewater need to be treated?

If all our wastewater were released straight into the environment our rivers would become foul and smelly and unsuitable sources for drinking water. This is because wastewater contains large amounts of nutrients (fertiliser, fat, grease), dangerous chemicals (bleach, detergents and other cleaners) and harmful bacteria. These nutrients create an environment in which harmful bacteria thrive and destroy other living organisms and can give rise to algal blooms (refer to the chapter on algal blooms in *Catchment Connections - Folder 3*).

Where is wastewater treated?

Urban wastewater is piped to the nearest sewage treatment plant of which there are several in the Onkaparinga catchment. Most residents in Onkaparinga catchment live near the coast in suburban Adelaide where the largest sewage treatment plant (Christies Beach) is located. Smaller sewage treatment plants serve communities in Aldinga, Hahndorf and Heathfield.

The metropolitan areas of the Torrens and Port catchments are served by the Bolivar Wastewater Treatment Plant. The nearest wastewater treatment plant for urban populations of the Patawalonga catchment is at Glenelg. Smaller sewage treatment plants at Mt Pleasant, Birdwood, Gumeracha and Heathfield serve communities in the upper Torrens and upper Patawalonga catchments. For details of the capacity and treatment method used at each of these wastewater treatment plants, visit: http://www.sawater.com.au/SAWater/ click Education and then Our Wastewater Systems.

Most rural homes are connected to septic tanks which are buried, usually near to the house. Septic tanks produce liquid waste (effluent) that needs to be collected and treated before it can be disposed of in the waterways. Some septic tanks are connected to a Septic Tank Effluent Disposal Scheme (STEDS) which are council-operated facilities that take effluent from the septic tanks in a certain area and provide further treatment before the effluent is piped to waterways or used to irrigate land.

Re-use of grey water

Some households direct their grey water (wastewater from shower, bath and laundry) onto their garden. A few houses have composting toilets and reed bed systems to treat their domestic wastewater for re-use purposes such as flushing toilets or watering the garden.

What happens in the treatment process?

In general the treatment process involves these stages: Solids are separated from the wastewater, dried and then disposed of. The remaining liquid is treated to remove harmful bacteria and excess nutrients. The liquid is then released into waterways or re-used for irrigation.

Details of how Adelaide's wastewater treatment plants work can be found on SA Water's web site at: http://www.sawater.sa.gov.au

Is treated water safe?
The treatment of wastewater creates large amounts of liquid and solid waste, both of which effect the environment. The aim of wastewater treatment is to minimise this environmental impact.
The solids separated out from the wastewater (bio-solids) need to be disposed of in a safe place where they will not leach into groundwater sources. In some catchments, bio-solids are dried and turned into fertiliser. Bio-solids may also be buried underground.

However, the practice of burying bio-solids is likely to stop in the near future, because it is feared that nutrients in the bio-solids may contaminate groundwater. One proposal has been put forward suggesting that the bio-solids should be mixed with green waste that has been collected by councils and turned into compost.

Even the disposal of the treated liquid effluent is a cause for concern. Most of this liquid is discharged after treatment into a waterway such as a river or the sea. The World Health Organisation is concerned that the chlorine (bleach) present in wastewater breaks down into a deadly carcinogen (cancer causing agent) because when discharged into waterways this chemical causes micro-organisms to mutate (change form). It is feared that this chemical may be passed on up the food chain with the possibility that mutations could occur in humans. Chlorine has also been associated with triggering asthmatic reactions and skin irritations as well as, with long term exposure, increasing the risk of certain types of cancer. There are now water treatment units that use banks of UV lamps to disinfect treated secondary wastewater and also drinking water. So far this seems to be successful, reducing the demand for chlorine.

Cooking oil	Ring local council for recycling opportunities. Bury in the garden but not in the compost. Do not dispose of to the sewer or your rubbish bin.
Fat	Let solidify and then bury in the garden or wrap in paper and place in the rubbish.
Motor coolant	Check with your local radiator repairer or ring SA Water Trade Waste on 8207 1350 or take to HHWCF. Do not dispose of on your garden or lawn area.
Motor oil	Check with council or take to Scotcher Petroleum, Mulherns, Inglewood Brick or take to HHWCF.
Paint Unused paints, stain and varnish	Check with council or take to HHWCF
Oil-based paint brush clean up water	Let paint settle, re-use thinner, let paint dry. Put the dried paint in the rubbish.
Water-based paint brush clean up water	Allow paint to settle to bottom of bucket. Tip out water into garden and scrape paint sludge into some newspaper and put to rubbish.
Pesticides	Take to HHWCF
Pharmaceuticals (un-used medicines)	Contact local pharmacy or Oversea Pharmaceuticals Aid for Life (OPAL) on Tel. 8359 6055. Take to HHWCF
Photographic chemicals	Take to HHWCF
Pool chemicals	Take to HHWCF
Solvents	Take to HHWCF

Table 1: Waste disposal guide for householders (from http://www.watercare.sa.gov.au) HHWCF is the Household Hazardous Waste Collection Facility on the corner of Magazine Road and Henschke Street, Dry Creek. It is conducted by the Environment Protection Authority on the first Tuesday of each month between 9am and 12 noon with listed waste items received free of charge.

At some wastewater treatment plants, effluent is given extra treatment to remove nutrients so that it will cause less damage to the environment. Bolivar treats over 70% of metropolitan Adelaide's wastewater and recycles approximately 20%, Glenelg also recycles 20% of treated wastewater. The Gumeracha Wastewater Treatment Plant recycles 100% of its treated wastewater. As water demand increases, it is likely that more wastewater will be re-used.

Sometimes sewage treatment systems fail, causing untreated wastewater to enter our waterways, polluting them with nutrients and harmful bacteria. This can be due to sewage pipes bursting, pump failure, illegal sewage connections or because stormwater flooded the sewage system. At such times the public may be warned not to come into contact with the water, about the risk of illness, or that swimming has been banned in some areas.

Risks from septic tanks

Leaking septic systems can be a major cause of contamination in waterways, as populations of harmful bacteria can explode when nutrient levels in creeks and rivers increase. When a septic tank becomes full of sludge, or when it has been contaminated with chemicals, it no longer functions correctly and this can cause untreated wastewater to leak directly into the groundwater or waterways. Therefore, the sludge must be pumped out by a certified contractor every few years. Most septic tanks reach capacity every five years (or sooner if the number of recommended users for the system is exceeded) but people often forget, or try to get by longer to avoid expense, with the result that the soil, waterways and aquifers are often heavily contaminated downstream of septic tanks.

How can you improve the quality of the wastewater that is leaving your house?

- SA Water is running education programs to help industries. It's best to produce not only less wastewater, but less contaminated wastewater, so that it is easier to treat and has less impact on the environment. SA Water has also published tips to encourage households to reduce wastewater and to contaminate it less, for example:
- use detergents sparingly and make sure they are biodegradable and phosphorous free (the label will tell you this).
- use natural cleaners such as vinegar, lemon juice or bicarbonate of soda.
- put used cooking oil in a container for appropriate disposal later (contact your council for disposal details).
- use a sink strainer to prevent scraps going down the drain.
- don't allow strong disinfectants , bleaching or cleaning agents to get into the wastewater; they will kill or inhibit the micro-organisms at the treatment plant or in the septic tank system.

More specific information about the disposal of liquid wastes has been provided by Watercare in Table 1.

Lesson ideas

Students research which wastewater system treats water from their house and describe the method this system uses to treat wastewater. Students could build a model of their wastewater system.

The Cleaning Up Wastewater activity Students make up samples of wastewater and are challenged to clean up their sample so it can be re-used.

Take a field trip to the Christies Beach Wastewater Treatment Plant. Phone (08) 8382 2633.

Which Type of Water? A worksheet that challenges students to consider differences between wastewater, stormwater, and other types of water (*Catchment Connections, Topic 8, Folder 3*).

Where Does That Water Go? A worksheet in which students trace the path of different types of water found around the home (*Catchment Connections, Topic 8, Folder 3*).

Sewage leak. A reading and comprehension exercise. What can happen if the wastewater system fails? (*Catchment Connections, Topic 8, Folder 3*)

Think Wastewater. A worksheet that asks challenging questions about wastewater.

Students could research other countries where wastewater is turned into drinking water.

Recommended resources

http://www.sawater.com

Go to Education and then Teacher Resources

A range of activities and detailed information about wastewater treatment throughout the state. SA Water's website also provides detailed information about the treatment processes used at a number of different sites.

http://www.epa.sa.gov.au

Information about the environmental challenge of managing wastewater.

http://www.zerowaste.sa.gov.au

Information about council pick-ups and recycling services for household hazardous waste.

Cleaning up wastewater

Concepts

- Types of pollutants that end up in wastewater.
- Treating wastewater for safe release to the environment is difficult.
- Strategies to reduce amounts of pollutants entering wastewater systems.

Instructions

1. Divide the class into groups to represent the following:
   - homeowners
   - a school community
   - farmers
   - manufacturers
   - miners

2. Provide each group with the task sheets (over the page) including the list of materials they will have to collect to make their sample. Samples should be placed in jars labelled with the group's name and a list of the substances that are in the jar.

3. Groups will also require the following equipment:

- jars/containers
- charcoal
- pieces of wood
- stockings
- moss
- sand
- kitchen sieve
- funnels
- paper towels
- small rocks
- cotton balls

4. Decide which tasks you want your students to complete and let the fun begin.

Group A - Householders

To simulate household wastewater obtain 1 tablespoon of cooking oil, 1 teaspoon detergent, 1 tablespoon toothpaste, 1 cup of cold tea and strips of toilet paper.

Group B - School Community

To simulate wastewater from a school obtain 1 tablespoon paint, 1 tablespoon glue, 1 teaspoon detergent and strips of toilet paper.

Group C - Farmers

To simulate agricultural wastewater obtain 1 cup vinegar, 2 cups soil and 2 cups coffee grounds or garden manure for the substitute waste.

Group D - Manufacturers

To simulate industrial waste obtain 1 cup flour, 1 cup vegetable oil and 1 cup tomato juice.

Group E - Miners

To simulate mining waste obtain 2 cups soil, 1 cup iron filings or a used kitchen steel scourer, 1 cup small rocks and 1 cup vinegar.

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Cleaning up wastewater

Student task sheet

Outline:

Your job is to make up a wastewater sample from a house, school, farm, factory or a mine. Your wastewater needs to be treated before being released to the environment. Your job is to use a range of equipment to try to clean up (treat) your sample.

Equipment for all groups:

- jars/containers
- cotton balls
- funnels
- pieces of wood
- stockings
- small rocks
- kitchen
- charcoal
- sand
- paper towels
- moss
- sieve

Group A - Householders

To simulate household wastewater obtain 1 tablespoon of cooking oil, 1 teaspoon detergent, 1 tablespoon toothpaste, cup of cold tea and strips of toilet paper.

Group B - School Community

To simulate wastewater from a school obtain 1 tablespoon paint, 1 tablespoon glue, 1 teaspoon detergent and strips of toilet paper.

Group C - Farmers

To simulate agricultural wastewater obtain 1 cup vinegar, 2 cups soil and 2 cups coffee grounds or garden manure for the substitute waste.

Group D - Factory Owners

To simulate industrial waste obtain 1 cup flour, 1 cup vegetable oil and 1 cup tomato juice.

Group E - Miners

To simulate mining waste obtain 2 cups soil, 1 cup iron filings or a used kitchen steel scourer, 1 cup small rocks and 1 cup vinegar.

Method:

1. Collect the materials your group needs to make up its wastewater sample.

2. Mix up your sample and place it in three separate jars. Label the jars with the name of your group and the items that are in the sample.

3. Now use the rest of your equipment to try to clean up the water samples.

4. Discuss the questions on the next page with the rest of your group.

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Thinking Tasks

In your group complete the following tasks

1. Suggest ways that your water sample could have become polluted. e.g. What pollutes the wastewater that leaves your home?

2. Describe what each of the pollutants contained in your water sample represents. e.g. Vegetable oil representing industrial waste.

3. Your group also needs to decide the following:
(a) Would you drink the water that is in your sample?

(b) Would you dispose of this wastewater into a creek or river?

(c) Would you dispose of this wastewater down a drain?

(d) If so, where would the water go and what effect might it have on the water treatment process?

4. Cleaning up your sample:
(a) Which pollutants were the easiest to remove from your sample?

(b) Which pollutants were the most difficult?

(c) What method was most successful in cleaning up your water sample?

5. Releasing to the environment:

(a) What rules would you make about how clean wastewater must be before it is released into a river or the sea?

(b) Does your water sample pass these rules?

6. Wastewater re-used by humans:
(a) Is your cleaned wastewater sample good enough for human use?

Explain your answer.

(b) List the uses that humans could have for treated wastewater.

7. You have removed pollutants from your sample. However this is only a very small amount of wastewater. Your home would produce many more times this amount in a day. Could your methods be adapted to use on a large scale? Explain your answer.

THINK.....Wastewater

Think.... Alphabet

Find related topic words for every letter of the alphabet for this word:

'Wastewater'

Think.... Disadvantages

List the disadvantages of collecting the wastewater from an entire city and pumping it to a Wastewater Treatment Plant.

Think.... What if?

What if the wastewater system stopped working?

Write a story or draw a picture.

Think.... Reverse

List at least 10 things that you would never see floating through the pipes of the wastewater system.

Think.... Re-use

Most treated wastewater is released into the sea. Write a list of better ways to re-use this treated wastewater.

Think.... Construction

Build a model of a Wastewater Treatment Plant. Use any materials you like.

Challenge: Can your model clean up a sample of wastewater?

Think.... History

Cities were once very smelly places indeed. Wastewater was tipped straight onto the streets. Research an invention that has helped clean up cities.

Think.... Questions

The answer is:

'Wastewater'

What are some possible questions?

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17. Ocean pollution

Concepts

- Land, waterways and sea are intrinsically linked.
- Ocean pollution has many sources.
- Ocean pollution impacts in several ways.
- Taking care of the ocean.

The land, river and sea connection

In previous topics it has been shown how water draining from the land enters the sea. The ocean is closely linked to the land and it follows that any changes made to the land and any pollution allowed to run off as stormwater will, ultimately, impact on the sea.

Many waterways in this region, such as the Onkaparinga River, Torrens River and Dry Creek flow directly into the sea.

Sources of ocean pollution

Ocean pollution has many sources. Table 2 located at the end of this chapter shows some of the ways that pollution can enter the ocean and how pollution can impact on marine life.

Impacts of pollution

Three main impacts of ocean pollution are:

- seagrass die-back.
- introduced marine pests.
- litter.

Seagrass die-back

Since the late 1940s, more than 4,000 hectares of seagrass have been lost from the area between Port Gawler and Sellicks Beach. Seagrass meadows off the coast of metropolitan Adelaide continue to decline significantly.

