Wetlands education toolkit

A field study and classroom teaching guide for Middle years–

National Curriculum Science and Geography.

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Wetlands Program

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We value your feedback on this product to update and expand on key aspects. Please send your feedback to wetlands@ehp.qld.gov.au

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Contents

Overview

About this teaching resource

The Wetlands Education Toolkit (WET) is a resource for teachers providing a collection of ideas to support effective teaching about wetlands. It is aligned to both the Australian Curriculum: Science, and the Australian Curriculum: Geography. It has a particular emphasis on the middle years of schooling (Years 6 to 9). However, it has been designed to be adaptable by teachers for flexible use across most Primary and Secondary year levels.

The science program offers a structured 5Es (Engage—Explore—Explain—Elaborate—Evaluate) approach to teaching with choices and flexibility being a fundamental aspect of each phase. Teachers are encouraged to devise a teaching plan from this toolkit of ideas that is appropriate for their students. They could also draw on other teaching resources such as those published by the Great Barrier Reef Marine Park Authority's Reef Guardian Schools program, which can be found at http://www.reefed.edu.au/home/guardians.

The geography section of the Toolkit provides a range of teaching ideas and resources for Years 6 to 9, aligned to the Australian Curriculum: Geography. There is a particular focus on Years 7 and 8 to address the relevant content descriptions in these years.

The geography framework substantially follows that of a geographical inquiry using broad-based Key questions. Activities, often appropriate to multiple year levels, are then presented under their relevant geographical inquiry question for teachers to select as appropriate. Teachers are encouraged to plan their units of work such that they meet the requirements of the Australian Curriculum: Geography and their internal school needs, while incorporating wetlands information, activities and case studies.

The focus of this toolkit is coastal freshwater and marine wetlands, rather than inland wetlands. The key messages conveyed throughout this resource have been derived from the Queensland Wetlands Program:

1. Wetlands are affected by our actions.
2. They remain wetlands even during dry periods.
3. There are lots of types of wetlands, many of which are in Queensland, and we have contributed to their modification and loss in many places.
4. They are of great value and provide important ecosystem services—they are hotspots for biodiversity; connect landscapes and keep waterways healthy; provide places for recreation; have spiritual and cultural importance to Aboriginal and Torres Strait Islander and non-Indigenous people; protect people and properties from floods, rising sea levels and storm surges; store carbon and regulate greenhouse gas emissions; and act as filter for pollutant, nutrients and sediments.

Background of the program

In 2007, *Our Wetlands: a field-based research unit*, was developed by Townsville Central State School with the Great Barrier Reef Marine Park Authority (GBRMPA) in cooperation with the Queensland Wetlands Program (the Program). The Queensland Wetlands Program funded the 10 week field-based wetland teaching unit preparation, development and implementation. The Program was established by the Australian and Queensland Governments to support activities that would result in the sustainable use, management, conservation and protection of wetlands. The Program provided one-off grants to nine schools in the Great Barrier Reef catchment and in South East Queensland to pilot the wetlands teaching unit and encourage adoption in 2009–10. The wetlands teaching unit was successfully implemented in these pilot schools exposing hundreds of students from Preschool through to Year 9 to learning experiences with Queensland's wetlands.

The success of the wetlands teaching unit is highlighted through its nomination for two awards as part of GBRMPA's Reef Guardian Schools Program. It generated interest from Education Queensland and Queensland Studies Authority for incorporation into the national curriculum. The outcomes from developing and implementing the wetlands unit were presented at the National Landcare Conference 2007 (Mackay), the International Youth Coastal Conference 2008 (Townsville) and showcased as part of the Values Education Good Practice Schools Project.

Australian Curriculum: Science

The Wetlands Education Toolkit (WET) combines content from the three interwoven strands of the science curriculum: Science Understandings, Science Inquiry Skills and Science as a Human Endeavour. Teachers can choose activities from each of the 5Es phases to suit their students and the year level/s they are teaching. The relevant Achievement Standards and content descriptions for Year 6, 7, 8 and 9 (www.australiancurriculum.edu.au/Science/Curriculum/F-10) and the Science Inquiry Skills checklists (see Appendix C) can be used to develop assessment criteria. Assessment criteria and suitable activities from the Wetlands Education Toolkit can support teachers to create a successful teaching and learning plan about wetlands.

It is important for teachers to note that the Australian Curriculum: Science states that…

> *Teachers use the Australian Curriculum content and achievement standards first to identify current levels of learning and achievement and then to select the most appropriate content (possibly from across several year levels) to teach individual students and/or groups of students. This takes into account that in each class there may be students with a range of prior achievement (below, at and above the year level expectations) and that teachers plan to build on current learning.*
> Implications for teaching, assessment and reporting [Retrieved on 2/5/13 from http://www.australiancurriculum.edu.au/Science/Implications-for-teaching-assessment-and-reporting]

This allows teachers of standard year levels and multi-age classes the freedom to design units of work about local contexts and to build on students' prior knowledge without feeling pressure to 'tick boxes' next to curriculum for specified year levels. It also allows for differentiation of tasks for students working above or below the expected level.

The curriculum from Year 6 to Year 9 develops science inquiry skills and the following concepts in relation to wetlands:

Year 6—living things and their physical environment; extreme weather conditions; scientific contribution by people from a range of cultures

Year 7—classification; food webs; mixtures and separation techniques; the water cycle; resource management; science careers

Year 8—cell structure and function; energy transfer in a simple system; resource management; science careers

Year 9—biological systems; ecosystems; the effect of emerging sciences and technologies.

Each of these main concepts is explored in the Wetlands Education Toolkit through a range of activities. The choices most relevant to each year level are mapped below (see Tables A, B & C).

Table A. What is a wetland?

	Year 6	Year 7	Year 8	Year 9
ENGAGE	Concept attainment strategy; Picture sort; Secret Envelopes	Concept attainment strategy; Picture sort; Secret Envelopes	Concept attainment strategy; Picture sort; Secret Envelopes	Concept attainment strategy; Picture sort; Secret Envelopes
EXPLORE	Field study: animals, vegetation	Field study: vegetation, water, soil	Field study: vegetation, water, soil, animals (micro-invertebrates)	Field study: vegetation, water, soil
EXPLAIN	Concept maps; terminology; concepts to explain	Concept maps; terminology; concepts to explain	Concept maps; terminology; concepts to explain	Concept maps; terminology; concepts to explain

Table B. What living things live in coastal, freshwater and marine wetlands?

	Year 6	Year 7	Year 8	Year 9
ENGAGE	Hot Potato	Flow chart	Postbox technique	Postbox technique
EXPLORE	Classification	Web of life	Vegetation	Adaptation
EXPLAIN	Concept maps; terminology; concepts to explain	Concept maps; terminology; concepts to explain	Concept maps; terminology; concepts to explain	Concept maps; terminology; concepts to explain

		Guest speaker	Wetlands news	

Table C. What is the role of wetlands? How do we impact on wetlands?

	Year 6	Year 7	Year 8	Year 9
ENGAGE	The Story of a River	The Story of a River	The Story of a River	The Story of a River
		True/False	True/False	
EXPLORE	flooding	Water cycle	cells	purification
	cultural	careers		
	ICTs	ICTs	ICTs	ICTs
EXPLAIN	Ramsar sites; sustainability; literacy; ICT	Ramsar sites; sustainability; literacy; ICT	Ramsar sites; sustainability; literacy; ICT	Ramsar sites; sustainability; literacy; ICT
ELABORATE	Field trip	Water cycle investigation: filtration	fertiliser	photographs
EVALUATE	Reflection; Sustainability	Reflection; Sustainability	Reflection; Sustainability	Reflection; Sustainability
		Resource Management	Resource Management	

Australian Curriculum: Geography

The geography resources in the Wetlands Education Toolkit (WET) are structured around a geographical inquiry and combine geographical knowledge and understandings with geographical skills according to the two strands of the Australian Curriculum: Geography; Geographical Knowledge and Understanding and Geographical Skills and Inquiry. The connection to wetlands is more comprehensive in Years 7 and 8.

In developing the Australian Curriculum: Geography, the Australian Curriculum and Assessment and Reporting Authority (ACARA) have identified geospatial technologies and fieldwork as areas of significance in geographical education. Care should be taken to usefully integrate geospatial technologies where appropriate and this can be done using a range of resources such as Google Earth or other simple online visualisation tools. Fieldwork should also be incorporated if time and resources permit as it is an essential component of geographical education and only enhances learning about wetlands. Advice has been given in the relevant year levels about fieldwork for geography.

The curriculum from Years 6 to 9 potentially incorporates wetlands in the following ways:

Year 6—the focus is on global connections as students examine the diversity of countries around the world and, in particular, the Asian region. Global connections around wetlands management, in particular the Ramsar Convention, can be examined, compared and contrasted.

Year 7—the 'Water in the World' unit focuses on our use, perception and value and movement of water in our world. There are ample opportunities to examine all aspects of wetlands in this unit.

Year 8—'Landforms and landscapes' focuses on the geomorphology of the world around us. The processes that shape our world are examined as well as our use and management of our landscapes.

Year 9—There are some opportunities to examine wetlands in Year 9. In Geographies of interconnections global treaties such as Ramsar could be considered. While in Biomes and food security, Aboriginal and Torres Strait Islander uses and management of wetlands could be explored.

There are many opportunities for primary teachers to incorporate variations on all of the activities presented in this toolkit in their classrooms, in particular in Foundation, Years 1, 4 and 5.
See www.australiancurriculum.edu.au/Geography/Curriculum/F-10 for specific Geographical Knowledge and Understanding content descriptions from the Australian Curriculum: Geography that provide opportunities for the integration of wetland education. Content descriptions for Geographical Inquiry Skills are provided in Appendix D Geography Inquiry Skills checklist.