What are seagrasses?

Seagrasses, unlike seaweeds (which are macro algae), are true flowering plants complete with root systems, stems and leaves, which evolved from land plants and adapted to marine life about 100 million years ago. They grow on sandy or muddy bottoms and are found in estuaries, coastal lagoons, bays and gulfs. Twenty two species of seagrass are found in South Australia, whose meadows extend over 9,620 square kilometers and many of which are unique to South Australia.

Why is seagrass important?

Seagrasses are important because they:

- Oxygenate the water
- Recycle nutrients
- Support marine animals. Seagrasses provide food and shelter for a diverse range of small organisms called Epiphytes (plants) and Epifauna (animals) which are, themselves, an important part of the food chain of larger organisms. Many organisms depend on seagrass for their survival and derive nutrients from not just the leaves, but the entire plant, including the stem and root system. The larvae of many species of commercially important fish, such as the King George whiting, depend on the food and shelter that the seagrass provides before they migrate to the open ocean as mature fish.
- Reduce erosion. In the same way that the roots of land-based vegetation hold the ground together to limit soil erosion, so do the roots of seagrasses bind sand particles together helping to reduce the movement of sand even in strong tides and currents.

Why are seagrasses declining?

Although the ecology of seagrasses is not yet fully understood, it is clear that seagrass does not grow well where sunlight is obscured, and human pollution has contributed much to the turbidity of coastal waters. The two factors causing this increase in turbidity are:

- nutrient levels
- suspended solids.

Increased nutrient levels

Sea water usually contains very little nutrient and since most marine organisms, including seagrasses, have adapted to living in a low nutrient environment, they are sensitive to any increase in nutrient levels.

Pollution of coastal waters from stormwater runoff, sewage discharge and oil spills puts seagrass communities at risk. The algal blooms topic in *Catchment Connections, Folder 3* describes how nutrients can give rise to algal blooms which reduce the amount of sunlight received by the seagrasses. However, nutrients also increase Epiphyte populations that live on the seagrass and the two phenomena together can reduce light penetration considerably.

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Suspended solids

Suspended particles in the water reduce the amount of sunlight filtering to the leaves of the seagrasses. Although some sediments are derived from natural causes such as wind-borne dust, human activities are mainly responsible for the silt, pollution and litter that cloud coastal waters. Even if sediment does manage, eventually, to settle on the floor of the ocean it is often stirred up again by passing dredges and boats.

Introduced marine pests

Over 100 species of imported marine pests have established populations in Australian waters where they compete with local native species for habitat and food or form large colonies which smother local species and kill them. They have been transported to Australian waters attached to ship hulls in the ballast tanks of unladen, or partially laden, vessels which need the ballast to make them more stable. If the ships are to take on a large cargo in Adelaide they would need to discharge their ballast water prior to loading.

Living in the ballast water are small marine creatures. Although most die before they reach the next port, a few survive. Before the ship takes on cargo at the new port, the ballast water is released along with any surviving foreign creatures, some of which thrive in their new environment and become harmful pests reproducing very quickly.

Species found in Adelaide

The European fan worm (*Sabella spallanzanii*)

First recorded in Outer Harbor in 1985, it can now be found along the metropolitan coastline and across to Kangaroo Island. So far there has been only one seen in the Onkaparinga catchment when a snorkeller reported sighting one at Port Noarlunga jetty in 1998. It can now be found along the Upper Gulf St Vincent, Edithburgh, the metropolitan coastline and across to Kangaroo Island. More specifically it has been located at North Haven, West Lakes, Port River and Glenelg.

European shore crab(*Carcinus maenas*)

This crab is now very commonly found on Adelaide beaches and is beginning to have an impact on local marine species. This pest has been identified in the Port Catchment at Barker Inlet, Outer Harbor and West Lakes.

However, no sightings have been recorded yet in the Onkaparinga catchment.

Caulerpa taxifolia

This aquarium bred seaweed was released into the Mediterranean Sea and was carted to South Australia via the release of ballast water from cargo ships. As well as out-competing native seaweed species, *Caulerpa taxifolia* also produces toxins that can poison herbivorous fish species.

Although over 60 million tonnes of ballast water are deposited in Australian ports each year, not all known pest species have yet established themselves in Adelaide's waters, but it may be only a matter of time before more do. One that may arrive soon is the Northern Pacific seastar, a voracious predator that will devour any animal tissue it can capture, but has a preference for shellfish. It arrived in Tasmania in 1986 and later spread to Victorian ports, but it is not clear whether the seastar migrates as larvae present in ballast water or whether it adheres to the hull of ships.

Litter

There are many ways in which litter makes its way into the sea, but much of it takes a long time to decompose (see Table 1). There are approximately 46,000 pieces of plastic floating around in each square mile of ocean.
World wide, each year, plastic litter accounts for the death of up to one million sea birds, 100,000 sea mammals and countless fish. Currently only 0.5 percent of consumer plastic is recycled. At 2,000°C, many plastic materials can be destroyed, however most waste incinerators in Australia cannot achieve this temperature.

Non-biodegradable plastic bags pose the greatest threat to marine life. Marine animals including birds, whales, seals and turtles often mistake plastic bags for jellyfish and then die from intestinal blockages. Their carcasses decay but the bag can be eaten by another animal as it survives intact. As the plastic may take anything up to 100 years to break down, each bag can account for the death of many animals. Australians throw away more than two billion plastic bags a year, most after having been used only once.

Throwing a bag 'away' does not necessarily mean the end of it. Recently thousands of waste bags were carried by the wind from a disused and forgotten dump site in Adelaide when it became uncovered at a construction site. The bags were still usable, even after 45 years.

Bags made from string or calico are much more durable and comfortable to carry. Bio-degradable bags made from tapioca starch which decomposes in 3 months are now available in Australia. Green grocers in the United Kingdom do not supply plastic bags and if, by chance, a customer forgot to bring one they will charge a high price for a calico bag.

Table 1
Decomposition rates

Item	Time taken to dissolve at sea
Cigarette butts	1-5 years
Plastic bottles	450 years
Nylon fabric	30-40 years
Plastic bags	20-100 years
Banana peel	up to 2 years
Plastic coated paper	5 years
Tin can	50-100 years
Paper bus ticket	2-4 weeks
Cotton cloth	1-5 months
Rope	2-14 months
Painted wood	13 years

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Monitoring marine environments

The health of a marine environment is not easy to assess, but two indicators that can be monitored are:

- seaweed populations on reefs.
- water quality.

Seaweed populations on reefs

Up until very recently, *Ecklonia radiata* (large brown kelp) populations were considered to be a reliable indicator as to reef health. It was a surprise, therefore, when the Port Noarlunga, the Horseshoe, and the Aldinga reefs went into significant decline recently and are now considered to be under threat, even though a 1999 survey by the University of Adelaide recorded that kelp populations were stable. It was only to be expected that the increased sediment being discharged by the rivers, an increased nutrient load in the Onkaparinga estuary, and a dredging program taking place near the reef and in the river, would cause a decline, but why didn't the kelp survey reflect this? Obviously kelp populations could no longer be considered a reliable indicator, but what could be used instead?
During their survey, researchers had noted that much of the red encrusting seaweed living on the reef surface had disappeared and been displaced by mussels. As large brown kelps use red seaweed to attach themselves to the reef, today's scientists find that red seaweed populations can not only give more reliable indication as to the health of a reef, but warn of a posssible decline several years into the future.

Scientists are presently hoping to find a way to re-seed kelp on the Port Noarlunga reef.

Water monitoring

The Environment Protection Authority takes regular water samples at metropolitan beaches to monitor 'faecal bacteria' (bacteria derived from faeces that can cause illness if swallowed), and 'turbidity' (murkiness). More frequent tests are carried out during the summer when more people use the beach. Results are posted on the EPA website (see *recommended resources* at end of this topic) as 'good', 'moderate' or 'poor' depending on which category, established by International and State Guidelines, best describes the water. Beaches such as Port Noarlunga, Glenelg and Largs Bay, are included in the testing program.

Protecting the marine environment

There are many ways in which the marine environment can be protected. Government agencies are in the process of implementing several initiatives, including:

- marine zoning and protected areas
- Adelaide Coastal Waters Study
- aquatic reserves.

Marine protected areas and zoning

There are six marine zoning plans being implemented for the South Australia coastline under which sections of the coast will be designated to specific activities such as:

- aquaculture
- conservation (marine biodiversity)
- commercial fishing
- protection of a cultural site
- recreation (for example sailing or swimming)
- resource extraction (for example mining)
- shipping.

Each of these zones will then be designated a Marine Protected Area (MPA) which will make the activity more sustainable by limiting and controlling it. The first plan, for the Gulf St Vincent is in the development stage while one for the Spencer Gulf region is currently awaiting approval.

Marine Protected Areas (MPAs)

South Australia's Representative System of Marine Protected Areas is a series of multiple use Marine Protected Areas proposed to conserve representative examples of South Austalia's marine biodiversity (more than 80% of the species of our southern temperate coastline are found nowhere else in the world). A marine reserve covering the Encounter Bay, Backstairs Passage and northern end of Kangaroo Island is being developed as a pilot to test the concept of an area used for multiple activities including conservation and recreation.

Coastal Waters Study

The Adelaide Coastal Waters Study began in 2001 to address gaps in knowledge about the marine environment in Gulf St Vincent. The area of the study is from Port Gawler to Sellicks Beach and about 20 kilometres offshore. The study looks at the chemical, physical and biological processes and will provide background knowledge to enable future management of the area.

Aquatic reserves

Aquatic reserves, such as the Port Noarlunga reef and Aldinga reef aquatic reserves, have been established to protect the diverse fauna and flora living on the reef. These rocky habitats support a range of algal and faunal communities which are not found any where else in the world.

Lesson ideas

- Research a marine introduced pest.
- Should people be allowed to undertake their normal activities in Marine Protected Areas? What are the social, economic and environment implications?
- Try the *Effect of oil on feathers* experiment.
- Try the *Pollution Problems* worksheet.

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- One student working alone or several students working in groups can write a jingle, magazine, TV or radio advertisement to encourage people to be more concerned about sea pollution.
- Students choose a marine pollution issue and imagine they are animals living in the affected area. Ask them to think of problems they would encounter. How would they overcome them? Would they survive? These issues can be explored further by writing a story about their adventures or designing a poster.
- Seagrass project: What animals live in seagrass? What products are made out of seagrass? Why is seagrass important? What happens when seagrass dies? Can too much seagrass be a bad thing?
- Discuss what wastes are produced:
  a) by neighborhood industries
  b) on farms
  c) by an average household.
  How many of these items can end up in the ocean?
  How will they get there?
  List the method of disposal for each type of waste.
  Ask each student to conduct a survey of his or her family.

Recommended resources

http://www.epa/sa/gpv/ai/water_beaches.html

Results of EPA beach water monitoring.

http://www.mesa.edu.au

Marine Education Society of Australia. Range of activities and information.

http://oils.gpa.unep.org/facts/wildlife.htm

Impact of oil on wildlife.

http://www.marine.csiro.au/crimp/Marine_pest_infosheets.html

A range of fact sheets on marine pests.

http://www.abc.net.au/science/features/bags

Information on plastic bags.

http://www.environment.sa.gov.au/coasts/pdfs/seagrasses.pdf

Brochure produced by the Coast Protection Board on seagrasses of South Australia.

Table 2
Sources of Ocean Pollution

Pollutant	Source	Impact
Litter	poor disposal of rubbish	ingested by animals leading to animal deaths visually pollutes the ocean
Oil	washed off roads into drains and out to sea oil leaks from boats into oceans accidental oil spills from oil carriers	destroys protective layer of bird feathers so they cannot fly marine animals ingest oil which damages airlways and increases stress fish ingest oil through gills - does not kill directly but causes range of health impacts
Sediment (soil & sand)	dredging of estuarine areas dredging of ocean to obtain more sand for beaches erosion run-off from land	increased water turbidity which can reduce amount of light available for growth of marine plants such as seagrass smothers filter feeding animals such as sponges and sea squirts so they cant feed
Ballast water	shipping vessels frrom overseascarrying ballast water which is dumped in Australian ports	introduces marine pests - introduced species compete for habitat and food.
Boating waste	litter and other waste products thrown overboard	visual impact ingested by animals - may cause death
Fishing tackle	recreational fishers leaving behind fishing line, hooks, bait containers, other rubbish	entrapping birds and other animals - if caught around necks or ingested can cause slow and painful deaths, ability to feed can also be greatly reduced.
Industry waste	disposed directly to ocean from cargo vessels or fishing boats	visual impact ingested by animals - may cause death
Stormwater	outlets directly entering ocean	increased nutrients in water which can lead to algal blooms visual pollution
Sewage	untreated and treated waste either from leaks or licensed disposal industries	increased nutrients and E.Coli in water which can lead to restrictions on beach usage

For further information:

Please refer to the complete Catchment Connections files online at www.waterwatchadelaide.net.au

Please note that weblink resources change quite frequently. The EPA, NRM Boards and water authorities in your area will have up-to-date information on their websites available for you.

Pollution Problems

Task: Fill in the gaps in the table below relating to pollutants, source and impacts. Then draw a picture of possible solutions to the pollution problems.

Pollutant	Source	Impact	Solution
Litter	Schools, beaches	Eaten by animals causing death	
Oil			
	Litter and waste thrown overboard		
		Strangles birds and animals	
Sewage			

Experiment

Effect of Oil on Feathers

Backgound

Before you run this experiment you may like to discuss or get students to research oil pollution, its sources and methods for ocean clean up.

A worksheet *Effect of Oil on Feathers* is provided to complement this activity.

You may like to get students to complete this activity in small groups or perform it in front of the class.

Aim

To investigate the effect of oil and detergent on feathers and bird life.

Introduction

Oil spills have the potential to cause many problems for marine animals. This experiment demonstrates the effect of oil on bird feathers and why oil is a major problem in the marine environment.

Method

- Fill a glass with clean water. Dip a feather in and look into the glass. When you pull the feather out, it will be mostly dry.
- Pour some cooking oil onto the water's surface. This floating oil may form a thin layer as it spreads out. This represents an oil slick in the ocean.
- Push the feather into the oily water. Now pull the feather out of the glass. You will find it is covered in oil. The oil has stuck to the natural oils in the feathers and clogged it. You will notice the feather structure has been damaged.
- Fill another glass with clean water. Add some detergent and push a new feather into this.
- Pull the feather out. Notice it is soaked in water. It is no longer waterproof and does not maintain its fine structure.