For Foundation and Year 1, the focus is on the importance and value of places to students. In introducing wetlands to these students, teachers should focus more on how students feel about wetlands than how wetlands form and operate. It would be highly beneficial to undertake fieldwork to a local wetland environment. To use the 'Wetlands slideshow' activity with students in Foundation or Year 1 the teacher would only need to select more obvious images of wetlands, preferably including images from the local area that may be familiar to students. The 'Story of a river' activity's narrative text can easily be simplified to suit students in these year levels while still allowing them to visualise inputs into catchments as they dump materials into the 'waterway'. The teacher should always bring the focus of any activity back to the individual student's perception and value of the wetland environment by asking students to articulate how they feel about the way wetlands are used and managed.

In Years 4 and 5 the focus is more on the characteristics of different environments and how people rely on them for different uses. Here, more time will be spent learning how wetlands form, how they function, their flora and fauna and the language of wetlands. For example, in the 'Impacts on wetlands' activity, students are given a range of groups that value and use wetlands in some way. To alter this activity for use with students in Years 4 and 5 teachers should simply alter the group titles to simplify students' thinking; the groups could become:

- farmers
- residents
- builders/developers
- loggers/forestry
- conservationists.

Field work is a significant part of the Australian Curriculum: Geography. Wetland education can be more enlightening if undertaken in the field where students can collect data and interact with the environment directly. Where appropriate, organise for your students to study wetlands in the local area.

The GeogSpace website contains a comprehensive fieldwork checklist that can be used as a planning template at: http://www.geogspace.edu.au/verve/_resources/3.4.3_1_fieldwork_checklist.pdf

Teaching framework: Science

Key inquiry question:

How can we sustain our valuable wetlands?

Within this inquiry the following focus questions are explored:

What is a wetland?

- Hydric soil
- Wetland plants and animals
- Ephemeral qualities
- Groundwater
- Diversity of wetlands

What living things can be found in coastal, freshwater and marine wetlands?

- Vegetation adapted to survive in a wetlands ecosystem
- Aquatic macro-invertebrates and other animals that have adapted to survive in a wetlands ecosystem
- How do some species use the freshwater, estuarine and marine environments for different parts of their life cycles?

What role do wetlands have in the environment?

For the environment:

- Water quality
- Hotspots for biodiversity
- Habitats for wildlife
- Carbon storage
- Filtering of nutrients and sediments
- Hydrological connectivity

For people:

- Protection from floods and rising seawater
- Recreation/visual amenity
- Primary production
- Cultural, spiritual and economic value for Aboriginal and Torres Strait Islander and non-indigenous people

What impact can we have on wetlands?

- Wetlands are affected by many of our actions
- Wetlands can be lost and never recovered
- Wetlands can be modified to serve other values
- Personal, community and global actions can lead to sustainable use, conservation and protection of wetlands
- Awareness and engagement can result in better management and protection of wetlands.

Teaching framework: Geography

Topic question:

How can we sustain our valuable wetlands?

Key and focus questions:

What are wetlands and where do they occur?

- How do we define a wetland?
- What are the different types of wetlands?
- Where do wetlands occur and why do they occur where they do?

How do wetlands interact with the biosphere?

- How do wetlands form?
- What flora and fauna exist in wetlands?
- What role do wetlands have in the environment?
- How does water move through wetlands?

What are our impacts on wetlands?

- How do different people/groups use wetlands?
- How does our society perceive and value wetlands?
- What are the environmental impacts of human activity on wetlands?
- What are the social impacts of human activity on wetlands?
- What are the economic impacts of human activity on wetlands?

What should be done to reduce negative impacts on wetlands?

- Who is responsible for managing wetlands in Queensland?
- What other groups are involved in managing wetlands?
- What strategies can be employed to improve wetland functions and values?

- How can we manage wetlands as a society?

The geography activities presented later in the toolkit will be organised using the general key questions above. Activities can be modified to suit the specific questions being asked and the year level of your students. It is envisaged that the general inquiry structure above will be used as a basis for designing your units in Years 7 and 8. See Appendix E for examples of how you might structure a whole unit geographic inquiry for Years 7 and 8.

Teacher background knowledge

What is a wetland?

Wetlands are areas of permanent or periodic/intermittent inundation (ephemeral qualities). This means that the land is regularly water-logged for a short period of time or even permanently. The water is static or flowing, fresh, brackish or salt. It includes areas of marine water of shallow depth (at low tide does not exceed six metres). To be classified as a wetland[1], the area must have one or more of the following attributes:

- at least periodically, the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their life cycle, or
- the substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers, or
- the substratum is not soil and is saturated with water, or covered by water at some time.

Traditionally, people have thought of wetlands as swamps, billabongs and mangrove areas. However, these areas represent only part of the landscape's features defined as wetlands. Other areas included in this definition are:

- rivers and creeks
- estuaries
- artificial wetlands, for example dams
- springs
- lakes, lagoons, billabongs
- swamps
- bays and marine areas
- salt pans/saltmarshes

[1] http://wetlandinfo.ehp.qld.gov.au/wetlands/what-are-wetlands/definitions-classification/wetland-definition.html

- groundwater, aquifers and caves.

What role do wetlands have in the environment?

While wetlands are often under threat and unfairly considered as smelly swamps, they are among Australia's most productive and biologically diverse ecosystems and a valuable resource for recreation, education and science.

By absorbing and slowly releasing floodwater, healthy wetlands filter and clean water and provide a buffer against coastal erosion, storm surges and flooding. Freshwater and marine wetlands filter out excess nutrients and sediment from run-off that would otherwise go into coastal creeks and rivers, and in coastal regions they are a nursery for varieties of fish and crustaceans.
Wetland plants shelter and provide habitat and roosting sites for countless animals and birds and are vital for the survival of many threatened species. Inland wetlands, though sometimes dry, provide an important habitat for wildlife, especially waterbirds. The species that use these areas have unique adaptations to allow them to survive during long dry periods.
Both coastal and freshwater and marine wetlands provide breeding sites for local waterbirds as well as habitat for migratory birds. http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-values/

What living things are found in coastal, freshwater and marine wetlands?

Most plants and animals depend on water for life, so it is not surprising that wetlands are species rich in both plants and animals. However, because of the dynamic nature of wetlands, with periods of drying and inundation varying in frequency and duration over time, not all plants and animals that live in wetlands are present in them all of the time.

Salvinia or Nardoo Photo by Gay Deacon

Some plants, such as Nardoo, may be hidden and lie dormant as seeds or bulbs in the soil waiting for water, while other plants, such as river red gums and mangroves, are more permanent and conspicuous landmarks of a wetland environment.

The use of wetlands by animals is also variable. There are some casual visitors, such as flocks of pigeons that drink at billabong fringes. For many animals wetlands are critical for their existence. Some use the habitat occasionally (e.g. dragonflies and frogs when they lay their eggs), while others use it permanently (e.g. freshwater fish).

Animals considered wetland indicator species are those that exhibit specific adaptations or modifications that make them dependent on wetlands for at least part of their life cycle.

Wetland plants

A plant that has adapted to and is dependent on living in wet conditions for at least part of its life cycle is called a hydrophyte.

http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/flora/

Wetland animals

Wetland ecosystems contain species that have evolved in a wet environment. Adaptations to an aquatic life are often obvious: fins on fish, webbed feet on frogs and ducks, and waterproof feathers or fur on the platypus. Other adaptations are less conspicuous, such as: gills on mayfly larvae and tadpoles (gills disappear as the tadpoles change into adults); salt glands on the tongues of crocodiles that remove excess salt in brackish conditions; and the *cloacal bursa* of the Fitzroy River turtle that enables this turtle to take up oxygen while submerged (hence the colloquial name of 'bum-breather').

The degree that animals are dependent on the wetland environment ranges from those with complete dependence (crayfish and freshwater fish), to those that exist in other habitats but need wetlands for some significant resource. For example, although they are terrestrial, grey and ornamental snakes hunt in wetlands where they feed on frogs.

Some animal species are so reliant on wetlands that evidence of their occurrence—such as with crustacean exoskeletons or crayfish burrows—can confirm the presence of a wetland. http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/fauna/

Soil

Hydric soil is tight and heavy and holds water. Once hydric soils develop they do not convert to other soil types; they remain hydric (Retrieved on 6/4/13 from http://www.bakeru.edu/wetlands/faq). Hydric soil is formed under wet conditions over a long period where anaerobic conditions develop under the surface. These conditions limit the amount of available oxygen necessary for living things to survive because of water saturation filling the available holes in the soil (Retrieved on 6/4/13 from http://en.wikipedia.org/wiki/Hydric_soil). For further information on soils visit http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/soils/

Groundwater

Groundwater is water located in the saturated zone beneath the earth's surface in soil pore spaces and in the fractures of rock formations. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from, and eventually flows to, the surface naturally; natural discharge often occurs at springs and seeps and can form wetlands.

Artesian water is water that occurs in an aquifer, which if tapped by a bore, would flow naturally to the surface. The majority of artesian water in Queensland exists within the Great Artesian Basin. Subartesian water is water that occurs naturally in an aquifer, which if tapped by a bore, would not flow

naturally to the surface [Retrieved on 3/5/13 from http://www.nrm.qld.gov.au/water/declaredareas/regulated-groundwater.html].

Groundwater dependent ecosystems (GDEs) are simply a subset of all ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services[2] View a groundwater visual model online at http://www.youtube.com/watch?v=Szf942jwveM&feature=player_embedded or http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/groundwater-dependent/

Wetland management

Management of wetlands is generally regarded as a state issue in Australia although at any given time there could be a number of political jurisdictions from all levels of politics impacting on any given wetland.