Class discussion suggestions

- When you pulled the feather out from the clean water, the feather appeared to be dry. Why is this the case? The trapped air layer makes the feather waterproof. This feature enables birds to sit in the water and then fly straight after. It also helps to insulate the birds, keeping them warm.
- After the feather is coated in oil, how would coastal and marine animals be affected by this? Seabirds are particularly sensitive to oil. In a cold climate an oil spill the size of 2-3 square centimetres can be enough to kill a bird. The insulating effect of the plumage is destroyed by the oil, and the bird freezes to death (hypothermia). If a bird gets smeared with a lot of oil, this may clog the feathers and making it impossible to fly. Marine mammals are affected in differing ways depending on the species. In addition to hypothermia, other effects include eye and skin lesions, stress, stomach ulcers, damaged airways and haemorrhaging.
- Discuss why detergent is used to remove the oil from bird feathers. Are there any other ways to remove the oil? Birds are washed with ordinary washing up liquid. The detergent works on the feathers in the same way it works to remove grease from dirty dishes. However, the birds may need to be washed several times and then may have to wait up to a month before being released back into the wild. Australian researchers have recently discovered that an iron powder spray (like talcum powder) can soak up greasy slicks on bird feathers. The oil sodden iron is then stripped away using powerful magnets in a manner that doesn't disrupt the bird's waterproofing.

For more information visit:

http://www.abc.net.au/science/news/enviro/EnviroRepublish_1062204.htm

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Name: _____

Effect of oil on feathers

1. Birds are able to live in the rain and swim in the ocean without getting very wet. How do they do this?

_____

_____

2. Oil spills <u>do not</u> cause problems for marine animals
TRUE/FALSE? Explain your answer.

_____

_____

3. Birds are not the only animals living in the ocean which are affected by oil spills. List 6 other affected animals.

_____ _____ _____

_____ _____ _____

4. Pick one of the animals which you listed above. How are they affected by the oil?

_____

_____

5. After oil spills, animals such as birds are washed but then kept in captivity for a while before release. Explain why this happens.

_____

_____

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6. Oil is not the only form of pollution that ends up in the ocean. Fill in the table below to show what other ocean pollutants there are and where they come from.

Pollutant	Where does it come from?
Oil	accidental spills from oil carriers

7. Use each of the letters in the word POLLUTION to create new words to describe how you feel about pollution in the environment.

8. Write an article for a newspaper, design a cartoon or create a song to show how oil and other pollutants can be prevented from ending up in the ocean.

18. Woeful Weeds

Concepts

- How do environmental weeds impact on the environment?
- How are they controlled?

Plants from similar climates can be the most serious environmental weeds

Many plants brought to Adelaide from other countries or even other parts of Australia do not grow well here because the climatic conditions such as unsuitable rainfall and temperature. The conditions are too different from where the plant has evolved and adapted. It may also be the case that the local insects especially like eating the non-local plants and eat them so much that they cannot grow. This is often the case with garden vegetables unless we use insecticide.

On the other hand, plants which we introduce here from places with a similar climate can grow very well, making them popular choices for gardens, pasture grasses and crops. Sometimes these plants move out of their designated areas and start growing in conservation areas and other places of indigenous vegetation, such as creek lines and bush patches on farms.

What is an Environmental Weed and why are they a problem?

A weed can be basically defined as a plant growing in a location where we do not want it to grow. An environmental weed is a non-indigenous plant growing in a location where it may pose a threat to the ecological integrity of a natural area. Threats include:

- Space, soil moisture, pollinators and nutrients. Weeds might form a dense cover and prevent the emergence and regeneration of native seedlings.
- Change of habitat and ecology by creating extra shade and altering the soil chemistry.
- Provision of only limited food resources or habitat to a small number of indigenous species, whilst taking resources from the indigenous plants which constitute food and habitat for native species.
- Promoting the spread of pest animal species, such as foxes and starlings which feed on their fruits.

Weeds in our region

Examples of garden plants and crops which have become environmental weeds in the local area include Olives, Phalaris grass, Kikuyu grass, Willows, Ash, Boneseed, Sweet pittosporum, Watsonia and Bridal creeper just to name a few. Weeds mostly reach these areas via seed or cutting dispersal by birds, animals, humans, wind and water. Australian native plants can become bad environmental weeds in other countries with similar climates as well. For example, Eucalyptus trees are considered to be weeds in America and Golden wattle, Australia's national floral emblem, is a bad weed in South Africa. There are also many Australian native plants which have become weeds in different parts of Australia. For example Sweet pittosporum (*Pittosporum undulatum*) is native to northern Queensland. It has been introduced to other states as a garden plant. The sticky orange fruits it bears are eaten by starlings which spread the seed. Sweet pittosporum is now invading many bush areas throughout NSW and the wetter parts of the Adelaide Hills. The dense shade that this tree provides prevents other plants from growing beneath it which also inhibits natural regeneration of our Stringybark forests and encourages Starlings to move into these areas.

Other Australian natives which have become weeds in our area include Sydney golden wattle (*NSW Acacia longifolia var. longifolia*), Golden wreath wattle (*WA Acacia saligna*), Grevillea rosmarinifolia (*QLD Casuarina glauca*), and Flinders Ranges wattle (*northern SA Acacia iteaphylla*).

A combination of favourable climate, large seed supply and a lack of natural predators or plant eaters will increase a plant's weed potential.

Classification of weeds

Weeds can generally be classified into groups based on the areas they tend to invade such as bushland weeds and watercourse weeds. Many weed species will invade several habitat types. Weeds can also be classified based on their size as outlined below.

Herbaceous weeds: Smaller ground cover plants such as grasses, which do not form woody stems, may be annual or perennial. Local examples include Freesia, Bridal creeper, Phalaris, African feather grass, Fennel, Watsonia, Kikuyu, Rice millet and African daisy.

Woody weeds: Shrub-like non-indigenous plants which often provide very direct competition to natural regeneration and new revegetation. Local examples include Gorse, Blackberry, Boneseed, Erica and Broom.

Exotic trees: Trees mostly introduced to the area as garden plants but often have invasive tendencies. Some are deciduous which can also directly impact on water quality. Local examples include Willow, Ash, Olive, Sydney Golden Wattle, Poplar, Sweet Pittosporum and Cottoneaster.

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Controlling weeds

Controlling weeds in bushland, watercourses, roadsides and crops is a laborious and expensive process. Many weeds have seed which can survive in soil for many years. This means that these weeds can continue to pop up long after adult plants have been removed from a site. Some herbaceous, annual weeds such as Watsonia, Freesia and Three cornered garlic have a short growth period each year, giving us only a narrow opportunity to treat these plants before they become unreceptive to herbicide.

Aside from the physical barriers to removing weeds, there are also many social barriers. There is still a strong belief that any plant is a good plant because it provides oxygen. Yet the benefits of oxygen provision are far outweighed by the destruction these plants can cause to local plants, wildlife and water quality. Despite the detrimental environmental and financial cost to society, some people are still very attached to trees and plants in their area or gardens, which are in fact serious environmental weeds. Weeds such as Erica and Broom are still available in many local nurseries and some of the push for water efficient gardens has taken people towards South African plants which grow well here with little water - perhaps a little too well. There are already two species of trendy South African grasses suddenly appearing in creek beds and roadsides throughout the Onkaparinga catchment. Many people have attachments to deciduous trees from the classic English gentleman's garden tradition, which has sucked our rivers dry for the last 150 years.

Everyone is entitled to their opinion, but should the aesthetic pleasure of a few continue to cost the rest of us? There is a huge variety of beautiful plants out there which are completely benign in the local environment with no weed potential whatsoever. There is also a huge variety of local indigenous species which enhance the environmental integrity of our local area. With so many choices, do we really need the weeds?

Lesson ideas

- Participate in the "Weed Warriors" program offered by the AMLR NRM Board.
- Students can use *Weed Identification* charts to identify environmental weeds in a local natural area near the school. Students can record whether the weeds are flowering or not and examine the bark, leaves and fruit for evidence of use of the weed by insects or birds.
- Have a group of students watch an exotic tree and another group watch an indigenous Eucalypt and record the birds that use these plants. Compare results and discuss any difference in use by birds.
- Have groups of students research a weed found in their local area and answer:
  -From which country did the weed originate?
  -For what purpose was the plant imported and why is (or was) it important?
  -At what time of year does the weed flower?
  -Does the plant provide food or habitat to any native or introduced species? Why is the weed a problem in natural areas?
  -Is the plant sold in the local nursery?
  -Name a specific location where they have seen this plant growing. What steps can be taken to prevent this weed from spreading?
  -Draw a picture or take a photo of the weed.
  -Students can present their results to the class. Extra marks can be awarded if they bring a cutting into the classroom.
- Show deciduous tree clippings to the class and discuss where the plants come from, how they spread, how they impact on the environment. Explain that many people really love these types of trees and don't like them to be cut down. Ask students to pretend they work for the council. The council knows that some Willows in the local creek which runs straight into a reservoir are threatening biodiversity and water quality in the area. It is their job to write a letter (or present a talk) to residents living near the creek, some of whom may be passionately fond of Willows. Make sure that students explain to the residents why the trees need to be chopped down and how they intend to restore the area after the trees have gone.
- Start a media file of articles appearing in your local paper concerning weed management issues in your local area. (Examples have been provided in this chapter). Students can research any likely benefits or disadvantages of the plants concerned and then discuss how community attitudes can be managed.
- Organise a debate. Divide students into groups and ask each to represent the interests of a community group, industrial company or residential household. Each group can research and develop a portfolio of material, both of the issues and of the interests of each of the organisations involved. The teacher, who plays the role of the council or other managing body, can serve judgment based on the strength of the arguments given during the debate.

Recommended resources

Http://www.environment.sa.gov.au/reporting/biodiversity/introduced/pest_plants.html

An outline of the cost of controlling weeds in South Australia, and a list of nationally significant South Australian weeds.

http://www.amlrnrm.sa.gov.au

Look for information about Weed Warriors and also find information on how bushland and pasture weeds are controlled.

http://www.urbanforest.on.net/backyard-q07.htm

For a list of common garden plants that have become environmental weeds**.** Discuss this list with your school grounds committee to ensure your school is not contributing to the problem of environmental weeds.

Deciduous trees in the Onkaparinga catchment

Local creeks and rivers become polluted with exotic leaves during autumn and winter.

With the exception of a couple of species indigenous to Tasmania, there are no Australian native trees which are truly deciduous i.e. they lose all of their leaves in autumn. All of the deciduous trees in Australia have been brought here from other countries as ornamental garden plants or food plants. Whilst most are very well managed and provide us with delicious fresh fruit, some deciduous trees have the ability to spread into areas where they can cause serious problems for our local environment.
Three species occurring in the Onkaparinga Catchment area currently causing problems are Willows, Ash and Poplars.

Problems caused by all three species

- All grow very well in watercourses and are able to spread of their own accord.
- All drop their leaves in autumn which pollutes local waterways. Leaves rot very quickly and deplete the water of dissolved oxygen, leaving no oxygen for fish, frogs and maroinvertebrates.
- Rotting leaves add nitrogen and phosphorous to the water which can in turn promote the growth of harmful algal species. Some algae are extremely toxic to anything touching or drinking the water. When the algae dies, oxygen levels are further depleted. If all of the oxygen is used, the rotting process cannot continue and water becomes anoxic and very smelly. Almost no wildlife can persist in these conditions.
- They provide habitat to feral species of birds such as Blackbirds and Starlings which compete with our native birds.
- They provide almost no habitat to natives species, particularly over the winter months when they have no leaves.

Other problems with Willows ...

- Over the summer months, Willows provide very dense shade. This shade prevents other plants from growing beneath them.
- Without an understorey beneath the Willows, the river banks are bare earth and easily eroded by water flows. Eroded sediment makes the watercourses murky, causing problems for fish as their gills become clogged and they can no longer see their prey in the cloudy haze.
- Many of the plants which naturally grow along river banks are excellent for filtering out excess nutrients and keeping the water clean. These plants cannot grow beneath Willows, so the opportunity for filtration to happen naturally is lost.
- Willows have a shallow, fibrous root mat which can often be seen along the base of infested creek beds. This root mat prevents the water from digging a channel downward but rather pushes the water sideways. In high flows this can lead to serious flooding on nearby property.
- Willows are extremely thirsty, using more than twice the amount of water of most native species. There are anecdotal reports of dry creeks flowing again only hours after Willows have been removed.
- Small twigs and branches which snap off Willows can take root and grow very quickly into large trees, making control difficult.

Note: Deciduous trees are not problematic in their own countries because they generally come from colder areas where the temperature of streams only allows for very slow breakdown of leaves.

A local creek infested with Willow trees. Note the bare banks without any reeds or other native vegetation.

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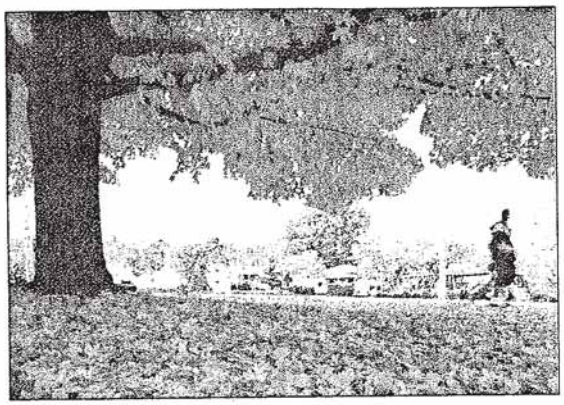
Media clippings for discussion

Sunday Mail 30/05/2004

Clean up 'lethal' autumn leaves



LEAVES: Lovely but lethal for fish and plants

AUTUMN leaves may look attractive but they can be lethal if allowed to enter local creeks and rivers.

High loads of leaf litter from deciduous trees in gardens and streets entering waterways at this time of year can have potentially deadly results for native plants and animals, according to the Patawalonga and Torrens catchment water management boards.

The boards' general manager Alan Ockenden urges everyone to play their part in protecting local environments by becoming a "gutter guardian" and sweeping up and removing their autumn leaves.

"Every year an estimated 60,000 cubic metres of leaves fall from street trees alone," he said.

"Much of this can get washed from our roads and footpaths into gutters and drains, and from there into local creeks and rivers."

Autumn leaf litter decomposes very quickly in the waterways, stripping oxygen from the water.

"The resulting drop in water quality can threaten the survival of native plants and animals like fish and frogs that call the catchments their home,'' Mr Ockenden said.

Since 1995, the boards and local councils have invested heavily to clean up local waterways, including the installation of trash racks to catch leaf and other litter.

"However, the most effective method of keeping our waterways clean and healthy is to stop leaf litter pollution from entering our waterways in the first place," Mr Ockenden said.

He said people shoulod dispose of autumn leaves properly through composting, garden mulching or council green waste disposal.

The Courier 19/05/2004

Part of our history

Sir:— One of the first things a visitor to Hahndorf is greeted by are the beautiful deciduous trees lining both sides of Main Street. In spite of the relentless trend towards urbanisation, a beautiful cool canopy of various "exotic" trees provides shade in summer and even some of the side streets have beautiful stands of oaks and willows.

Or maybe I should use the past tense.

My 12 year old son was quite speechless when we looked at the scene of devastation along the Hahndorf Creek. And while I tried to point out to him that this was done for reasons of biodiversity, I had to admit that the net result looked exceedingly ugly.

As far as I am concerned, the Hahndorf willows are part and parcel of a pattern of settlement and land use that goes back at least half a millenium before anyone had the bright idea to ship convicts to Botany Bay.

They were planted by peasants from Silesia who used them for a variety of reasons and are as much part of the cultural landscape of Hahndorf as the trees on Main Street. And they are also beautiful in their own right.

W. WESTERMANN
Kangarilla

The Courier 26/05/2004

Heritage Lost

Sir:— I write in support of your correspondent W. Westermann of Kangarilla, whose letter concerning Hahndorf's willow trees appeared in last week's *Courier* (19/5/04).

Upon enquiry, I find that Mt Barker Council is removing the willows against the advice of Hahndorf's heritage adviser.

Council should consider that Hahndorf's willows were an integral part of the town's daily life, not just planted for beauty's sake.

In the 1850s, basketweaver Heinrich Steffens settled in Hahndorf and for the rest of his life made a full-time living from using pliable young willow branches to create a variety of containers which Hahndorf's citizens used in their daily lives.

Likewise, clogmaker Hans Bom came from Denmark and used willow wood to make his footware.

Moreover, the internationally renowned cricket bat maker, Ewald Kumnick from Lobethal, made regular trips to Hahndorf (as elsewhere in the Hills), to inspect the willows. With a penknife, he tapped the trees for suitable branches which he scored and then left for further growth. Later, Mr Kumnick returned to remove the selected timber for turning into cricket bats. Visiting English cricketers on Ashes tours in Australia regularly received Kumnick bats as gifts.

Hahndorf is a national heritage site, selected for such an honor because it retains unique features which help to interpret the nation's pioneering life for future generations to study and enjoy.

Surely the Mt Barker Council must live the aims of its recent heritage weekend which it sponsored with such fanfare. To strip Hahndorf of its willows is yet another example of insensitive bureaucratic action which has monumentally plagued this town for many a year, gradually robbing the oldest non-British settlement in Australia of its world-recognised charm.

REG BUTLER
Hahndorf

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Media clipping for discussion

Read the three articles on the opposite side of this page and answer the following questions.

What problems do deciduous trees cause in the local environment and what are the benefits from removing them from creek lines?

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.....

.....

Why are some members of the community opposed to removing deciduous trees?

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.....

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What is your opinion on this issue: Do you think deciduous trees should remain or be removed? Give reasons for your answer.

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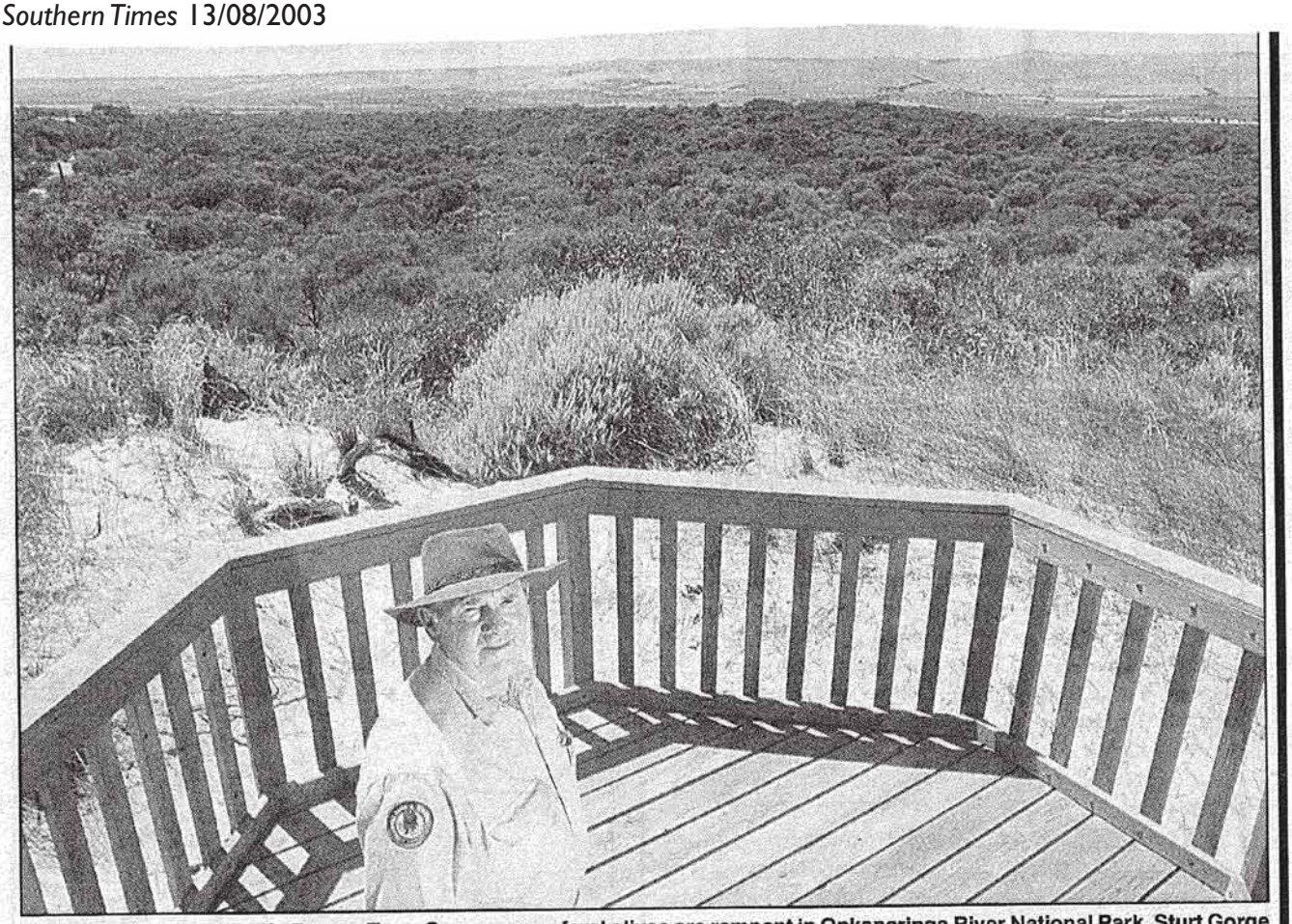
Southern Times 13/08/2003



National Parks and Wildlife Ranger Terry Gregory says feral olives are rampant in Onkaparinga River National Park, Sturt Gorge and Aldinga Scrub Conservation Park. Picture: Roy Van Der Vegt 13204

Olive crunchtime

By LAURA DARE & CRAIG FARMER

ENVIRONMENTALISTS have called for olive planting to be banned outright in the Hills Face Zone.

And the State Government should consider imposing a bond on new plantations, to cover the cost of cleaning up abandoned groves, they say.

Conservation Council vice-president **Jasemin Rose** said State Environment Minister **John Hill's** task force to examine laws governing olive plantations was a step in the right direction.

But she said the government must go further.

"We'd like to see the planting of olives prohibited completely in the Hills Face Zone," Ms Rose said.

The government should also create a water management plan that does not allow olives to use water from the Murray River, she said.

The government's task force will consider tightening the approval process for new olive groves.

It will report to State Cabinet in October.

National Parks and Wildlife Ranger **Terry Gregory** said the olive problem was rampant in Onkaparinga River National Park, Sturt Gorge and Aldinga Scrub Conservation Park.

"It doesn't help our environment and it doesn't help our animals," he said.

Mr Gregory said it was vital to target the southern area to get rid of the weeds and to reduce the "fuel load from the southern hills in the event of fire".

Mr Gregory said controlling the olives was a "very large task, but it is not a hopeless task if we keep working at it".

"Olive plants grow and spread at an alarming rate, destroying natural vegetation.

"Their high oil content means they also pose a significant fire risk," he said.

Friends of Onkaparinga Park spokesman **Ray Rogers** said olives were the group's principal enemy.

Despite the group's persistent efforts attacking the weeds, there were now more in the park than when the group started ripping them out more than 10 years ago.

He said the group was adequately funded but needed more active members rather than "armchair volunteers".

19. Threatened species

Concepts

- Defining threatened species; rare, vulnerable, endangered and extinct
- Causes and consequences of species decline
- Threatened species - some local case studies

What is a threatened species?

In South Australia, the term threatened species refers to species classified as either 'Rare', 'Endangered', or 'Vulnerable' under Schedules 7, 8 and 9 of the *National Parks and Wildlife (NPW) Act* 1972.

'Endangered' species are under the most threat and likely to become extinct in the near future unless the circumstances and factors threatening their survival change for the better. The endangered list includes several species which experts believe are already extinct but, because insufficient time has elapsed since their last official sighting, are not yet listed as extinct.

'Vulnerable' species are likely to move into the endangered category in the near future unless circumstances and factors threatening their survival change for the better.

'Rare' species are the least threatened, but which are at some risk due to natural low populations, restricted distributions or observed, actual declines.

Species listed as 'threatened at National level' under the *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999 include plants and animals that often receive priority for government funded conservation activities because they are threatened at both the National and State level. Section 179 of the *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999 lists a total of 185 species occurring in South Australia as 'nationally threatened'.

Facts and figures

Australia has a total of 1,181 plants and 306 animals listed as 'threatened'. Approximately 31% of Australia's nationally threatened mammal species occur in South Australia, 2.8% of plant species, 7.4% of bird species, 4.4% of reptiles and 4% of amphibians. In South Australia 1,041 of the approximately 4,350 species recorded in the State (or 24%) are listed at the State level including 785 plants, 88 mammals, 127 birds, 39 reptiles and 2 amphibians. It is known that 23 mammals, 2 birds and 26 plants have become extinct in South Australia since European settlement.

A review of the official listing of threatened species in South Australia was completed in 2000. This review has resulted in an increase in the total number of threatened species occurring in South Australia from 778 in 1991 to 1,041 in 2000. Freshwater fish have been included in the schedules for the first time.

Why are species declining?

Species decline is almost never caused by one single factor but rather a host of complex factors usually stemming from human impacts on the environment. Previous topics have described some of the most significant factors leading to the decline of Australia's local species. Other contributing factors include:

- dieback of native vegetation caused by introduced plant diseases
- loss of drought refuges (cleared water courses, swamp drainage)
- altered fire regimes (burning back of native vegetation by humans)
- climate change caused by human-induced emissions of greenhouse gases
- nest predation by rats and cats
- disturbance during feeding and resting by cats, dogs and humans

'Increaser species'

The onset of European settlement has enabled certain native species to grow in numbers and to expand their natural home ranges, displacing other smaller or more timid species. Human impacts have provided these 'increaser species' with more habitat and other resources than before and their populations have exploded as a consequence. These species have broader dietary or habitat requirements, and often adapt well to feral plants which they can use as food and habitat, thus exacerbating the problem.

Birds

One good example of a bird that has adapted well to urban and disturbed areas is the Magpie which, because it prefers to live in large trees where there is little ground cover, has found cleared grazing land an ideal habitat. Increaser species are often similar in life-cycle and have many characteristics and behaviors in common with introduced feral species and their impact on other native species is

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often just as great. For example, Magpies, being extremely aggressive, will attack any smaller or more timid species that attempt to migrate across grazing land thus confining them to small remnant patches of vegetation and further reducing their chance of survival.

Amphibians

The Frog Census and associated surveys have been useful tools in locating where Bibron's Toadlet is found in South Australia, and in determining whether they are becoming less common in some areas over successive years. It is believed that population numbers around the country are undergoing decline, due to increased urbanisation and habitat clearance. Bibron's Toadlet is currently in the process of being recognised as a threatened species in South Australia.

Mammals

Kangaroos can select from a wide range of introduced pasture grasses and their grazing land covers a greater area today than prior to European settlement. Although stock watering troughs ensure their survival in times of drought, the explosion of kangaroo populations often forces them into bushland areas where they damage the habitat and reduce food supply for other native species.

Why should we care about losing species?

Some of the environmental, social and economic effects associated with the loss of species are outlined below.

- Loss of biodiversity. Any loss of native plants and animals contributes to loss of biodiversity. Biodiversity underpins the very processes that make life possible such as the provision of clean water, oxygen, and productive soils.
- Loss of native vegetation. Native vegetation can mitigate the harmful effects of greenhouse gases. More than 90% of today's drugs have been derived from plants growing in natural vegetation. Very little is understood about the chemistry of these plants and it is expected that many new discoveries will come about if the natural vegetation can be preserved.
- Loss of genetic potential. The genetic material in wild plants and animals is necessary to ensure that the quality of domestic strains is maintained.
- Impact on tourism. Our native plants and animals provide a focus for tourism, which produces a significant economic return for the State.
- Impact on cultural identity. Many Australians place a high value on native plants and animals, which contribute to recreation activities and a sense of cultural identity and spiritual enrichment.
- Impact on indigenous culture. Many native plants and animals are central to Aboriginal cultures.
- Ethical issues. It may be argued that we do not have the right to cause the extinction of any other species.

What can we do to help threatened species?

The first requirement of any successful conservation program is to find out as much as possible about Australia's native plants and animals and their extremely complex ecology. This will enable better understanding of what the animals need to survive and how to manage any threats. Researching their behaviour, restoring food sources and habitat, and controlling feral species are some of the techniques employed. See the recommended resources for weblinks to current threatened species recovery programs as well as the fact sheets included with this chapter. (Source: Department for Environment and Heritage, SA)

Lesson ideas

- Students can research their favourite South Australian threatened species and answer:
    1. What does it eat?
    2. What type of habitat does it need?
    3. Where does it currently live?
    4. What are the threats contributing to its decline?
    5. What can we do to stop this species declining in the future?

- Use the fact sheet included with this chapter to learn about some of the threatened species of the Adelaide and Mt Lofty Ranges region.

- Complete the *Nature Foundation of SA* worksheets on Southern brown bandicoots (*Catchment Connections - Folder3, Topic 13*). Follow this up with an excursion to Warrawong Earth Sanctuary or the Adelaide Zoo to see Southern Brown Bandicoots in captivity.

- Discuss whether animals are better off living in the wild than in captivity. Discuss the complex relationship native animals and plants have with one another and whether humans could survive as a species in a world that contained no native species. Imagine a world in which all native species exist only in zoos or botanic gardens.

Recommended resources

http://www.environment.sa.gov.au/biodiversity/threatened.html

For information about threatened species of South Australia, their major threats, and current recovery projects.

http://www.echidna.edu.au

For information about echidnas in South Australia. Look for the section on monotremes.

For a well illustrated explanation of how several species of animals became extinct around the world, read *A Gap in Nature* by T. Flannery & P. Schouten, 2001 (The Text Publishing Company).