> *One of the challenges in wetland management is the division of responsibilities between different authorities in a catchment. Wetland management requires a multidisciplinary process that integrates the technical, economic, environmental, social and legal aspects of water management on a catchment-wide scale.*
>
> Wetland*Info* website

When considering the impacts of people on wetlands, a simple way to categorise those impacts in geographical studies is to consider the environmental impacts, economic impacts and social/cultural impacts on the wetlands. This is also useful when considering how we should manage these areas.

Monitoring of wetlands is important to wetlands management as it provides benchmarks for assessment and the basis for future management decisions. The Wetland*Info* website contains a large amount of information on assessment methods and wetlands throughout Queensland as well as interactive mapping

[2] Richardson, E, Irvine, E, Froend, R, Book, P, Barber, S & Bonneville, B 2011, *Australian groundwater dependent ecosystems toolbox part 1: assessment framework*, National Water Commission, Canberra.

tools that can also be used to meet the geospatial technology requirements of the Australian Curriculum: Geography.

http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-management/

Teacher background knowledge retrieved from Wetland*Info* on 15/04/2012

Students' alternative conceptions

The Queensland Wetlands Program supports teachers in identifying children's existing ideas and creating experiences for students that challenge their existing ideas and any alternative conceptions they hold to help them develop new understandings.

> **Alternative conceptions** *are the ideas that students develop about phenomena they experience that enable them to make sense of their world. These alternative conceptions are not the same as current scientific theories and, when they are challenged, can help students to revise their explanations and develop new understandings of the phenomena.*

Classification

Biological classification revolves around similarities and differences but students are more likely to group living things based on observed differences (e.g. colour, size, movement) rather than similarities (e.g. presence of a backbone, body covering, life cycle stages). Research studies have shown that high school students sometimes have alternative conceptions of classification, such as classifying a sandpiper as a bird but a penguin as a mammal, fish or amphibian. Younger children often have difficulty with scientific classification, recognising a flower as a plant but not a tree or grass and recognising a cow as an animal but not an insect or a human.

The environment

Students living in urban areas may believe that nothing happens without a human cause. They may think that everything to do with the environment is good and pretty and human influence is all destructive. This may leave them with an attitude of 'why bother' instead of one of empowerment.

Adaptation

Plants and animals adapt to their wetland environment. However, students sometimes think this is a conscious and fast adaptation by individual living things. Rather than saying: 'Birds grow a long beak to live in this wetland', it is better to say that: 'Birds with long pointed beaks will thrive in this habitat'.

Food webs

Food webs can be an abstract idea for students to understand. The arrows they use are often used to represent eating habits rather than the flow of energy and food. Students also often do not represent the sun as the ultimate source of energy in their food webs, providing energy for green plants and in turn food for animals.

High school students (and often adults) recognise photosynthesis as the chemical reaction that transforms sunlight, water and air into sugars and starch for the plant but will still identify water and soil as a plant's food source (through the roots).

The ephemeral nature of wetlands also needs to be explored to show the 'boom and bust' associated with changes in the environment (e.g. floods).

Students' alternative conceptions are from *Teaching Primary Science Constructively* by Keith Skamp (1998) and *Understanding Science Ideas*, Nuffield Primary Science Series (1997).

SCIENCE

ENGAGE

The purpose of this stage of teaching and learning is for the students to share what they know about wetlands and to engage their interest in the topic. It's important to elicit their ideas without teaching them any new ideas or defining terms. This is an opportunity to diagnose any alternative conceptions they might have (see p. 21) so that a plan can be devised to challenge them. Collect and display new terminology as it emerges.

Choose activities to suit your students' needs and abilities and try to use relevant, local examples where possible. Encourage students to ask questions and reflect on their learning through each stage in a journal, on a blog or by another means.

<table>
<tr><td colspan="3">What is a wetland?</td></tr>
<tr><td>Concept attainment strategy</td><td>Picture sort</td><td>Secret envelopes</td></tr>
<tr><td>The teacher places pictures (see below) into two columns, one at a time. One column is an example of the unnamed concept (wetlands) the other is not. Students gradually tell the teacher where to place the next picture based on their developing understanding of what a wetland is. Then they name the concept.</td><td>Students work in groups of three to sort possible pictures of wetlands (see below) into Yes/No groups based on the question: Is it a wetland? Then they justify their choices to another group or the teacher or the whole class.</td><td rowspan="2">Students write a definition of what a wetland is and place it secretly in an envelope with their name on it. At the end of the unit of study they write another using their new understandings, then open their envelope and compare how their ideas have changed.
Adapted from Smart Thinking by Wilson and Wing Jan (2008) Curriculum Corporation.</td></tr>
<tr><td colspan="2"><u>Pictures of wetlands:</u>
Pictures should include images of water that are not wetlands, such as a swimming pool, a tropical fish tank, a goldfish pond and a rain puddle and a variety of genuine wetland such as: swamps, marshes, billabongs, dams, coral reefs, mangroves, bays, rivers and lakes. These can be photographs from the local area and pictures cut from brochures such as Queensland's wonderful wetlands from the Brochures and posters section of EHP's WetlandInfo (http://wetlandinfo.ehp.qld.gov.au/wetlands/resources/publications/brochures-posters.html)</td></tr>
<tr><td colspan="3">What living things are found in coastal, freshwater and marine wetlands?</td></tr>
</table>

Hot Potato	Flow chart	Post-box technique	Wetland animals
Students write or draw a plant or an animal they think would be found in a wetland. On a signal they pass their work to the left and add to the list put in front of them from their right. Display their ideas in the room for review at the end of the unit of work.	Students create a food chain for a wetland animal, showing a predator and its prey. They work in a small group to see if they can make connections between their food chain and other students' food chains (a food web).	Introduce the students to the concept that living things produce energy by telling them the following scenarios and asking the following questions. This is an independent activity. Each student writes/draws an answer, indicates on the slip of paper the question number it refers to and drops it in 3 'post boxes' with corresponding numbers. They must answer, even if it is a guess, but they don't need to identify themselves. (Don't give answers at this point, just accept those given) 1. An adult is the same genetic material as a baby, just a bigger version. Where does the size of an adult come from? How does the adult get big? (*energy from eating food*) 2. A tree is the same genetic material as a sapling, just a bigger version. Where does the tree get its size from? How does the tree get big? (*energy from starch and sugars produced in leaves)* 3. Wetlands plants often live in water. How do you think they get bigger? (*photosynthesis—explained later*) Empty the post boxes separately and have groups of students sort them into similar ideas and share the main ideas with the class. Record these ideas to return to at the end of the unit of study.	Some simple craft activities can be found at http://www.ramsar.org/cda/en/ramsar-activities-wwds-/main/ramsar/1-63-78^26125_4000_0__

What role do wetlands have in the environment?

More true than false	The story of water and Catchment role play
The students work in teams to discuss each statement (see below, or create your own) and decide if it is 'more true than false' or 'more false than true' or 'cannot agree'. Then each pile can be sorted from most to least true. • Wetlands protect us from flooding • Everyone can make a difference in helping the environment, if they try • Only some wetlands should be protected from development • The cost of maintaining wetlands is too high • Wetlands are not found in suburbs, only in the country • Wetlands purify our water • Wetlands are only useful as nice places for people to visit • Technological advances will help us to save wetlands that are in danger • Aboriginal and Torres Strait Islander people only valued wetlands in the past as a source of food and water	Prepare The Story of a River from Lesson 1 at http://www.nrm.qld.gov.au/waterwise/education/units/pdf/y6y7/y7-geography-explaining-our-catchment.pdf If the school has a wetland or is near a wetland the students could develop their own story for their local wetland. Questions 1. How did you feel about the change in the colour and look of the 'river'? 2. How would you feel about drinking or swimming in this water? 3. Why was the water so different in appearance at the end of the story? 4. Do you think this is like the real situation – is this how pollution might occur in our river? 5. List the ways that pollution in a catchment might affect you personally, how might this accumulated pollution affect the coast/beach/ocean, and in turn you? 6. Were any types of water pollution in the activity illegal? If so, why does this pollution still happen? If not, why aren't laws or penalties to protect waterways more effective? 7. What other kinds of measures could be used to prevent or reduce water pollution? 8. Where could this activity be used to raise people's awareness of water pollution?

• Once a wetland is lost it can be replaced • Everything we do with water at home, at school and at work impacts on wetlands Adapted from *Smart Thinking* by Wilson and Wing Jan (2008) Curriculum Corporation.	9. Write your own story about the catchment in which you live, drawing on the different issues in your area. http://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/resources/education/catchment-role-play-08-04-13.pdf

EXPLORE

The purpose of this stage of teaching and learning is for the students to have experiences that help them develop a common understanding of what wetlands are and why we value them. Collect and display new terminology as it emerges.

A field study to a local wetland will provide students with an opportunity to have a real experience of a wetland ecosystem. It is particularly important to do this early in the unit of work for students for whom English is a second language, students from dense urban areas and students who struggle to learn new concepts in an abstract form. Visiting the wetlands as a class gives all of the students a common experience to discuss and analyse and helps with developing new vocabulary.
Field studies need preparation and organisation of equipment, students, helpers, tasks and safety procedures and the development of risk assessments (see Appendix G).

Choose activities to suit your students' needs and abilities and use relevant, local examples where possible. Encourage students to ask questions and to reflect on their learning through each stage in a journal, on a blog or by another means.

What is a wetland?
Pre-field study activities
Demonstrate the field study tests and explain what they are for. Ask students to describe what the results would provide about water quality. (see Appendix F)
Field study activities
SAFETY: Encourage students to organize safety processes and follow them during the field trip. (see Appendix F) **ETHICS:** Encourage students to consider the effects of their actions and those of the community. Sample water and macro-invertebrates should be returned to their origin.