Fact Sheet

Threatened species of the Mt Lofty Ranges
Black-chinned honeyeater

The Black-chinned honeyeater (*Melithreptus gularis*) is a small greenish bird, with a black crown, white nape and pale blue skin around the eye. The black chin for which it is named is only evident when very close. These birds are generally seen high up in the canopy of large Eucalypts and are often most easily located by their loud 'churring' call. They move in response to the flowering cycles of their food plants.

Image courtesy of Frank Knight

In South Australia the Black-chinned honeyeater has two main strongholds, the Mount Lofty Ranges and the South East. The population in the Mount Lofty Ranges has suffered a dramatic decline in its distribution and abundance in recent decades. Once inhabiting over 80 locations from Victor Harbor in the south to an isolated group at Laura in the Southern Flinders Ranges, it was found as far east as the Tothill Ranges at Rockleigh and Milang.

Habitat

Black-chinned honeyeaters prefer grassy woodland and dry sclerophyll forest habitat. At most of the sites where Black chins have been observed, there is blue gum (*Eucalyptus leucoxylon*) and red gum (*E. Camaldulensis*) woodland along creek-lines, (e.g. Inman River, Hindmarsh River, North Para River at Altona, Scott Creek Conservation Park, Sturt Gorge Recreation Park, Christies Creek). Where the species has been recorded in pink gum woodland it has probably been utilising a nearby sand scrub, which contains species such as silver banksia (*Banksia marginata*) and native pine (*Callitris gracilis*). These habitat preferences are also displayed at sites outside of the Mount Lofty Ranges. Black-chinned honeyeaters in the Little Desert in Victoria can be found in blue gum, pink gum and native pine woodland.

This holds true for the area around Bangham and Joanna in the South East of South Australia and along the River Murray near Mannum where they are found near large areas of Native Pine woodland. In the Mid North they occur in Red Gum lined creek lines near native pine woodlands. A year-long project in 1994 recorded Black-chinned honeyeaters at only 11 locations in the Mount Lofty Ranges and estimated the total population to be about 60 individuals.

SA Blue Gum grassy woodland: preferred habitat of Black-chinned Honeyeaters

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Threats to survival of the Black-chinned honeyeater

- **Clearance of suitable habitat:** As with many threatened species, the areas favoured by Black Chins are the habitat types that have been cleared in South Australia for agriculture. Clearance of these woodlands continues to occur for many purposes including sand mining, housing development, viticultural and other agricultural pursuits.
- **Habitat is poorly protected:** Suitable habitat types are poorly represented in South Australia's reserves system.
- **Lack of information on life cycle:** Black-chinned honeyeaters are presumed to be sedentary however, there is little ecological information on reproduction, movement and isolation effects, which is restricting attempts to manage this species.
- **Predation of nests by increaser species**, e.g. Possums, Magpies, Currawongs.
- **Lack of genetic diversity within the small population:** A low population and small gene pool means less chance of survival and means the species is less able to cope with environmental changes.
- **Loss of habitat due to changed fire regimes:** If areas remain unburnt for long periods, Native Pine will start to dominate at the expense of Eucalypt species which are used by Black Chins as breeding and feeding habitat.

Actions needed for recovery:

- Cease clearance of suitable habitats, including isolated trees which may form a link between patches of bushland and preserve suitable habitat types in the State reserves system
- Investigate ecology of the species to determine reproductive habits and movement between patches of bush
- Investigate the role of fire on vegetation structure in suitable woodland areas
- Revegetate suitable habitat areas which are degraded, e.g. Sauerbier Creek, Inman River
- Increase public awareness about Black-chinned honeyeaters and the need for habitat protection

Current projects - population monitoring

Birds SA is monitoring the numbers and distribution of Black-chinned Honeyeaters in the Mount Lofty Ranges. Individuals and community groups can assist this project by reporting sightings of Black-chinned honeyeaters; adopting a site and monitoring the population on a regular basis; assisting Birds SA with field work to locate populations of honeyeaters; assisting with site revegetation work.

Photo: Brian Furby, courtesy Birds for Biodiversity program

Sources

Urban Forest Biodiversity Program

Chapman, T.F. (1995) The Ecology and Management of the Black-chinned honeyeater (*Melithreptus gularis*) in the Mount Lofty Ranges. Unpublished Thesis. University of Adelaide

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Fact Sheet

Threatened Species of the Mt Lofty Ranges
Yellow-bellied Sheathtail Bat (Saccolaimus flaviventris)

The Yellow-bellied Sheathtail Bat is found in many parts of Australia, but only 2 specimens have been recorded from the Mount Lofty Ranges region. This bat is considered rare in South Australia. The Yellow-bellied Sheathtail Bat has dark fur covering its back and head, while the fur covering the underside is pale. Insects constitute the main diet for this bat, which, like all bats, uses echolocation to search and hunt for prey. The Yellow-bellied Sheathtail Bat searches for its food above tree canopies, reaching great heights. Weighing in at between 30 and 60 grams, and reaching a wingspan of between 69 and 82 millimetres, the Yellow-bellied Sheathtail Bat is a microbat. Microbats are some of Australia's smallest mammals.

Habitat

Tree-hollows make roosting sites for the Yellow-tailed Sheathtail Bat, where they can form colonies of up to 6 members. Artificial habitats ('bat boxes') can be constructed from wood or PVC piping to replace tree hollows that may not be available.

Threats to Survival

In the Mount Lofty Ranges, approximately 95 per cent of native vegetation has been cleared for several purposes, including residential development, farming and industry. As such, less tree hollows could be available for bats to use as roosting sites. Because the Yellow-bellied Sheathtail Bat searches for its food above tree canopies, the clearance of native vegetation could also be impacting on the diets of these bats.

What can be done?

Preservation of trees can certainly aid the survival of the Yellow-bellied Sheathtail Bat in the Mount Lofty Ranges. Revegetation can help to provide extra habitat to the bats, as well as providing habitat for insects that the bats eat.

Source: SA Museum

Sources

Urban Forest Biodiversity Program

Upper River Torrens Landcare Group (2001) "Bats of the Mount Lofty Ranges" South Australian Museum, Adelaide.

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Fact Sheet

Threatened species of the Mount Lofty Ranges
Short-beaked Echidna (Tachyglossus aculeatus)

Short-beaked echidnas are small mammals, reaching lengths of approximately 50 centimetres. Covered in spines, short-beaked echidnas can dig into the ground with their sharp claws to search for food or anchor themselves in place if they feel threatened. Short-beaked echidnas will feed on ants, termites and other invertebrates, using their sensitive snout to find prey and their sticky tongue to catch prey.

Short-beaked echidnas are monotremes, meaning they are mammals that lay eggs. Females lay one small, soft-shelled egg, which is moved by the echidna into her pouch. After the young echidna has hatched, the female echidna will carry her young in her pouch and let it feed on her milk until it develops lengthy spines. In Australia, the only other egg-laying mammal is the platypus.

Habitat

Short-beaked echidnas eat ants, termites and other invertebrates, so prefer areas with fallen tree matter that houses these creatures. Short-beaked echidnas have been known to live in several habitat locations including woodlands, scrublands and sometimes agricultural or urban areas.

Threats to Survival

While *Tachyglossus aculeatus* is not currently listed as a threatened species, continuing development, clearance of habitat and encroachment upon home ranges have the potential to threaten the Short-beaked echidna. As with all of our native animals, it is necessary that we take care not to disturb them, as this can result in future threats. If you find a sick or injured Short-beaked echidna, as with other native animals, you should contact your nearest Animal Rescue group like the RSPCA. Try to keep contact with the animal to a minimum as it may distress the animal.

Sources

http://www.iucnredlist.org/search/details.php/41312/all IUCN Threatened Species Red List.

http://www.australianmammals.org.au/Species/Echidna%20Profile.htm Australian Mammal Profiles.

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20. Taking action towards personal sustainability

Concepts

- We all need to take responsibility to improve our environment
- Completing a personal environmental audit is a great way to find out what you can do to work towards sustainability.
- Set yourself environmental goals and work to achieve them
- Your ecological footprint is a measure of the amount of land required to maintain your lifestyle

Getting started

"There are too many environmental problems." "I can't make a difference on my own." "Nobody else cares about the environment!" "Why should I give up my quality of life if others don't?" These are all common reasons why people avoid taking action to help the environment. However, taking action to help the environment can be as simple as making small changes to your daily routine. Educators who work to reduce their own impact on the environment provide a good example to their students.

Identifying environmental problem areas

To find out how you can reduce your impact on the environment, you can complete an environmental audit. An environmental audit is a quick questionnaire that asks you questions about your daily routine. Audits can be used to investigate your water use, electricity use, or the general environmental performance of your home. Try some of the audits that are listed in recommended resources. After completing an audit you can find out ways that you can reduce your impact on the environment.

Completing an environmental audit

One of the simplest environmental audits has been included with *Catchment Connections - Topic 1 Folder 4* and is available at www.waterwatchadelaide.net.au

This water use audit will help you determine ways that you can reduce water use around the home. Detailed instructions are provided with the audit which takes about one hour to complete. In brief, this audit asks you a range of questions about your water use around the home. As you answer each question you add up your score. If you scored less than the maximum then you can read through the 'Water smart actions' to identify the steps you can take to reduce your water usage and protect the environment. Once you have identified areas for improvement it is time to set goals and take action.

Personal action

The most important part of environmental awareness is to turn it into action. This can be as simple as using the results of your environmental audit to set between 5 and ten environmental goals to achieve over the next 12 months. Environmental goals can be simple statements such as the following:

- fix all the leaky taps in my house
- use an egg timer to help limit my showers to 5 minutes
- buy and install a water saver shower head.

Set your goals and work to achieve them. This simple process will reduce your impact on the environment. As you set new environmental goals each year, you will come closer to living sustainably.

Ecological footprint

When browsing some ecological audit resources you may see the term environmental footprint. An environmental footprint is the amount of land and water needed to produce the resources you consume and absorb wastes you generate. It can be measured for an individual, a city, country, or all of humanity. People that consume more resources will have a larger footprint. Aim to reduce your footprint and you will help to improve our environment.

Lesson ideas

- Visit the Planet Slayer web page: **http://www.abc.net.au/science/planetslayer/greenhouse_calc.htm** Students can use this environmental audit web page to calculate their greenhouse environmental footprint. Students can use the results of this audit to set environmental goals for the coming year. At the end of the year encourage students to evaluate their progress and to set new goals for the following year

- Students can complete the eco spider web activity (*How sustainable are we?)* included in this topic. This is a simple family environmental audit activity that involves graphing answers on a web shaped graph. A large web indicates that the student has an eco friendly family.

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Students should consider a range of ways to increase their 'Eco spider web.'

- Students can use their water audit results to come up with 5 goals for their family to save water. Ask them to work with their parents to develop the water saving goals and then at the end of a set period of time (end of term, for example) get them to report back to the class on how their water saving goals are going.

Recommended resources

www.sustainableliving.sa.gov.au

Has a footprint calculator as well as information on water conservation, climate change and food.

www.epa.vic.gov.au/ecologicalfootprint/calculators/default.asp

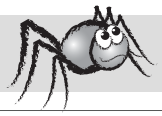
An online ecological footprint calculator from the EPA in Victoria. Find out how much of the earth you use to sustain your lifestyle.

http://www.agl.com.au/content/athome/energy_advice/sa/index.html

The AGL home energy use audit. Full of tips to save on energy bills and help the environment.

How sustainable are we?

How eco friendly is your family? Look in the eco web to find out!



Hey kids!

Did you know that at home and school and with every activity, we have an impact on the environment?

Being sustainable means living in a way that doesn't destroy the environment for other animals, plants and future generations. Now you can have fun and measure how eco friendly your family is using the eco spiderweb.

The bigger the spider the better!

1 **Check out these questions** and tick each box that applies to your family. Count the number of ticks to give you a score for each section.

How is our energy use?

We

- □ use compact fluorescent lights wherever we can
- □ turn off lights and appliances at the wall when not in use
- □ buy 'energy star' rated appliances
- □ do not heat our home above 20°C or cool it below 25°C
- □ don't heat our hot water above 60°C
- □ don't use a second refrigerator
- □ dry washing outdoors, not in an electric dryer
- □ use hand tools rather than power tools in the workshop
- □ have a solar hot water system OR have solar PV panels and generate our own solar electricity

your score

How is our indoor water use?

We

- □ have a dual flush toilet
- □ have a low flow head in our shower
- □ reuse suds for several loads of washing
- □ reuse greywater from the bathroom and laundry
- □ save and use cold water that arrives before hot water gets to the tap
- □ turn off the tap while brushing teeth
- □ turn off the shower between getting wet and rinsing off
- □ flush the toilet with rainwater or recycled water
- □ have a rainwater tank big enough to supply all our water needs

your score

How is our outdoor water use?

We

- □ use only rainwater or recycled water for the garden
- □ have no lawn or do not water the lawn
- □ have a garden specially designed for low water use
- □ only water the garden when needed, not on an automatic timer
- □ do not use water features for decoration eg fountains, fish ponds
- □ do not have a swimming pool
- □ wash the car with a bucket and rinse with a trigger hose only
- □ wash the car on the lawn so the water is not wasted
- □ do not use a hose instead of a broom for sweeping driveways

your score

How is our generation of waste?

We

- □ try to buy stuff we need rather than stuff we only want
- □ try to buy stuff that has less useless packaging to throw out
- □ try to make things last as long as possible before being replaced
- □ don't discard things for reasons of 'fashion' only
- □ try to reuse discarded articles for other purposes wherever we can
- □ sort our waste for recycling
- □ compost food waste from the kitchen and use it in the garden
- □ compost green waste from the garden to help improve the soil
- □ put garden green waste in a special wheelie bin for collection

your score

How is our local self sufficiency?

We

- □ grow and use our own vegetables
- □ eat fruit from our own fruit trees
- □ swap fruits and veggies with neighbours when we have extra
- □ dry or preserve extra fruit and veggies to eat later
- □ feed food scraps to chickens to get eggs or meat
- □ participate in a local food co-op
- □ buy local fruits and vegetables in their natural season only
- □ have a regular direct order of fruit and veggies from local growers
- □ practise principles of permaculture

your score

How do we care for the health of wildlife in the garden?

We

- □ grow only native or food producing plants
- □ have trees high enough for birds and animals to be safe
- □ have shrubby, undisturbed areas in the garden with plenty of cover
- □ have plants that attract native honey eating birds
- □ have fences that allow small wildlife such as lizards to pass through
- □ do not have a cat or our cat is always confined to a cat run
- □ do not have a dog or our dog is confined to a restricted area
- □ practise organic gardening with no artificial pesticides
- □ use compost, not artificial fertilisers in our garden

your score

How is our use of fossil fuel in transport and motors?