Vegetation	Water quality	Soil	Animals
Distribute clipboards and worksheets. The students work with a friend to record their observations of the wetland, in particular its form, the vegetation and information about the riparian zone (see Appendix H).	Students do the following water quality tests: • Turbidity • Temperature • Salinity • pH • Dissolved oxygen (see Appendix I) If laboratory equipment is not available to take on a field trip then take a large water sample and record the time, date and temperature. Negotiate with another school to do the tests using their equipment or in their laboratory or in partnership with their students. or Use a qualitative instrument to assess the health of the wetland. See resource 1 in http://www.nrm.qld.gov.au/waterwise/education/units/pdf/y6y7/y7-geography-mapping-our-waterway.pdf	Conduct soil tests with samples to ascertain the type of soil at the wetland site. For instructions see http://www.cmg.colostate.edu/gardennotes/214.pdf	Students photograph, list or draw animals they see at the wetlands, where they were spotted and what they were doing. They also keep a tally of how many they spot (up to a predetermined number). • Birds • Insects • Mammals • Amphibians • Fish • Wetlands macro-invertebrates Students work in groups to examine water samples for macro-invertebrates. They can use an identification booklet (see Appendix J). They will need: Nets, buckets, white containers (such as ice-cream containers), field guides, plastic spoons, ice cube trays, insect repellent, covered shoes and a hat and skin protection. They may also find that cue tips and fine paintbrushes are useful for handling very delicate animals.

Classroom activities post-field study

What living things are found in coastal, freshwater and marine wetlands?

Web of life	Classification	Wetlands adaptation	Wetlands vegetation
Create a relationship web using a ball of wool and picture cards or word cards to represent plants and animals found in a wetland. Each student in the circle holds a card and rolls the wool to another student to represent a relationship between the living	Students work in groups of three to sort and classify plants and animals from a wetlands ecosystem using a branching database. Have the students practise using them online first (type 'branching databases' into your search engine), and then jointly construct one before they attempt	Students independently research a wetlands plant or animal that has adapted over time to survive in wetlands conditions. They prepare and present a brief oral presentation of their findings focusing on the physical conditions of the wetlands and the adaptations	Draw a wetlands plant on the board. Around it put 'thinking clouds' with statements like those below. Students choose those they feel closely align with their own views and write a brief statement with an illustration for review at the end of the unit of study. Wetland plants are water resistant; Wetland plants only need water, sunlight and air to produce energy to live on;

things on their cards, such as feeding or shelter. When a complicated web has been created introduce a problem, for example; a truck has crashed on a nearby road losing its load into the wetlands. What are the consequences? Start slowly and discuss the impact as it spreads throughout the web. (Adapted from Lessons in the Gardens at Brisbane Botanic Gardens—Mt. Coot-tha; see also Resource 1 in reef guardians Year 9 unit—Ecosystem for further explanations).	their own. A template is available in Appendix H. The Microsoft Office PowerPoint application can be used to make a digital version. The class can swap completed branching databases when finished and try to use another group's version.	of the plant/animal. Students complete a Plus/Minus/Interesting review of their peers' presentations.	They have air sacs to stay afloat; They get their food from the water; They are floppy and soft because the water supports them; … add an empty cloud for ideas from the students ("I think…."). and Ask the students what they think wetland plants need to stay alive. Students plan fair tests in groups of three to test their ideas about what wetland plants need to stay alive. Discuss results. (Green plants need air, sunlight and water). Try fast-growing radishes or watercress that can grow on damp cotton wool. Test if they need air by placing the plant and container in a snap lock bag and briefly opening it to add water.

What role do wetlands have in the environment?

Water purification	Water cycle	Flooding	Cell structure
Do the Mystery Filter activity from the Year 7 Waterwise unit (page 16) at http://www.nrm.qld.gov.au/waterwise/education/units/pdf/y6y7/y7-science-water-cycles-web.pdf or Use a learning object (From Scootle) at http://www.scootle.edu.au/ec/p/home such as 'Making water drinkable: water treatment' (L3103) or Seqwater has an online water game that deals with water management at http://www.seqwater.com.au/education/water-island-game or Provide groups of three students with kitchen sieves, coffee filter paper and fabric to	Teachers can order and use the free water cycle series of posters and guidelines for teaching activities on the DNRM website at http://www.nrm.qld.gov.au/waterwise/councils_program/water_cycle_poster.html or Use the Year 7 'Water cycles' DNRM unit in the Water: Learn it for life! program at http://www.nrm.qld.gov.au/waterwise/education/units/pdf/y6y7/y7-science-water-cycles-web.pdf or Play a simple online game at http://apps.southeastwater.com.au/games/education_kidsroom_wcactivity.asp or Play the Catchment Detox online game at: www.catchmentdetox.net.au	Students use newspaper pictures and articles and online sources to find out where, when and how flooding occurs in Queensland. See the Healthy Waterways newsletters at 'Flood Information'; then 'Flood resources'; 'An overview of the flood event' PDF at www.healthywaterways.org or In groups of three students choose a picture of past Queensland floods and respond to it using question prompts, such as: i) How can? ii) Why would? iii) How did? iv) Who might? v) What is? Photographs can be sourced online at http://trove.nla.gov.au/general/australian-pictures-in-trove or at	Use a digital microscope to display microscopic properties of Wetlands plants and microscopic living things in a sample of water from the field study. [If your school has no microscopes consider negotiating the use of a laboratory in your local high school]. Place a drop of wetlands water on a microscope slide and examine the creatures found. Students create a pictorial tally to show the diversity and quantity of animals found in a drop. or Challenge the students to work in groups of three to create a model of a plant or animal cell using

separate dirt from water. Use dirt from the garden and water in clear cups. Scooping the less dense organic material off the surface with sieves or pouring it through fabric or paper introduces the separation technique of filtration. Pouring the water off and leaving the more dense soil at the bottom introduces the separation technique of decanting. (From 'Water cycles' Year 7 in the Water: Learn it for life! Resource from DNRM at http://www.nrm.qld.gov.au/waterwise/education/units/pdf/y6y7/y7-science-water-cycles-web.pdf)	or Explore the Water Cycle Activity at: www.healthywaterways.com.au/HealthyWaterways/Education/Litterwasteresources.aspx	http://news.nationalpost.com/photo_gallery/gallery-floods-ravage-queensland-displace-thousands/ and View a Catalyst story about the impact of Queensland 2011 floods on the Moreton Bay marine park at http://www.abc.net.au/catalyst/stories/3480317.htm Explore the 'Flood of Ideas' website by Healthy Waterways at http://floodofideas.org.au/	construction materials or edible materials (non-perishable). The model should be labelled correctly using reference information from text books or online. Or Use a digital resource to explore cell structure, such as 'Inside a cell' on the Learn. Genetics website at http://learn.genetics.utah.edu/content/begin/cells/insideacell/

Information Communication & Technology (ICT)	**Cultural perspectives**	**Careers**
Students use the *Exploring Wetlands* WebQuest to do virtual field testing and learn more about wetlands. See http://www.reefed.edu.au/home/students/web_quest/exploring_wetlands	Contact Aboriginal and Torres Strait Islander community elders through the local council. Students can learn the names and pronunciation for their wetland plants and animals in the local language. Aboriginal and Torres Strait Islander people have their own way of grouping plants and animals that differs from a western scientific view. Students can invite elders to teach them about their way of knowing the wetlands. and Summarize the information about traditional ecological knowledge after viewing the CSIRO video clip about burning in Kakadu wetlands on YouTube at http://youtu.be/e1uYBgaqeT0 or on the CSIRO site at http://www.csiro.au/en/Outcomes/Environment/Bushfires/KakaduWetlandBurning.aspx	View videos about Aboriginal and Torres Strait Islander working in Environmental protection roles. Search for 'Parks Australia Indigenous protected Area'—JobsPark rangers in NT at Kakadu National Park at: http://www.environment.gov.au/parks/publications/kakadu/culturecamp.html Discussion: 1. Explain how you think the employees feel about their roles. 2. Describe any benefits and/or issues to the community and the environment you think are inherent in the employment of Aboriginal and Torres Strait Islander Australians to environmental roles.

EXPLAIN

The purpose of this stage of teaching and learning is for the students to represent their current understanding and for the teacher to give feedback on their learning. It is also the time to define terms, explain scientific concepts and introduce terminology.

Choose activities to suit your students' needs and abilities and use relevant, local examples where possible. Encourage students to ask questions and reflect on their learning through each stage in a journal, on a blog or by another means.

<table>
<tr><td colspan="4">What is a wetland?
What living things are found in coastal, freshwater and marine wetlands?</td></tr>
<tr><td colspan="4">Concept maps</td></tr>
<tr><td colspan="4">Students work in groups of three to arrange multiple circles and arrows from Appendix I into a concept map on the floor, wall or desks to represent local wetlands. The circles can contain plants/animals/the Sun/the water/abiotic factors/rainwater/weeds/pollution/local urban sprawl/human infrastructure (drains, roads etc.) and the arrows represent relationships, such as: feeds on…lives in….shelters under…etc. The teacher can supply all or some or none of the words for the circles and arrows.
The teacher pays particular attention to the negotiations that occur and notes the students that are not progressing in their understanding of wetlands. These students may need further activities or a return to previous activities to understand the concepts. Students take a digital picture when they have completed the task and look at other group's work.</td></tr>
<tr><td>Concepts to explain</td><td colspan="2">Terminology to share</td><td>Guest speakers</td></tr>
<tr><td>This can be done through 'teacher talk' and sharing of books and other resources. Social construction of knowledge is a powerful way for students to learn, so try reaching a group consensus about the concept and then recording it on a board/poster/display for all the students to copy, rather than just telling them.

Define:
'wetlands', 'interdependence', 'ecosystem', 'ephemeral', 'adaptation'.

Explain:</td><td>hydric soil
ephemeral
ecosystem
inundation
hydrophyte
aquatic
macro-invertebrates
brackish
anaerobic
erosion
adaptation</td><td>ecology
protection
larvae
vegetation
nutrients
swamps
marsh
billabong
estuaries
habitat
urban</td><td>Extend an invitation to a local environmental officer/worker/group to be a guest speaker about their area of interest. For example:
• Fish identification (Fisheries officers) See https://www.facebook.com/FisheriesQueensland
• Local council environmental officers. Find your local council at http://www.qldcouncils.com.au/web/guest
• Environmental engineers. Contact details for Engineers Australia QLD division</td></tr>
</table>

The water cycle; photosynthesis, mixtures and solutions, classification, how wetlands purify water and protect against storm surges and flooding, Ramsar convention Describe: Adaptation of plants and animals to wetlands, Aboriginal and Torres Strait Islander knowledge of the natural world; abiotic components of a wetlands ecosystem Teacher information can be found at the front of this resource (p. 11), on Wetland*Info* (http://wetlandinfo.ehp.qld.gov.au/wetlands/resources/education/) and in science text books.	nutrients dependent classification photosynthesis abiotic conservation economic	sediment catchment sediment fertilizer values recreation	at http://www.engineersaustralia.org.au/queensland-division/contact-us • Environmental/conservation groups. For a list of groups see the QLD conservation site at http://www.qccqld.org.au/index.php?option=com_content&task=view&id=361&Itemid=113 • Regional Natural Resource Management Groups at http://www.rgc.org.au/find-your-regional-group/ • Local Universities
Wetlands news			
Students work in pairs to prepare a 3 minute presentation on one of two wetland related news articles at: http://www.environment.gov.au/water/education/index.html Each pair presents to another pair with a different topic and vice versa and then everyone writes a short summary in their journals on both topics.			

What role do wetlands have in the environment?
What impact can we have on wetlands?

QLD Ramsar sites	Sustainability	Literacy	ICT
View a short video about the importance of wetlands and the Ramsar convention at http://www.ramsar.org/cda/en/ramsar-media-video/main/ramsar/1-25-331_4000_0 Queensland has five Ramsar sites (internationally recognised wetlands sites of importance). Students find them on a map and use	Environmental issues usually have many facets. A holistic view of the environment includes: economic systems, social and cultural systems, natural systems and political systems. Use the 'Sustainability compass' in Appendix J to discuss the issue of wetlands being drained and filled in for urban development. Students can take on a role of someone whose belief system falls	Use *Queensland's wonderful wetlands* in a literacy activity. Students find and list all the characteristics that make wetlands valuable and all the threats to wetlands. Teachers can order a class set of *Queensland's wonderful wetlands* from the Brochures and posters section of Wetland*Info:* http://wetlandinfo.ehp.qld.gov.au/wetlands/resources/publications/brochures-posters.html	Students can search for the following on QWIKI.com • Ecosystem • Ramsar convention And two examples of Ramsar wetlands in other states: • Watervalley wetlands • Perth wetlands and Read and discuss 'Toxic algal blooms' at: http://www.science.org.au/nova/017/

information from http://wetlandinfo.ehp.qld.gov.au/wetlands/ to research their unique characteristics and values. PDF maps can be found at: http://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/	firmly in one quadrant of the compass and argue their point to the class. and Students calculate their water footprint using a water footprint online calculator. The average annual water footprint of a person in Australia is 1,400 cubic metres. There are many of calculators available but they are often very complicated or based on water consumption in other countries. This Facebook version is simple (pictorial) and focuses on positive changes to make to reduce water consumption: www.facebook.com/waterfootprintcalculator You will need a Facebook account to access it or try: www.waterfootprint.org	and Use Wetlands, more than just a wet land (Queensland) colour information sheet in a literacy activity. Students summarise the main points from the information sheet. Students make signs for their local wetlands. Use Learning Object L353 'Rainforest: make signs' as an example http://www.scootle.edu.au/ec/p/home.	017key.htm and Learning Objects (from Scootle) at http://www.scootle.edu.au/ec/p/home – Teacher's resource about the flow of energy. Links to dozens of Learning Objects for students. R11995 and Who's for dinner? L25 Flow of energy; pond L11713 Population modeller: pond L11721 Environmental evaluation project: frog pond habitat L418 Aboriginal wetland burning in Kakadu, 2005 (3 parts) R9851, R9862, R10323 (videos) The role of leaves in photosynthesis R11893 Plant cells R11873 Photosynthesis builder L11709 Producers (concept cartoon) R11933 Cells and structures R11822 Making water drinkable L3198

ELABORATE

The purpose of this stage of teaching and learning is for the students to apply their developing understanding and participate in a student-led investigation. This stage is an opportunity to assess their investigation skills (Science Inquiry Skills checklists can be found in Appendix C).

Choose activities to suit your students' needs and abilities and use relevant, local examples where possible. Encourage students to ask questions and reflect on their learning through each stage in a journal, on a blog or by another means.

<table>
<tr><td colspan="5">What role do wetlands have in the environment?</td></tr>
<tr><td colspan="5">SAFETY: Encourage students to organize safety processes and follow them during scientific investigations. Risk assessments are needed for field trip investigations.
ETHICS: Encourage students to consider the effects of their actions and those of the community. Sample water and macro-invertebrates should be returned to their origin.</td></tr>
<tr><td>Photosynthesis investigation
(guided inquiry)</td><td>Fertiliser investigation
(guided inquiry using replication)</td><td>Water filtration
(open guided inquiry using replication)</td><td>Water Cycle investigation
(open inquiry using replication)</td><td>Field trip
(open survey investigation)</td></tr>
<tr><td>To test for starch in the leaves of plants to identify if photosynthesis has taken place
Materials
• One pot plant with plenty of leaves that has been kept in the sun for a few days
• One pot plant with plenty of leaves that has been kept in the dark for a few days
• A hotplate
• Forceps
• Petri dish
• 500ml beaker of boiling water
• Test tube of ethanol
• Iodine solution</td><td>How to test the influence of various fertilisers on algal growth
Fertilisers used on farms and suburban parks and lawns contain phosphorus and nitrogen which wash into our waterways. Compare how different fertilisers affect the growth of algae.
Investigation question: Which fertilizers grow the most algae in water?
Do a variables scan with the class:
• Amount of fertilizer
• Amount of water
• Shape and size of containers
• Time to grow</td><td>Filtration is a separation technique and a wetlands value.
Ask the students 'what do you think affects how well a filter purifies water?'
Make a list:
• The type of filter (folded cotton cloth/coffee filter paper/sand in a nylon stocking…)
• The size of the filter mesh/holes/spaces</td><td>Evaporation is a separation technique and one phase of the water cycle.
Ask the students 'what do you think affects how quickly a liquid evaporates?'
Make a list:
• Amount of liquid
• Type of liquid (water/methylated spirits…)</td><td>An important part of monitoring an ecosystem is to record data at intervals to look for patterns of change.
Repeat the field trip from the Explore stage, focusing on a comparison</td></tr>
</table>

• Pipette • Small sample of potato starch in a Petri dish ***Procedure*** Remove a leaf from the plant that has been kept in the sunlight. 2. Dip the leaf into the boiling water for one minute to soften it. 3. Place the leaf into the test tube of ethanol. CAUTION: ethanol is flammable – do not place it near a naked flame. 4. Stand the test tube of ethanol in the beaker of boiling water and leave for 10 minutes. What happens to the colour of the leaf? What did the ethanol do? 5. While the leaf is in the ethanol, test a small sample of potato starch in a Petri dish with the iodine solution. Note any colour change. 6. Remove the leaf from the ethanol with the forceps and dip it into the hot water in the beaker again to remove any excess ethanol. 7. Place the leaf into a Petri dish and use the pipette to cover it with iodine solution. Does the colour change on the leaf? Where on the leaf did the colour change? 8. Repeat steps 1–7 for the leaf from the plant that has been kept in the dark (you do not need to repeat step 5 with the potato starch). 9. Answer the following questions a. Glucose is produced during photosynthesis and is then converted to starch and stored in the leaves of the plants. Did your test show any differences in starch production between the leaves exposed to the light and the leaves kept in the dark? b. Why was one of the plants kept in the dark for a few days before completing this investigation? Students evaluate their investigation and recommend improvements they could make.	• Placement of jars These variables need to be kept the same while the brand/type of fertilizer will change. Each group of 3 students will need to plan their investigation, predict what will happen and why they think so and record observations accurately. ***Materials (for the class)*** pond water (source of algae), distilled water, large glass jars, measuring cylinder, fertilisers (choose some that are high in nitrogen and others that are high in phosphorus) tall, thin glass container with a flat bottom; newspaper ***Procedure*** Set up a number of large glass jars equal to the number of fertilisers you wish to test, plus one jar which will act as the control. To each jar add 1 litre of distilled water and 100 millilitres of pond water. Do not add fertiliser to the control jar. Make the concentration of fertiliser recommended on the respective packets. Add 1% of the mix to each of the sample jars. Let all the jars stand in a well-lit position for about 4 weeks. Compare the amount of algal growth by comparing the turbidity (cloudiness) of the water. This can be done by placing a jar on some newsprint. Repeat with the other samples, including the control, and compare the difficulty in reading the newsprint through the top of the jar. Do any algae stick to the sides of the jar? How would you include them in your measurement of algal growth? Students evaluate their investigation and recommend improvements they could make.	• Amount of water • Speed water is poured • How dirty the water is Students work in groups of 3. They choose one variable to change and keep the others the same. They need to decide how to measure the extent of purification (perhaps by comparing the turbidity/cloudiness of the water. This can be done by placing a jar on some newsprint). Findings should be recorded in numbers in a table (put graduated measurements on masking tape at the side of the glass/jar). Students write an investigation question: How is the purification of water affected when we change ……..? (Add one of the variables as an example.) They plan and conduct their investigation and report on their results. The teacher should support students to look for patterns in their results and explain them. Students evaluate their investigation and recommend improvements they could make.	• Surface liquid is on (kitchen towel/ceramic tile…) • Air temperature • Wind strength • Amount of direct sunlight Students work in groups of 3. They choose one variable to change and keep the others the same. They need to decide how to measure the speed of evaporation. Findings should be recorded in numbers in a table. Students write an investigation question: How is the speed of evaporation affected when we change ……..? (Add one of the variables as an example.) They plan and conduct their investigation and report on their results. The teacher should support students to look for patterns in their results and explain them. Students evaluate their investigation and recommend improvements they could make.	between the findings. For instance, students could start with a research question such as 'is there a difference between a shaded portion of the creek and an unshaded (cleared) portion of the creek?' The teacher should support students to look for patterns in their results and explain them. Students evaluate their investigation and recommend improvements they could make.