We

- □ have only one car in the family
- □ do not have a car with more than a 2L engine capacity
- □ have a hybrid petrol/electric car OR put biodiesel fuel in our car
- □ carpool with friends or neighbours to share car trips
- □ use walking or cycling for shorter trips eg to school
- □ use public transport whenever possible
- □ do not use a car for commuting to work
- □ take holidays in our home state rather than in distant places
- □ use non motorised garden tools for mowing, trimming, digging and mulching

your score

How is our local community involvement?

We

- □ know our immediate neighbours' names
- □ visit our neighbours' homes
- □ help our neighbours out
- □ swap garden plants, produce and knowhow with our neighbours
- □ share family activities with invited friends and neighbours
- □ are involved in local sports or other club activities
- □ are part of a local social community eg church
- □ do volunteer work in the community
- □ use our local library

your score

Eco Voice

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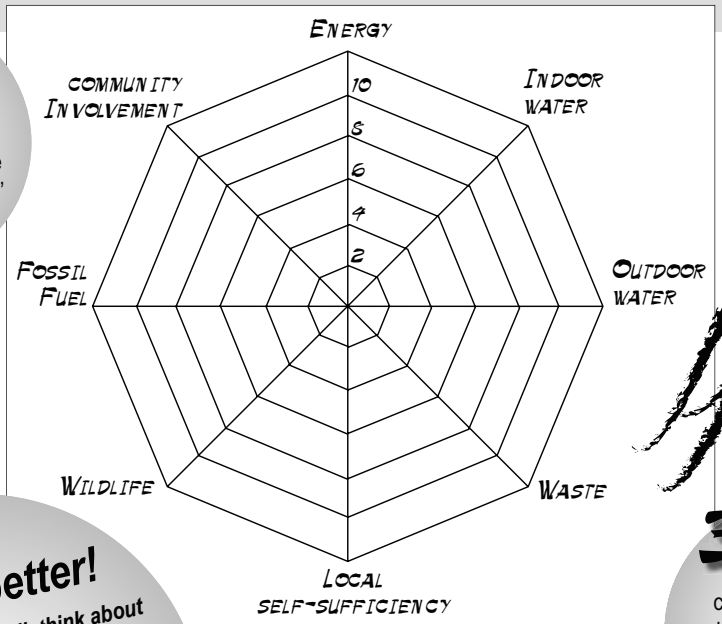
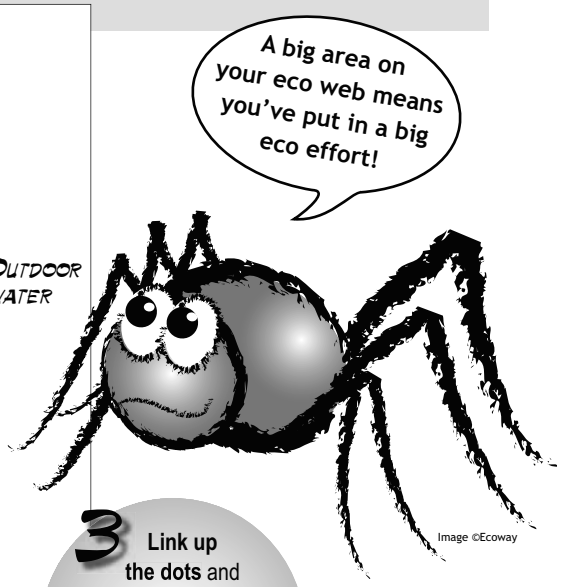
How sustainable are we?

How eco friendly is your family? Look in the eco web to find out!

At home and school and with every activity, we have an impact on the environment

2 **Enter your score for each section** as a dot along the appropriate arm of the 'spiderweb' plot.





3 **Link up the dots** and colour in your 'impact shape' or spider so you can compare it with the shapes of your friends.

Bigger is better!

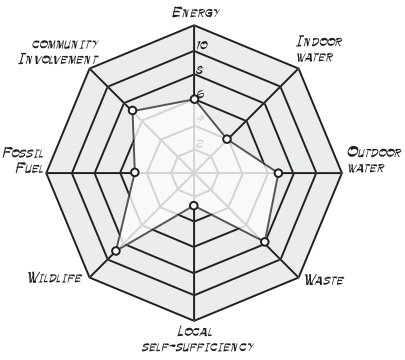
If your spider is quite small, think about what you can do to make it grow. Look at the questions and think about what changes you could make straight away. Some things might take more time. Try doing the survey again in 3 weeks or 3 months, and see how your spider has changed!

Talking about the reasons for the differences is a good way to learn new tips on how to reduce your impact on the environment, and how to help build a stronger, healthier and more sustainable community.

You can make your own eco web to measure anything you like. Just write some questions in several categories and make sure your web has an arm for each category. For example, you can go to an area and count birds, plants, insects and mammals.

Here's an example of a spiderweb plot with a set of scores filled in:

□	Energy	6
□	Indoor water	4
□	Outdoor water	7
□	Waste	8
□	Local self-sufficiency	3
□	Wildlife	9
□	Fossil fuel	5
□	Community involvement	7



For an electronic copy of this survey, contact Elizabeth Heij of CSIRO Sustainability Network Elizabeth.Heij@csiro.au. ***Survey by the CSIRO Sustainability Network***

To find out more about the Sustainability Network, see www.bml.csiro.au/sustnet.htm.

Hey kids! *Become an Eco Reporter!*

The Challenge

Report on what your school, class or community has been doing to help the environment. Tell why this is important • Maximum 250 words plus photos or drawings

The Prizes

Publication of state, territory or region winning report in *Eco Voice Newspaper*! • Winning schools/groups receive subscription to Eco Voice worth $250 • When report is published, each student in winning class/group receives a free copy of that issue • Certificate of Achievement

Guidelines

Primary/Secondary school students, Scouts and Guides only • One entry per class/group • Format by students with 250 word limit. Email photos or drawings - jpeg or tif at 300dpi • Winners published in the following issue of *Eco Voice Australia and New Zealand's Environment Newspaper*

21. Monitoring animals

Concepts

- Monitoring animals allows for population size to be estimated and can help to determine the health of an ecosystem.
- There are several different techniques for monitoring animals.

Types of animal monitoring

There are many very simple and highly sophisticated methods used by biologists for monitoring animals. These range from simple counts through to technologically advanced tracking equipment.

The first step in any kind of monitoring is being able to identify the organism which you intend to monitor. For most animals, identification is easily performed by using pictures. For plants and insects (ants in particular), an identification key may be more useful.

Assuming that an animal can be competently identified by the observer, the next step is to estimate the population size. This can be done through a variety of techniques, depending on the type and behaviour of the animal. Some of these techniques are described below.

Counts of a whole population within an area. This technique is used for animals which are easily spotted such as seals, whales, dolphins. Bats come back to roost during the day, making counts of whole population while roosting a suitable method for estimating abundance of these animals. Taking photographs of bat roosts or seal colonies during the day or at different times of day can provide an easier means of counting the animals as they can't move!

Trapping mammals provides a sample of the total population from which equations can be applied to estimate total abundance in a particular area. Cage traps or pit-fall traps are used to capture the animal. The animal is often marked or tagged in some way. Over the trapping period if very few animals are re-caught, it would indicate there is a higher abundance of animals than if the same individuals are caught over and over again. Similar techniques can also be used for birds.

Insects are notoriously one of the most difficult groups to monitor, hence little is known of many species of insect. Beating vegetation, light traps, pitfall traps and sweep nets are all methods commonly used for monitoring insects.

As a general rule, most methods of estimating population size will have high levels of variance. Complex natural environments and the reluctance of animals to stay still or be completely habitual will always lead to inaccuracy. In all cases, sampling should be repeated many times to improve the precision of population estimates.

Home range and territories of an animal are often measured by fitting an animal with a radio-transmitter which is detected remotely by a receiver and directional aerial. This technology has been used to map the movements of seals and sharks as well as koalas on Kangaroo Island. Changes in the size of home ranges or territories are likely to correlate with habitat quality, with smaller home ranges usually occurring in areas of better quality habitat.

All trapping, handling and tagging of vertebrates is subject to approval by Animal Ethics Boards to ensure the welfare of animals.

Lesson ideas

- It is amazing how many tiny insects live in a small patch of lawn. A simple way of showing this is to vacuum a small patch of lawn (square metre) with an empty dust-buster. Empty the contents into a white tray and count how many bugs have been collected. From this, estimate how many bugs would be living in a suburban patch of lawn or the entire school oval. Discuss what these bugs might be doing in the grass and how they contribute to the local ecosystem. This might include; eating grass, eating other smaller insects, assisting in the composting process of dead grass, soil building, providing food for other insects and animals such as birds, aerating the soil.
- Pit fall traps for insects:. Take a class out and dig a series of holes deep enough to fit a glass jar or plastic cup inside, one hole per four students would be sufficient. The cup or jar should sit flush with the soil surface with no gaps around the edges. Check the traps every 48 hours and have students record the actual species, draw, or make up names for their captives before carefully setting them free. Traps will likely collect up to 5-10 different species over a couple of days. Try setting traps in two different areas such as the school oval and a bush garden and see if the variety of insects caught varies at all.

Note: Do not set and forget traps as some animals such as frogs may perish if left too long.

♦ *Catchment Connections - Folder 2: Understanding Ecosystems* provides several simple monitoring activities for birds and macroinvertebrates.

♦ *Catchment Connections - Folder 2: Topic 14 Scrape, jiggle and sweep* describes how to perform sampling of aquatic macroinvertebrates. Identification posters and monitoring charts are included at the back of this folde (also included in this *Best Of Catchment Connections* booklet).

♦ *Catchment Connections - Folder 2: Topic 18 Bird identification: More than just pretty feathers*, describes a bird surveying lesson for which data can be collected over a period of time. Students may observe changes in the presence of bird species over time. Identification and monitoring charts are included at the back of this folder.

Recommended resources

http://www.cmar.csiro.au/whitesharks/index.html
Tagging and monitoring of White Sharks in South Australian waters.

Http://www.abc.net.au/nature/island/ep1/default.htm
Information about seal tagging and other research on one of Australia's most biologically rich sub-Antarctic islands, Macquarie Island south of Tasmania.

22. Water testing

Concepts

- A monitoring program can help your school.
- A range of chemical and physical tests can indicate pollution levels in a waterway.
- How to interpret water quality test results.
- Regular water testing can help identify problems in a catchment.

What is water quality monitoring and why is it important?

Water quality monitoring can be defined as the regular testing of a waterway to determine its health. A range of tests are used to measure the physical and chemical characteristics of a waterway. Physical characteristics include water temperature and flow rate, and chemical characteristics include pH or the amount of nutrients. By measuring the physical and chemical characteristics of our local waterways, we can determine the health of our water and therefore its ability to sustain life.

Water quality monitoring provides the opportunity to identify pollution problems and then to find ways to solve these problems. For example if a higher than normal nutrient reading is found in a stream, then this can indicate a nearby pollution problem. In the Mount Lofty Ranges region, several leaking septics have been identified and fixed after high nutrient levels were recorded at monitoring sites in the nearby stream.

Becoming a Waterwatch school

Waterwatch Australia is an initiative to help us understand, monitor, care for and sustainably manage our most precious natural asset - water. It is a community water monitoring network that is all about understanding and keeping an eye on your local water body - it could be a creek, pond, lake, dam, wetland, lagoon or estuary. Waterwatch supports schools and community groups to monitor the health of waterways; to participate in environmental education activities and workshops; and to develop action programs to protect, rehabilitate or restore the health of our local waterways.

Groups participate in regular monitoring events by conducting tests and sending their results into Waterwatch Adelaide. Groups receive feedback about the health of their waterway from Waterwatch staff.

If you would like to become involved, contact your local Waterwatch Regional Coordinator for further details.

Which tests are carried out?

When carrying out water testing to determine the overall health of a stream it is important to note that a range of waterway characteristics need to be measured. Waterwatch groups carry out the tests for the following physical and chemical parameters: pH, flow rate, turbidity, salinity, temperature, phosphate and nitrate.

There are many different ways to conduct each of these tests. The Waterwatch Australia technical manual outlines many of these methods.

All groups in our region use standard equipment and methods to collect their water samples and to carry out tests. Instructions for water quality testing can be found at www.waterwatchadelaide.net.au

What do our results mean?

Interpreting results is a challenging task (even for scientists). Your test results are affected by complex relationships between living and non living parts of the environment.

It is important to monitor your site over several years. In this way you will become familiar with the normal range of measurements recorded at your site.

As a general rule, unusual results can indicate a problem with waterway health. You can spot unusual results by comparing your results with data from previous years or with data from other groups in your area. As you become familiar with your site, identifying an unusual result will become simpler.

To learn more about what specific results mean in the AMLR region, refer to our website.

To identify the cause of the problem, or unusual result, may require further investigation.

For example: if turbidity levels are higher than usual at your site and readings are normal upstream then there may be a pollution source in your area. Look around to find the source. Visit the stormwater drains or look out for poorly managed building sites. Conduct further turbidity testing upstream and downstream from the suspected source to confirm your suspicions.

Turbidity

Turbidity is a measurement of how cloudy, dirty or muddy the water is. Water can appear cloudy if it contains particles of clay, silt, sand, algae, plankton, chemicals or micro-organisms.

A turbidity tube measures turbidity in NTU (nephelometric turbidity units). Turbidity values of waterways can vary from <10 NTU (clear mountain

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streams) up to several hundred NTU (naturally turbid streams or after rainfall).

Problems caused by high turbidity

- The growth of water plants is reduced due to lack of sunlight penetrating the water.
- Fish gills become clogged with particles leading to infection and possibly death.

Interpreting turbidity

A high turbidity reading may indicate the following:

- soil erosion; dirt particles have entered the waterway during rain or times of high stream flow.
- an algal bloom; algae numbers have increased
- waste discharges from residential or industrial properties; dirt particles, chemicals, or micro-organisms are discharged.
- stormwater; many kinds of particles have washed through the stormwater system after rain.

pH

pH measures how acidic or alkaline water is on a scale of 0-14. Distilled water has a pH of 7 (neutral). Acidic water has a pH score lower than 7 and alkaline water has a higher pH value.

Problems caused by pH changes

- All animals and plants are adapted to specific pH ranges, generally between 6 and 8.5. If the pH of a waterway is outside the normal range for a plant or animal, it may become stressed or die.

Interpreting pH

It should be noted that pH values of a waterway can vary naturally due to:

- rainfall; which is slightly acidic as it contains dissolved carbon dioxide.
- the time of day; changes of sunlight and water temperature cause a rise and fall of pH.
- source of water; waterways in areas with a lot of limestone are alkaline, while waterways near the sea (estuaries and wetlands) are often acidic.

Human impacts that can alter pH are:

- acid rain.
- run-off from disturbed acid sulphate soils.
- discharges of industrial wastes.

Salinity

Salinity is a measure of the amount of salt found in a waterway. The types of salts (ions) causing the salinity are sodium and chloride, found in table salt, and sulphate, carbonate, magnesium, calcium and potassium.

Salty water conducts electricity more readily than pure water, therefore electrical conductivity is used to measure salinity. An electrical conductivity meter can give a measure of salinity in EC (electrical conductivity) units.

Pure water has a salinity of 0 EC while the sea has a salinity of about 50,000 EC. Drinking water should have a salinity of less than 800 EC.

Problems caused by high salinity

- many water plants and animals cannot tolerate high salinity levels and become stressed or die
- nutrients may be less available to plant roots.

Interpreting salinity

High salinity readings at your site may indicate:

- inflow of high salinity groundwater; occurs where the water table has risen and become more salty due to poor agricultural practices.
- salty soil or rocks; these can naturally release salts as they erode.
- low flows; salt levels increase during low flows partly because salt is left behind as river water evaporates.
- high water temperature; salt dissolves more easily in warmer water.
- poor land use in your catchment; over irrigation, removal of vegetation, and poor development (industrial and sewage discharges).

Temperature

The temperature of the water is measured in Celcius using a thermometer. Most Waterwatch groups may have a thermometer inside their Electrical Conductivity meter.

The temperature of a waterway fluctuates during the day and night as well as throughout the year. This fluctuation is normal, however extreme temperature change is of concern.

Problems caused by extreme temperature change

- plants and animals may not adapt quickly enough to the temperature change and may become sick or die
- algal blooms are more likely to occur in warm waters.

Interpreting temperature

Extreme changes in temperature may indicate:

- water discharges; warmed water from industry and power plants or cool water from dams.
- groundwater inflows; flushing cooler water into a stream.
- high turbidity; causing an increase in water temperature.
- extreme changes can be observed by comparing your result with data collected at your site on previous months or years.

Nutrients (nitrates and phosphates)

Nitrates and phosphates are nutrients that are required by living things. There are many different methods to measure

these nutrients. Our groups are provided with kits to test for these nutrients themselves.

Nitrates and phosphates are measured in mg/l. Good readings are less than 0.1mg/l for both nitrogen and phosphorous. Poor readings in our area would be higher than 1 mg/l for these nutrients.

Problems caused by high nutrient levels

- The growth of algae increases rapidly and algal blooms may result. Algal blooms may be unsightly, smelly, use up oxygen in the water and release toxins that are poisonous to other living things.

Interpreting nutrient levels:

Phosphate and nitrate levels will vary naturally due to:

- Rocks and soils; release nutrients as they erode.
- Vegetation; release nutrients as part of the growth process.
- The season; nutrient levels are generally higher in warmer months.
- Animal and human wastes; wash into waterways after rain or from leaking septic systems.
- Fertilisers; contain nutrients and when incorrectly used can wash into waterways
- Stormwater run-off; contains leaves, lawn clippings and animal faeces that release nutrients.

Stream flow

Stream flow is a measure of the amount of water that passes your site during a set period of time. Groups measure creek velocity (speed) as an estimate of stream flow. The creek velocity is measured in metres per second.

Waterways vary greatly in creek velocity due to seasonal conditions. During summer there may be no stream flow but after heavy rain, stream flows can become quite fast and dangerous. Measuring stream flow is important because it can help you interpret results for other tests.

For example:

You measured high temperature and salinity but find your waterway has stopped flowing. Then the main cause of the high temperature and salinity at your site at this time is likely to be the low stream flow, and not a more serious human impact such as discharge of warm effluent from a factory.

Problems caused by very low stream flow

- Oxygen dissolved in the water may be used up causing the death of fish and other water animals.
- Algal blooms may occur.
- Salinity and temperature may increase causing plants and animals to become stressed or die.

Low flow may indicate the following:

- Dams or weirs upstream; stopping or slowing stream flow.
- Overuse of the waterway; for irrigation, industry and domestic use.
- Natural seasonal variation.

Other measurements to make

As part of the monitoring process, groups observe anything unusual at their site, the state of the water, and the presence or absence of frogs.

Groups are encouraged to carry out a macro invertebrate sample at the time of water testing.

The presence of frogs and a good range of waterbugs would indicate good waterway health.

By keeping an eye out for anything unusual you may be able to help stop a pollution problem.

Water testing instructions for the tests described in this topic can be found at:
http:\\www.waterwatchadelaide.net.au

Lesson ideas

- Become a Waterwatch school and begin monitoring your local creek. Kits are available for loan from Waterwatch Adelaide - see the website at www.waterwatchadelaide.net.au for more details.

- Identify water quality problems in your area and ask students to develop action plans to help solve these water quality problems. Students may set up a display at a local shopping centre, carry out a gutter guardians gutter sweep, or develop posters to put up around the school.

- Complete the *Red Cabbage pH test* activity included with this topic.

- Measure salinity of different substances found around school and the home. Consider which substances could potentially pollute waterways with unwanted extra salt.

- Create an algal bloom experiment. Students work in groups and collect water from the local creek in 5 soft drink bottles. Add a different substance to each bottle (and keep one bottle with plain creek water). Choose substances that are likely to contain nutrients (fertiliser, detergent and soil) and observe what happens when the bottles are left on a sunny window sill. Students can monitor results over several weeks and then draw conclusions about which substances are most likely to cause algal blooms.

- Turbidity challenge: Calculate the temperature of water in bottles that have different turbidity. This is to demonstrate to students the fact that turbid waters

can warm up and cause problems for the animals and plants living within. Ask students to develop a creative story or roleplay about what happens to the plants and animals of the local creek as soil washes into the creek making it more turbid.

- Participate in a Waterwatch Adelaide Testing Times session. This will provide your class with the hands on experience to conduct their own water quality monitoring at school.

Recommended resources

http://www.waterwatchadelaide.net.au

For instructions to carry out water quality monitoring tests.

Http://www.waterwatch.org.au/publications/

On the national Waterwatch website you will find the national training manual for water quality monitoring. Module 4 provides detailed technical information about water quality testing.

Red Cabbage pH Test

Aim

To measure the pH of common household substances.

Time

40 minutes

Safety

Adult supervision is necessary. Many household products contain dangerous chemicals. Ask your teacher to help you select appropriate products. Test substances from their original containers, and read all safety precautions on the labels before beginning the experiment.

Materials

- one head of red cabbage
- spoons or plastic stirrers
- one electric blender
- three samples each from four different groups of household substances: foods, cosmetics and hygiene products, cleaning products and medicines (The samples must be liquid or soluble in water.)
- eyedropper or straw
- one large wire strainer
- one small bowl
- plastic cups

Procedure

Preparing the indicator

Acid/alkaline indicators are substances that show the presence of different pH values by changing colour. Some plants contain pigments that do this.

You can use red cabbage to prepare an effective acid/alkaline indicator.

1. Tear three or four red cabbage leaves into pieces and put them in the blender.

2. Add approximately 1 cup (250 mL) water.

3. Blend until the cabbage is well chopped and the juice mixes with water.

4. Pour the mixture through the wire strainer into the bowl, removing cabbage pieces.

Testing pH

1. Select at least three items from each group (foods, beauty and hygiene products, medicines, and cleaning products) to test.

2. Place a small amount of one of the substances in a plastic glass. If the substance is not liquid, dissolve it in a little water.

3. Using the medicine dropper or a straw, with your finger over the end, add two or three squirts of cabbage juice to the substance to be tested. Note the color, and write the name of the substance in the correctcolumn on the results table.

4. Continue until all substances have been tested and listed in the results table.

Results Table 1: pH of household items

5. On a separate sheet of paper, group the products you tested in their function categories, and next to their names, write the color and pH range your test showed for each product.

6. Look for patterns among the substances

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Acid		Neutral	Alkaline	
Pink (pH 2–3)	Lavender (pH 4–5)	Blue/purple (pH 7)	Yellow (pH 8–9)	Green (pH 10–11)

you tested. What colors were produced when the foods were tested? The beauty and personal hygiene products? The medicines? The cleaning products?

7. Make a statement about the usual pH of each type of substance and whether it tends to be acidic, alkaline, or neutral, or if there seem to be several different pH values in a single category.

What's going on?

In general, foods will be slightly to moderately acidic (lavender or pink) and cosmetics will be close to neutral or slightly acidic (blue or lavender). The pH of medicines will depend on the use or type: acidic for aspirin, slightly basic for antacids, etc. Cleaning products are usually very acidic or very alkaline, depending on their use.

Connections

The substances we encounter in everyday life are usually categorized according to their functions, for example, substances good to eat, that have medicinal value, that are cleaning agents, or that are used as cosmetics or for personal hygiene. The way we use a substance is partly determined by its chemical makeup, one aspect of which is its pH value. The pH scale is used by scientists to describe whether a substance is acidic (pH 0-6), neutral (pH 7), or alkaline (pH 8-14). In this experiment, you tested the pH of different kinds of household products to see whether there seems to be a relationship between the pH value of a substance and its common uses.

Table adapted from
http://www.fofweb.com/Onfiles/SEOF/Science_Experiments/5-35.pdf

23. Water conservation in the home and school

Concepts

- The first step in saving water is identifying the amount of water used.
- Water auditing for school and at home
- Tips for identifying leaks in your water system
- Water saving ideas for the home and school

Introduction

Water is a valuable and precious resource. A lot of water is wasted because so many people give so little thought about where water comes from and where it goes after being used. Less than 1% of the world's fresh water is available for human use.

When you consider that South Australia's water treatment plants receive more than 90 billion litres of water each year you can see that much of our precious resource is quite literally going down the drain!

Details of water saving tips are given in a wide range of internet resources including the AMLR NRM Board - website **http://www.amlr**nrm**.sa.gov.au** and the SA Water website **http://www.sawater.com.au**

The aim of this topic is to outline how you can take action to reduce water use in your area.

A water audit: the first step to save our water

Many of us waste water without realising it. We might stay in the shower a little longer than necessary, forget about the sprinkler on the garden or brush our teeth with the tap running. To find out where you are wasting water it is a good idea to complete a water audit. A water audit involves working out how much water you use on an average day. After completing the audit you are then able to work out where water savings can be made.

Included in this topic are some water use audits. They are simple to use and will give you an idea of how much water you are using for many household tasks. Once you have the results from your water audit it is time to take action. Identify those areas around the home where water savings can be made, identify methods to save water, set some personal goals for reducing your water use and take action. For example, if your showers are longer than 5 minutes, use an egg timer to remind you when the 5 minutes is up.

Identifying leaks in your water system

On average 2% of the water used in a house is lost through leaking pipes and taps. Follow the leak check activities included in *Catchment Connections - Folder 4, Topic 12,* to check for leaks at home and at school. Once identified, leaks should be repaired right away.

Saving water at home and school

There are many ways to save water at home. Front loading washing machines and water saver shower heads are just a few of the many water saving devices that can help you save water. Further water savings can be made by changing a few of your habits, for example you can turn off the tap while you brush your teeth or wash your hands. Even simple changes like this can lead to considerable water savings over a year.

Gardens are the biggest users of water for most households, and provide the best opportunity for water savings. Consider taking steps to make your garden more water friendly such as planting drought tolerant plants and using mulch. Refer to *Catchment Connections, Folder 4 Topic 13* on water wise gardens to find out more. Further water saving strategies for your home can be found in the 'waterwise in the home' fact sheet included in this topic.

Some specific tips for saving water at school are:

- Consider using waterless urinals in the boys' toilet.
- Involve students in conducting regular leak checks of all the schools water fixtures and fix leaks as soon as they are identified.
- Consider installing a rain water tank at the school to use on the schools gardens.
- Grow as many local native plants around the school as possible, as once established they do not require watering.
- Contact the Plumbing Industry Association of Australia on (08) 8292 4000. They can put you in touch with your nearest waterwise plumber who can visit your school and suggest changes that can be made to save money on the water bill.

Water conservation and the law

The South Australian Government and SA Water have introduced permanent water conservation measures to encourage all SA water users to save water. Refer to the SA Water Website for up-to-date information: www.sawater.com.au

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Lesson Ideas

- *Water Use Survey*. This worksheet for lower primary requires students to survey water use in their home and to ask friends the ways that they use water at home. Topic 14

- *Water Use in the Home*. An activity for students from middle to upper primary to investigate the amount of water used at home. Topic 14

- *How Much Water Do We Use at Home?* A series of four waterwise worksheets that direct students through a survey of the amount of water that they use at home over a day, weekend and an entire week. Catchment Connections Folder 3, Topic 5

- *Leak Check*. This set of four waterwise worksheets directs students to survey water using appliances at home and school to detect leaks. Catchment Connections Folder 3, Topic 5

Recommended resources

http://www.environment.sa.gov.au/reporting/education/pdfs/fact_sheets/06_water_use.pdf

Up to date information about water use in South Australia.

http://www.sawater.com.au/sawater/education/teacherstudentresources/

-A unit of work on water use in South Australia. Information and lesson ideas. No blackline masters.

http://www.savethemurray.com.au/get_involved_top_five_ways_to_save_water.php

Information on household water use and tips for saving water.

http://www.murrayusers.sa.gov.au
School Water Audit Kit, River Murray Urban Users Committee.

A copy of this waterwise resource folder should be in each school in Onkaparinga catchment. Please visit www.waterwatchadelaide.net.au for the folders in .pdf format.

Fact sheet

Being waterwise in your home

All year round we use a lot of water inside our homes. About half of the water used by households is used up inside the home. If we all reduced our usage, even by a small amount, a lot of water could be saved.

Simple measures like installing a water efficient appliance or plumbing fitting enable us to save water whenever they are being used. Look for the 'AAA' ratings applied by Standards Australia to many water-using appliances and plumbing fittings.

In addition, we can save water by changing our habits, like taking shorter showers. Water conservation in the home is an important way to protect our precious resource.

Here are 10 practical ways to save water in your home without affecting your lifestyle.

Toilet

1. Too many flushes
The toilet is a big user of water in the home, with anything from 3 to 11 litres needed for every half or full flush. It is surprising how many people use the toilet to flush away cigarette butts, tissues and other rubbish. Apart from the potential to cause problems in the sewerage or septic system, this practice wastes large volumes of water.

2. The unseen leak
A leaking toilet cistern can be extremely wasteful - up to 16,000 litres of water in a year, and you might not even be aware of it! To check your cistern, place a few drops of food colouring in the tank. Without flushing it, look for colouring in the toilet bowl. If it's getting through, you've got a leak, and it's time to call a plumber.

Shower

3. Keep it short
Long, hot showers waste water and power. So keep your showers short. Conventional showers typically use around 25 litres of water per minute. A minute or two less showering time adds up to a lot of water over a year.

Bath

4. Relaxing soak
For a long, relaxing soak, a bath will use less water than a long shower.

Dishwasher

5. Run it full
Dishwashers can be thirsty items.

Even a dishwasher with a low water use rating can use the equivalent of two sinks of water per wash. Older models can use as much as 50 litres of water. The way to save water is to operate your dishwasher only when it is full. This way you will also save on your power bills.