From Year 9 Reef Guardians unit—Ecosystems	*From the Australian Academy of Science.*			

EVALUATE

The purpose of this stage of teaching and learning is for the students to reflect on their learning and represent their new understandings.

Choose activities to suit your students' needs and abilities and use relevant, local examples where possible.

What impact can we have on wetlands? **How can we sustain our valuable wetlands?**		
Reflection	**Sustainability**	**Resource management**
Repeat activities from the Engage phase and ask students to compare their own work to see how their understanding has changed. Reflect on learning by asking students to review their journals/blogs to share interesting parts and identify activities that helped them to learn.	A key aspect of Education for Sustainability is social action. In society it is not unusual for people to be knowledgeable about environmental issues but to act in a contrary manner to what they know to be 'good for the environment'. Thus, it is not enough to only teach students about why wetlands are valued. To assess their learning and to commit to social action students could work towards influencing other's views or actions towards wetlands. Brainstorm a list of people or organisations that the students believe need to be influenced in relation to wetlands (i.e. young children, local business owners, the mayor, the town/city council members, residents who live near local wetlands etc.). Choice is also empowering for students, particularly those in the Middle Years of schooling. Students choose a group/individual/organisation as the target of their campaign. Form small groups (2–4) to plan and prepare their campaign. They need to choose a suitable way to present ideas to their chosen audience (i.e. a picture book for young children, a display at the local library for residents, a presentation for invited council members, a webpage for locals, a brochure/pamphlet for local business owners, a letter to the mayor, a movie, a board game, posters etc.). The student's work can be judged on science content and skills (see Appendix A and Appendix B) and on relevant media or English content, if their choice of presentation warrants it.	Students work independently or in small groups to devise a detailed twelve month work plan for their local wetlands (from the field study). It should include information about relevant stakeholders, timelines, tasks and goals. The focus of the work plan should be conservation of the wetland. and Students write a text that explains why wetlands are valued and need to be sustained for future generations and utilised carefully by the present generation. The student's work can be judged on science content and skills (see Appendix A and Appendix C) and on relevant English content. or Students design interpretive signs for visitors to the wetlands.

GEOGRAPHY

Irrespective of the year level, most geography teachers will adopt a geographical inquiry as a structure when planning units of work. For this reason the activities presented in the geography section of the toolkit are organised under geographical inquiry key questions. These key questions have been designed to be broad enough to be adaptable to most classrooms and across the year levels indicated. For more information on geographical inquiry see the GeogSpace website's geographical inquiry section.
http://geogspace.edu.au/support-units/geographical-inquiry/gi-introduction.html

What are wetlands and where do they occur?

This key question focuses on defining the issues and patterns being studied. Students will develop knowledge and understanding about wetlands while examining these questions. Activities should be modified and adapted to suit your year level.

Wetlands slideshow
Year level(s): 7 & 8
Activity overview:
Use an online image search tool such as Google Images or Bing Images to find a range of images illustrating the features, flora and fauna, that could be found in wetlands. Consider a range of wetland types from estuarine, to freshwater, to marine, with water flowing, static or not evident to highlight the range of landscapes that could be defined as wetlands. Photos can also be found on the Wetland*Info* site—
http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/riverine/lake-eyre-bulloo/photos.html
http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/riverine/south-east/photos.html

Tell your students that they have to use the visual clues you will give them to work out what they are looking at. Show the images to your students without initially giving them any information. Ask them to list the features of the landscapes they see. Discuss what things are similar or different in all of the images. Finally, ask your students to discuss with a partner what common landscape features the images all display.

Story of a river
Year level(s): 7 & 8
Key question(s): What is a wetland? How do wetlands interact with water? How do they occur?
Overview:
Use the story of a river resource to introduce a whole-of-catchment approach to thinking about wetlands at the beginning of your study. Adapt the story and resources to reflect your local catchment and include a wetland environment in your story.

http://www.nrm.qld.gov.au/waterwise/education/units/pdf/y6y7/y7-geography-explaining-our-catchment.pdf (p. 5–6, p. 17–18)

How do wetlands interact with the biosphere?

This key question allows students to analyse information about wetlands, how different wetlands form, the environmental processes at play in wetlands and the plants and animals that are found in wetlands. The focus here in Year 7 is water and the movement of water through wetlands while in Year 8 the focus is on the wetlands as part of the landscape and the formation and structure of wetlands.

Wetland tour
Year level(s): 7 & 8
Key question(s): Where do they occur? How do wetlands interact with water?
Overview:
Use Google Earth to create a tour showing five wetland areas of international significance. Ask students to view the Ramsar Convention website http://www.ramsar.org and select three wetlands of significance. These wetlands could be global or within your immediate area, depending on the unit you are teaching. When students create a 'placemark' in Google Earth they should incorporate some information about why that site is an important wetland and what are its threats. Students can also include images, hyperlinks and YouTube videos in their 'placemarks' to make their tour more engaging.

Try the 'Learn Google Earth: Navigation' video from the YouTube playlist below to help you and your students get started using Google Earth to create interactive tours.
https://www.youtube.com/playlist?list=PLC5E193AC559FCBF3

Structure of a wetland
Year level(s): 7 & 8
Key question(s): What role do wetlands have in the environment? What flora and fauna can be found in coastal, freshwater and marine wetlands? How do wetlands form? What role do wetlands have in the environment?
Overview:
Give each student in your class a number that corresponds to a type of wetland. For instance, 1. could be marine wetlands, 2. could be estuarine wetlands and 3. could be freshwater wetlands. You could add categories as students develop their knowledge of wetlands. Tell students that they are going to use their own knowledge and the internet to research and create a cartoon for children that outlines how their type of wetland (i.e. the number they have been allocated) is created using only two panels. Tell them to include labels and annotation to help children understand the formation and geology of their type of wetland. Students should include a border, title and author information in their cartoon. A blank A4 page of recycled paper, folded in half should be used by students to create their cartoon. For information on the detail that could be included in students' sketches, see the following information sheet.
http://www.geogspace.edu.au/verve/_resources/2.1.2.3_2_photo_sketching.pdf
Pictorial conceptual models may also assist students with the inclusion of
labels http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/

Wetland field sketch
Year level(s): 7 & 8
Key question(s): What role do wetlands have in the environment? What flora and fauna can be found in coastal, freshwater and marine wetlands? How do wetlands form? What role do wetlands have in the environment?
Overview:
Draw a field sketch of a wetland ensuring students include the appropriate features of a field sketch. Students' diagrams should clearly indicate the type of wetland and examples illustrating the flora and fauna that could be found there.

The following links provide some background on what should be expected in a good field sketch:
http://www.geogspace.edu.au/core-units/f-4/inquiry-and-skills/year-f-4/yf4-is-illus2.html
http://www.geogspace.edu.au/verve/_resources/2.1.2.3_1_field_sketching.pdf
Pictorial conceptual models may also help students to identify key features for their sketch
http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/

Wetland plants
Year level(s): 7 & 8
Key question(s): What role do wetlands have in the environment? What flora and fauna can be found in coastal, freshwater and marine wetlands?
Overview:
Students should be familiar with the concept of species adaptations but spend some time discussing how different plants and animals adapt to survive in different environments. Discuss specific examples such as the humps on a camel or how penguins have adapted downy, yet waterproof feathers to survive in the cold.
Your students will need to find at least three separate plants that are found in wetland environments http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/flora/. They can find these while in the field or using an online image search to find high quality images of particular species. Students should complete field sketches of at least three plants that can be found in Queensland wetlands with annotations describing at least one adaptation per plant that helps it survive. Complete these sketches in your notebooks.

Wetland animal adaptations
Year level(s): 7 & 8
Key question(s): What role do wetlands have in the environment? What flora and fauna can be found in coastal, freshwater and marine wetlands?
Overview:
Students should be familiar with the concept of species adaptations but spend some time discussing how different plants and animals adapt to survive in different environments. Discuss specific examples such as the humps on a camel or how penguins have adapted downy, yet waterproof feathers to survive in the cold.

Ask students to design a new wetland animal that could survive in your local wetlands or those nearest to your location. Students should consider adaptations they are already familiar with as well as adaptations of plants (covered in previous activity). Use the Wetland*Maps* online mapping tool to find out more about the wetlands close to you to help decide what types of survival adaptations may be required by the animal:
http://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/

Groundwater Dependent Ecosystems profile
Year level(s): 7 & 8
Key question(s): What role do wetlands have in the environment? What flora and fauna can be found in coastal, freshwater and marine wetlands? How do wetlands form? What role do wetlands have in the environment?
Overview:

Ask students to go to the Wetland*Info* website http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/groundwater-dependent/ and answer the following questions:

- What is groundwater?
- What is a groundwater dependent ecosystem?
- What are the main types of groundwater dependent ecosystems?
- The website states 'groundwater dependent ecosystems vary temporally and spatially'. What does this mean?
- Are there any in your local area? (Hint: look for the 'Facts and maps' link in the left-hand menu.)