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Washing Machine

6. Save those suds
Washing machines are major users of water in the home.

As with dishwashers, try not to operate them with small loads. If you are buying a new machine look for Standards Australia ratings which indicate good water efficiency: the more 'A's the better.

Consider buying a front loading machine. They generally use less water than top loaders.

Use the suds saver option if you have several loads to put through.

Taps

7. Stop leaks
Check for worn tap washers. A dripping tap might not appear to be wasting much water, but it quickly adds up.

Repair leaking pipes. A single leak over a long period can waste thousands of litres.

Don't let water run while carrying out tasks such as rinsing dishes, washing fruit and vegetables or washing your hands. A tap running strongly can use 15 litres or more per minute. People who regularly keep the tap running while cleaning their teeth may use about 11,000 litres per year in the process. You could save this water by using a glass to rinse out your mouth. When shaving use the plug and run some water into the basin instead of leaving the tap running.

8. Catch the cold water
Water is wasted each time cold water is flushed from a hot water pipe. Keep containers near the sink and shower, and use this excess on the garden or indoor plants.

General Maintenance

9. Hidden leaks
Undetected leaks can be extremely wasteful and costly. A way to check for leaks is to read the water meter late at night and early the next morning to see if water was running while everyone was asleep.

10. Reduce the pressure
High water pressure increases flow rates and drips. If you have extreme high water pressure, a registered plumber can fit a pressure reduction valve at your property boundary.

Reducing your water pressure will also reduce water hammer which is a banging noise that can occur when you turn a tap off.

Remember to get professional advice from a Waterwise plumber (contact the Plumbing Industry Association of Australia for details on 08 8292 4000 for details).

This fact sheet was adapted from**:**
http://www.ourwaterfuture.com.au

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Best of Catchment Connections

Catchment Connections – Links to the SACSA Framework

Note: the entire suite of Catchment Connections is available online at www.waterwatchadelaide.net.au

Key Learning Theme:
Folder 1: Understanding Catchments

Topics	Waterwatch/ Catchment Care Activity	Description	Discussion topics and information provided	Lesson Ideas provided	Resources: Worksheets, ID charts or similar provided	Education Officer required	Band	Society & Environment	Science	Other
What is a catchment?	**1. What is a catchment?**	Explains the concept of a catchment and relates it to our everyday life systems.	y	y	y	n	E P M	Place, space & environment	Life systems Earth & space	Arts: Arts practice
	2. The Onkaparinga catchment	Provides specific information about the Onkaparinga catchment. Map included.	y	y	y	n	E P M	Place, space & environment	Life systems Earth & space	Arts: Arts practice
	3. How land uses affect the catchment	Describes impacts of land uses on the health of the catchment.	y	y	y	n	E P M	Place, space & environment	Life systems Earth & space	

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	4. Catchment Care	Provides a range of strategies to improve the health of the catchment	y	y	y	n	E P M	Place, space & environment	Life systems Earth & space	
	5. Catchment Capers	Classroom: Students learn about: what is a catchment, the impact of rural and urban land uses on water quality and students look at solutions to pollution problems.	y	y	y	n	E P M	Time, continuity & change Place, space & environment Social systems	Life systems	
	6. Danny the Drip	Classroom: students are actively involved in learning about the effects of pollution on waterway health through participating in the story of Danny the Drip as he makes his way from the Hills to the Sea.	y	y	y	n	E P M	Place, space & environment	Life systems	
	7. Catchment Crawl	Field: the tour enables students to experience a variety of habitats including Mt Bold Reservoir, Clarendon weir, Port Noarlunga Wetlands and the mouth of the Onkaparinga river. Students participate in activities at each stop.	y	y	y	n	P M	Place, space and environment Time, continuity & change	Earth & space Life systems	
The Water Cycle	**8. There is a finite amount of water on earth**	Facts provided about water on planet Earth.	y	y	n	y	E P M	Place, space & environment	Earth & space	

	9. Three states of water: liquid, solid, gas	Details about how water changes between the 3 states	y	y	y	n	E P M	Place, space & environment	Earth & space	
	10. Water is essential for survival	Explains the use of water by humans and other living things	y	y	n	n	E P M	Place, space & environment	Earth & space Life systems	
	11. Where does our water comes from?	Provides information on the source of Adelaide's drinking water	y	y	n	n	E P M	Place, space & environment	Earth & space Life systems	
	12. Where does our water go?	Information about wastewater in and around the home and its effects on the environment	y	y	n	n	E P M	Place, space & environment	Earth & space Life systems	
What is Biodiversity?	**13. Introducing biodiversity**	Outdoor or indoor activity: Defining biodiversity and gauging learner's awareness of local biodiversity and why it is important.	y	y	n	n	E P M	Place, space & environment	Life systems Earth and space	
	14. Biodiversity of your local catchment	Outdoor activity: Interpretive walk at your local natural area or school grounds where students are introduced to the variety of organisms in their immediate environment.	y	y	n	n	E P M	Place, space & environment; Time, continuity and change; Social Systems	Life systems Earth and space	Health and PE: Physical activity and participation

	15. Biodiversity is the basis of all life systems: What do we need for survival?	Outdoor or indoor activity: Investigating biodiversity and ecosystem services which relate to our own survival through provision of basic requirements such as oxygen, food and water.	y	y	n	n	P M	Place, space & environment	Life systems Earth and space	Health and PE: Personal and social development
Healthy catchments and unhealthy catchments	**16. The effect of land use on stormwater**	Classroom activity which explores the effect that increased urbanisation has on the capacity of the landscape to absorb rainfall runoff.	y	y	y	n	P M	Place, space & environment; Time, continuity and change; Social Systems	Life systems Earth and space	

Catchment Connections – Links to the SACSA Framework

Note: the entire suite of Catchment Connections is available online at www.waterwatchadelaide.net.au

Key Learning Theme:
Folder 2: Understanding Ecosystems

Topics	Waterwatch/ Catchment Care Activity	Description	Discussion topics and information provided	Lesson Ideas provided	Resources: Worksheets, id charts or similar provided	Education Officer required	Band	Society & Environment	Science	Other
What is an ecosystem?	**1. Habitats, Ecosystems and Biodiversity**	Practical classroom exercise: Students prepare an information card about an animal in their local area and consider its role in the ecosystem.	y	y	y	n	P M S	Place, space & environment; Time, continuity and change	Life systems Earth and space	Arts: Arts practice

	2. What do you need to survive?	Classroom activity: Learners consider the specific life systems and resources needed to survive within an isolated biosphere for one year.	y	y	n	n	P M	Place, space & environment	Life systems Energy systems Earth and space	Health and PE: Personal and social development
	3. What do other animals need to survive?	Outdoor or indoor classroom activity: Students consider what the requirements of other species occurring in their local area may be and compare this to their own requirements.	y	y	y	n	E P M S	Place, space & environment	Life systems Earth and space	Health and PE: Personal and social development
	4. Construct a food chain	Practical classroom exercise: Learners see how loss of biodiversity affects ecosystem function, using the example of a food web.	y	y	n	n	P	Place, space & environment; Time, continuity and change	Life systems Earth and space	
Native Vegetation	**5. Vegetation associations**	Outdoor or indoor classroom activity: Introduction to the concept of a plant community and students identify which (pre-European) plant community they are living in/schooling in.	y	y	y	n	E M	Time, continuity and change; Place, space & environment	Life systems Earth and space Matter	

	6. Introduction to Botany	Outdoor or indoor classroom activity: Discussion as to how plants are named and how names can help to tell us about the properties of a plant	y	y	n	n	P M S	Place, space & environment; Time, continuity and change	Life Systems	English: Language, Arts: Arts Practice
	7. Monocot or Dicot?	Practical classroom activity where students learn basic botanical skills of identifying monocots and dicots.	y	y	y	n	M P	Place, space & environment; Time, continuity and change	Life systems Matter	Arts: Arts practice
	8. Local indigenous plant Identification	Practical classroom exercise or outdoor activity where students learn how to identify individual species within Australia's largest genus, Eucalyptus.	y	y	y	n	P M S	Place, space & environment	Life systems	
	9. Buds flowers and fruit for insects fur and feathers.	Outdoor monitoring activity whereby students look closely at different plants and record the presence of buds, flowers or fruit and hence determine which resources are available to local animals. This activity is best commenced in Spring when most plants are flowering.	y	y	y	n	P M S	Place, space & environment; Time, continuity and change; Social Systems	Earth and space Life systems	Mathematics: Pattern and algebraic reasoning; Exploring, analysing and modeling data

	10. Accolades to Acacias	Outdoor or indoor classroom activity: Students discover why wattles are so important in Australian ecosystems and are introduced to their local wattle species. (Best performed June to October when Wattles are flowering)	y	y	y	n	P M	Place, space & environment; Time, continuity and change; Societies and Cultures	Life systems Earth and space Matter	English: Texts and contexts
	11. The Seeds of Life	Classroom activity: Experiment to test the viability of an indigenous seed collection and discuss influencing factors.	y	y	n	n	P M S	Place, space & environment	Life Systems Earth and space Matter	Mathematics: Exploring, Analysing and modeling data
	12. Seed Structure relates to function	Practical classroom exercise whereby students investigate how seeds move through the environment.	y	y	y	n	P M	Place, space & environment	Life systems Earth and space Matter	Design and Technology: Critiquing; Designing
Wildlife / Bioindicators	**13. Introduction to aquatic macroinvertebrates**	Classroom: students are actively engaged in learning about: the aquatic macro invertebrates living in their local waterway, their requirements for survival and what they tell us about water quality and habitat.	y	n	y	y	E P M	Place, space and environment,	Life systems	Education: personal & social development

	14. Scrape, jiggle and sweep	Outdoor activity whereby student go to their local creek and sing best-practice techniques, sample for and observe macroinvertebrates.	y	y	y	n	EPM	Place, space and environment,	Life systems	Health & Physical Education: personal & social development
	15. Introduction to frogs	Classroom: this session engages students in learning local frog species through key characteristics and their call. Threats, the importance of habitat, and frogs as bioindicators of healthy waterways is discussed.	y	y	y	y	E P M	Place, space and environment	Life systems	Health & Physical Education: personal & social development
	16. Introduction to Birds	Indoor or outdoor activity: Introduction to ornithology and how birds are named. The class's baseline knowledge is ascertained. Learners describe the different parts of a bird and have an opportunity to 'invent' a bird name based on the colours they give the bird.	y	y	y	n	E P M S	Place, space & environment	Life Systems	English: Language Arts: Arts Practice

	17. Field Guides are friendly	Outdoor or indoor classroom activity: How to use field guides like the professionals	y	y	y	n	P M S	Place, space & environment	Life systems	English: Strategies
	18. Bird identification: more than just pretty feathers	Outdoor activity whereby students learn bird watching techniques and the true function of colours on a bird	y	y	y	n	PMS	Place, space & environment	Life systems	English: Strategies Health & Physical Education: personal & social development
	19. Birds as Biological Indicators	Outdoor or indoor classroom activity: Exploring interactions between birds and plants and what the presence of certain birds can tell us about our local environment.	y	y	n	n	P M	Place, space & environment	Life systems Earth and Space	

	20. Bird Cards	Outdoor or indoor classroom activity: Fun quiz games designed to increase learner's knowledge of their local bird species	y	y	y	n	E M P	Place, space & environment; Time, continuity and change	Life systems Earth and space	
	21. Funky Fish	Classroom: This session engages students in an exploration of the native and introduced fish species of the catchment and the importance of habitat for their survival.	y	n	y	y	P M	Place, space and environment	Life systems	Health & Physical Education: personal & social development
	Woorabinda Wonders	Woorabinda (indoor/outdoor): focusing on 'what lives in a catchment' students are engaged in a variety of activities to gain an awareness and understanding of the flora & fauna of the Onkaparinga catchment	n	n	y	y	P M	Place, space & environment Time, continuity and change	Life systems Earth & space	
Inland Freshwater Ecosystems	**22. Introduction to wetlands?**	: A wetland visit where students learn about the role of wetlands and its local inhabitants.	y	y	y	n	P M S	Place, space & environment	Life systems Earth & Space	Health & Physical Education: personal & social development

Estuarine/Coastal/Marine	**23. The Onkaparinga River Estuary**	Learn about the third largest estuary in South Australia; the Onkaparinga river estuary.	y	y	y	n	PMS	Place, space & environment	Life systems Earth & Space	Health & Physical Education: personal & social development
Groundwater	**24. Introduction to groundwater**	An introduction to the mysterious ways of groundwater, definitions of terms and issues for management	y	y	n	n	PMS	Place, space & environment	Life systems Earth & Space	Health & Physical Education: personal & social development

Catchment Connections – Links to the SACSA Framework

Note: the entire suite of Catchment Connections is available online at www.waterwatchadelaide.net.au

Key Learning Theme:
Folder 3: Human Impacts

Topics	Waterwatch/ Catchment Care Activity	Description	Discussion topics and information provided	Lesson Ideas provided	Resources: Worksheets, id charts or similar provided	Education Officer required	Band	Society & Environment	Science	Other
Changed Land Use	**1. Vegetation clearance in the Onkaparinga Catchment**	Overview of the historical and current impacts of local vegetation clearance. This chapter explores the methods of past and present clearance practices as well as the reasons behind it. Two activities accompanying this chapter look at development in the rural and suburban settings which require some land clearance. Students consider the impacts of development on native vegetation.	y	y	y	n	P M S	Place, space & environment; Time, continuity and change; Social Systems; Societies and Cultures	Life Systems; Earth and Space; Matter	Mathematics English

	2. Farming and urbanisation	A historical look at local farming practices and some of the resulting environmental impacts. The growth of towns and cities and the different types of environmental impacts associated with this growth are outlined. The lesson ideas with this chapter suggest a historical timeline whereby local development events are plotted and environmental impacts of these events are documented. Students are encouraged to think of sustainable options for development. A checklist of everyday actions, impacts and alternatives is provided. A teacher cheat-sheet is provided for both of these activities.	y	y	y	n	P M S	Place, space & environment; Time, continuity and change; Social Systems; Societies and Cultures	Life Systems; Earth and Space; Matter	English
	3. A system of Parks, Reserves and open space	Definitions, history and importance of reserves owned by the State, Commonwealth, Local Government and other organisations. The benefits and shortcomings of our current reserve system is outlined as are the threats to Reserves. Activities accompanying this chapter allow students to determine the appropriateness of certain human activities in reserves. An opportunity to design the ultimate system of reserves for the Onkaparinga catchment is also provided.	y	y	y	n	P M S	Place, space & environment; Time, continuity and change; Social Systems; Societies and Cultures	Life Systems; Earth and Space; Matter	Mathematics English