Each student should then select one type of groundwater dependent ecosystem and draw a profile field sketch or use the profile backgrounds on the IAN tool to create a profile conceptual diagram. The following link contains information on conceptual diagrams as well as a link to a free, online tool for creating conceptual diagrams that can then be printed or saved as an image file:
http://ian.umces.edu/learn/conceptual_diagrams/
Students can find information about their specific groundwater dependent ecosystem as well as examples of conceptual diagrams on the Wetland*Info* website, indicated above.

What are our impacts on wetlands?

This key question asks students to consider the different users of wetlands and their perception of and impacts on wetlands, both positively and negatively. Students will examine the economic, social and environmental impacts of our use of wetlands.

Uses of wetlands

Year level(s): 7 & 8

Key question(s): How do we use and value/perceive wetlands? What impact can we have on wetlands? How are we managing our wetlands? How do different people/groups use and value wetlands?

Overview:

Give students, pairs or small groups titles such as Aboriginal and Torres Strait Islander local, environmental group, bird watcher, local school kid, city council, local business, farmers in the catchment or any phrase that would identify an entity that uses and impacts on the waterway and wetlands in the local area.

Ask students to specify how their 'role' would use the catchment and the wetlands using the wetlands use T-Bar in Appendix O.

The Black Hat column represents considered, rational thought. Students should consider the disadvantages of the person/entity they have been given and record any ways in which that person/entity would use the wetland in a way that might degrade the environmental quality of the wetland. The Green Hat represents new beginnings and creative ideas. Students should think about creative ways they could alter the way their person/entity uses the wetland to reduce negative impacts of their use.

As a class discuss the different viewpoints on how the waterway should be used. Do different perceptions of the value of the waterway affect how it is used? Are there ever any conflicts over how the waterway is used? How are these resolved?

For further information on wetlands values visit: http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-values/

Our impacts on wetlands

Year level(s): 7 & 8

Key question(s): How do we use and value/perceive wetlands? What impact can we have on wetlands? How are we managing our wetlands? How do different people/groups use and value wetlands?

Overview:

Have students work in pairs or groups of three.

Use the K.W.L chart (What I know, What I want to know, What I have learnt) in Appendix N to develop some ideas as to how the following activities or groups use or perceive wetlands:

- agriculture
- infrastructure
- roads
- rail
- urban development
- mining
- conservation groups
- governments.

Select pairs or groups that have interesting answers to use as discussion stimuli. In your discussion refer to the ways in which these groups value wetlands, use wetlands as well as the on-going impacts of their use.

The following Wetland*Info* link provides additional information on wetland pressures: http://wetlandinfo.ehp.qld.gov.au/wetlands/management/pressures/

Aboriginal and Torres Strait Islander uses of wetlands

Year level(s): 7, 8 & 9

Key question(s): How do we use and value/perceive wetlands? What impact can we have on wetlands? How are we managing our wetlands? How do different people/groups use and value wetlands?

Overview:

Show students the video (or a segment from) titled 'Aboriginal wetland burning in Kakadu': http://www.csiro.au/en/Outcomes/Environment/Bushfires/KakaduWetlandBurning.aspx

Ask your students, why are these wetlands are deliberately burnt by people? What are the advantages or benefits of doing this?

The best way to understand how Aboriginal and Torres Strait Islanders use wetlands is to develop relationships with local Aboriginal and Torres Strait Islander groups, elders, Aboriginal and Torres Strait Islander support units, community or cultural centres. If possible

explore the myriad of ways Aboriginal and Torres Strait Islanders use and have used wetland environments in field locations with the help of an Aboriginal and Torres Strait Islander guide. While in the field exploring the different ways wetlands are used by Aboriginal and Torres Strait Islanders, relevant data collection is also encouraged. Consult Appendix F: Pre-field trip activity sheets and Appendix G: Risk Assessment as well as the comprehensive fieldwork checklist from the GeogSpace resource at: http://www.geogspace.edu.au/verve/_resources/3.4.3_1_fieldwork_checklist.pdf.

The Queensland Studies Authority maps how to build relationships with potential local Aboriginal and Torres Strait Islander contacts at: http://www.qsa.qld.edu.au/downloads/approach/indigenous_build_relationship.pdf . For more general information on appropriately integrating Aboriginal and Torres Strait Islander perspectives into your teaching, consult the collection of resources from the Queensland Studies Authority at:
http://www.qsa.qld.edu.au/3035.html.
For additional information on Traditional values of wetlands visit: http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-values/traditional-owners.html

How do we reduce negative impacts on wetlands?

While working through this key question, students focus on solutions to the problem identified to sustainably manage wetlands. Students should develop criteria and use these in some way to evaluate alternative solutions to problems.

Wetlands management
Year level(s): 6, 7, 8 & 9
Key question(s): How are we managing our wetlands? How can changes to wetlands be managed?
Overview:
Students will work in groups of three to complete this task with one designated prosecutor, one defender and one will be the judge. They should use information they have obtained in class or via a reputable website such as Wetland*Info* at: http://wetlandinfo.ehp.qld.gov.au/wetlands/.

Each group will be given a scenario, either local or global depending on the scale of study, and students will get three minutes to put their case together with the student playing the role of judge assisting both sides with their arguments. Each side will then have one minute to argue their case, followed by a 30 second rebuttal. The judge will then consider each argument and decide on the winner, clearly stating their reasons behind their decision.

Wetlands management scenarios:

Local

The Haytchtooh District lies 450km north-east of Brisbane and relies heavily on its managed forestry program and associated wood processing and chipping industries. Over recent years the health and condition of the local waterway, Haytchtoooh Creek, has noticeably deteriorated. The local catchment association is recommending that tighter conditions be placed on what local industries can release into the waterway. The Aboriginal and Torres Strait Islander community would also like to see action as the creek is important in local history. In reply, local industry thinks these costs might put undue financial strain on these businesses, thus affecting everyone in the district.

Charges: That local industry is negatively affecting local waterways and wetlands due to the release of industrial wastes into the catchment.

Global

The South-East Asian country of Kamaria exports much of its garbage waste and some industrial waste by barge to neighbouring Ragaan. Both countries benefit from moving the waste, Kamaria by getting rid of it and Ragaan by reusing and processing some of the materials as well as the economic benefits paid by Kamaria. However, some of the waste is being lost in transit due to accidents, poor quality machinery and illegal dumping. This lost waste affects the quality of water, local sea grass beds and thus the health of local marine species. It also washes up on beaches and mangroves severely impacting on the amenity and health of these areas along the coastlines of both countries.

Wetlands interview

Year level(s): 6, 7, 8 & 9

Key question(s): How are we managing our wetlands? How can changes to wetlands be managed?
Overview:
This activity is designed as a concluding activity to students' work on wetlands. Once students have examined what wetlands are, how we value and use wetlands, our impacts on wetlands and how we manage wetlands, have students complete this activity. It could be set as a homework task if time is limited.
Ask students to consider all they have learnt about wetlands to date. You could spend a short amount of time summarising the key points of your unit with the class before you continue. Get them to draft a series of questions that they would ask a wetlands expert now that they have completed their study of wetlands. Get students to think about the unanswered questions they still have about wetlands, our impacts on wetlands and how we manage them. The purpose of the task is to identify any gaps in students' knowledge. The teacher could review the questions of the whole class to see if any can be or have been answered. Any particularly good questions could be submitted to a wetlands expert to review.

Appendix A: Science Curriculum focus

Year 6

Relevant parts of the ACHIEVEMENT STANDARD:
By the end of Year 6, students explain how natural events cause rapid change to the Earth's surface. They describe and predict the effect of environmental changes on individual living things. Students explain how scientific knowledge is used in decision making and identify contributions to the development of science by people from a range of cultures.
Students follow procedures to develop investigable questions and design investigations into simple cause and effect relationships. They identify variables to be changed and measured and describe potential safety risks when planning methods. They collect, organise and interpret their data, identifying where improvements to their methods or research could improve the data. They describe and analyse relationships in data using graphic representations and construct multimodal texts to communicate ideas, methods and findings.

Note: Curriculum details provided in this Appendix have been sourced from the Australian Curriculum, Assessment and Reporting Authority, at:
www.australiancurriculum.edu.au/science/curriculum/F-10
They are current as at December 2013.

Relevant CONTENT DESCRIPTIONS:

Science Understanding		
Biological sciences	The growth and survival of living things are affected by the physical conditions of their environment	(ACSSU094)
Earth and space sciences	Sudden geological changes or extreme weather conditions can affect Earth's surface	(ACSSU096)
Science as a Human Endeavour		
Nature and development of science	Important contributions to the advancement of science have been made by people from a range of cultures	(ACSHE099)
Use and influence of science	Scientific knowledge is used to inform personal and community decisions	(ACSHE220)
Science Inquiry Skills		
Questioning and predicting	With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be	(ACSIS232)
Planning and conducting	With guidance, plan appropriate investigation methods to answer questions or solve problems	(ACSIS103)
	Decide which variable should be changed and measured in fair tests and accurately observe, measure and record data, using digital technologies as appropriate	(ACSIS104)
	Use equipment and materials safely, identifying potential risks	(ACSIS105)
Processing and analysing data and information	Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate	(ACSIS107)
	Compare data with predictions and use as evidence in developing explanations	(ACSIS221)
Evaluating	Suggest improvements to the methods used to investigate a question or solve a problem	(ACSIS108)
Communicating	Communicate ideas, explanations and processes in a variety of ways, including multimodal texts	(ACSIS110)

Year 7

Relevant parts of the ACHIEVEMENT STANDARD:
By the end of Year 7, students describe techniques to separate pure substances from mixtures. They analyse how the sustainable use of resources depends on the way they cycle through Earth systems. They predict the effect of environmental changes on feeding relationships and classify and organise diverse organisms based on observable differences.
Students identify questions that can be investigated scientifically. They plan fair experimental methods, identifying variables to be changed and measured. They select equipment that improves fairness and accuracy and describe how they considered safety. They communicate their ideas, methods and findings using scientific language and appropriate representations.

Relevant CONTENT DESCRIPTIONS:

Science Understanding		
Biological sciences	There are differences within and between groups of organisms; classification helps organise this diversity	(ACSSU111)
	Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions	(ACSSU112)
Chemical sciences	Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques	(ACSSU113)
Earth and space sciences	Water is an important resource that cycles through the environment	(ACSSU222)
Science as a Human Endeavour		
Use and influence of science	Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management	(ACSHE121)
	People use understanding and skills from across the disciplines of science in their occupations	(ACSHE224)
Science Inquiry Skills		
Questioning and predicting	Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge	(ACSIS124)
Planning and conducting	Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed)	(ACSIS125
	In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task	(ACSIS126)
Processing and analysing data and information	Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate	(ACSIS129)
Evaluating	Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method	(ACSIS131)
Communicating	Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate	(ACSIS133)

Year 8

Relevant parts of the ACHIEVEMENT STANDARD:
By the end of Year 8, students identify different forms of energy and describe how energy transfers and transformations cause change in simple systems. They-analyse the relationship between structure and function at cell level. Students examine the different science knowledge used in occupations.
Students identify and construct questions and problems that they can investigate scientifically. They consider safety and ethics when planning investigations, including designing field or experimental methods. They identify variables to be changed, measured and controlled. Students construct representations of their data to reveal and analyse patterns and trends, and use these when justifying their conclusions. They explain how modifications to methods could improve the quality of their data. They use appropriate language and representations to communicate science ideas, methods and findings in a range of text types.

Relevant CONTENT DESCRIPTIONS:

Science Understanding		
Biological sciences	Cells are the basic units of living things and have specialized structures and functions	(ACSSU149)
Science as a Human Endeavour		
Use and influence of science	Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management	(ACSHE121)
	People use understanding and skills from across the disciplines of science in their occupations	(ACSHE224)
Science Inquiry Skills		
Questioning and predicting	Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge	(ACSIS139)
Planning and conducting	Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed	(ACSIS140)
	In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task	(ACSIS141)
Processing and analysing data and information	Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate	(ACSIS144)
	Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions	(ACSIS145)
Evaluating	Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method	(ACSIS146)
Communicating	Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate	(ACSIS148)

Year 9

Relevant parts of the ACHIEVEMENT STANDARD:
By the end of Year 9, students analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They describe technological factors that have influenced scientific developments.
Students design questions that can be investigated using a range of inquiry skills. They design methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They use appropriate language and representations when communicating their findings and ideas to specific audiences.

Relevant CONTENT DESCRIPTIONS:

Science Understanding		
Biological sciences	Multicellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment	(ACSSU175)
	Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems	(ACSSU176)
Science as a Human Endeavour		
Use and influence of science	Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities	(ACSHE161)
Science Inquiry Skills		
Questioning and predicting	Formulate questions or hypotheses that can be investigated scientifically	(ACSIS164)
Planning and conducting	Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods	(ACSIS165)
	Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data	(ACSIS166)
Processing and analysing data and information	Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies	(ACSIS169)
	Use knowledge of scientific concepts to draw conclusions that are consistent with evidence	(ACSIS170)
Evaluating	Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data	(ACSIS171)
Communicating	Communicate scientific ideas and information for a particular purpose, including constructing evidence based arguments and using appropriate scientific language, conventions and representations	(ACSIS174)

Appendix B: Geography Curriculum focus

The following sections of the Australian Curriculum: Geography represents the content descriptions that give teachers opportunities to teach wetlands between Foundation and Year 10.

Note: Curriculum details provided in this Appendix have been sourced from the Australian Curriculum, Assessment and Reporting Authority, at:
www.australiancurriculum.edu.au/science/curriculum/F-10
They are current as at December 2013.

Year level	Content descriptions
Foundation	The representation of the location of places and their features on maps and a globe (ACHGK001). The places people live in and belong to, their familiar features and why they are important to people (ACHGK002). The Countries/Places that Aboriginal and Torres Strait Islander Peoples belong to in the local area and why they are important to them (ACHGK003). The reasons why some places are special to people, and how they can be looked after (ACHGK004).
Year 1	The natural, managed and constructed features of places, their location, how they change and how they can be cared for (ACHGK005). The weather and seasons of places and the ways in which different cultural groups, including Aboriginal and Torres Strait Islander Peoples, describe them (ACHGK006). The ways the activities located in a place create its distinctive features (ACHGK007).
Year 2	The definition of places as parts of the Earth's surface that have been given meaning by people, and how places can be defined at a variety of scales (ACHGK010). The ways in which Aboriginal and Torres Strait Islander Peoples maintain special connections to particular Country/Place (ACHGK011).
Year 3	The representation of Australia as states and territories, and Australia's major natural and human features (ACHGK014).

	The many Countries/Places of Aboriginal and Torres Strait Islander Peoples throughout Australia (ACHGK015). The main climate types of the world and the similarities and differences between the climates of different places (ACHGK017). The similarities and differences in individuals' and groups' feelings and perceptions about places, and how they influence views about the protection of these places (ACHGK018).
Year 4	The location of the major countries of Africa and South America in relation to Australia, and their main characteristics, including the types of natural vegetation and native animals in at least two countries from both continents (ACHGK020). The types of natural vegetation and the significance of vegetation to the environment and to people (ACHGK021). The importance of environments to animals and people, and different views on how they can be protected (ACHGK022). The custodial responsibility Aboriginal and Torres Strait Islander Peoples have for Country/Place, and how this influences their past and present views about the use of resources (ACHGK023). The natural resources provided by the environment, and different views on how they could be used sustainably (ACHGK024).
Year 5	The location of the major countries of Europe and North America in relation to Australia and the influence of people on the environmental characteristics of places in at least two countries from both continents (ACHGK026). The influence of people, including Aboriginal and Torres Strait Islander Peoples, on the environmental characteristics of Australian places (ACHGK027). The influence of the environment on the human characteristics of a place (ACHGK028). The influence people have on the human characteristics of places and the management of spaces within them (ACHGK029). The impact of bushfires or floods on environments and

	communities, and how people can respond (ACHGK030).
Year 6	The location of the major countries of the Asia region in relation to Australia and the geographical diversity within the region (ACHGK031). The various connections Australia has with other countries and how these connections change people and places (ACHGK035). The effects that people's connections with, and proximity to, places throughout the world have on shaping their awareness and opinion of those places (ACHGK036).
Year 7	Unit 1: Water in the world The classification of environmental resources and the forms that water takes as a resource (ACHGK037). The ways that flows of water connect places as it moves through the environment and the way this affects places (ACHGK038). The quantity and variability of Australia's water resources compared with those in other continents (ACHGK039). The economic, cultural, spiritual and aesthetic value of water for people, including Aboriginal and Torres Strait Islander Peoples and peoples of the Asia region (ACHGK041). The causes, impacts and responses to an atmospheric or hydrological hazard (ACHGK042).
Year 8	Unit 1: Landforms and landscapes The different types of landscapes and their distinctive landform features (ACHGK048). The aesthetic, cultural and spiritual value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples (ACHGK049). The geomorphic processes that produce landforms, including a case study of at least one landform (ACHGK050). The human causes and effects of landscape degradation (ACHGK051). The ways of protecting significant landscapes (ACHGK052).

Year 9	Unit 2: Geographies of interconnections The perceptions people have of place, and how this influences their connections to different places (ACHGK065).
Year 10	Unit 1: Environmental change and management The human-induced environmental changes that challenge sustainability (ACHGK070). The Aboriginal and Torres Strait Islander Peoples' approaches to custodial responsibility and environmental management in different regions of Australia (ACHGK072). Wetlands could also be used as the mandated environment case study.

Appendix C: Science Inquiry Skills checklists

These checklists can be used to monitor the development of students' inquiry skills during Wetlands teaching guide activities.

YEAR 6 SCIENCE INQUIRY SKILLS CHECKLIST

SKILL		
Questioning and predicting		
• With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be (ACSIS232)		
Planning and conducting		
• With guidance, plan appropriate investigation methods to answer questions or solve problems (ACSIS103) • Decide which variable should be changed and measured in fair tests and accurately observe, measure and record data, using digital technologies as appropriate (ACSIS104) • Use equipment and materials safely, identifying potential risks (ACSIS105)		
Processing and analysing data and information		
• Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS107) • Compare data with predictions and use as evidence in developing explanations (ACSIS221)		
Evaluating		
• Suggest improvements to the methods used to investigate a question or solve a problem (ACSIS108)		
Communicating		
• Communicate ideas, explanations and processes in a variety of ways, including multi-modal texts (ACSIS110)		

YEARS 7 and 8 SCIENCE INQUIRY SKILLS CHECKLIST

SKILL		
Questioning and predicting		
• Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS124)		
Planning and conducting		
• Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125) • In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task (ACSIS126)		
Processing and analysing data and information		
• Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate (ACSIS129) • Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions (ACSIS130)		
Evaluating		
• Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method (ACSIS131) • Use scientific knowledge and findings from investigations to evaluate claims (ACSIS132)		
Communicating		
• Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate (ACSIS133)		

YEAR 9 SCIENCE INQUIRY SKILLS CHECKLIST

SKILL		
Questioning and predicting		
• Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)		
Planning and conducting		
• Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165) • Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (ACSIS166)		
Processing and analysing data and information		
• Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS169) • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)		
Evaluating		
• Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS171) • Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems (ACSIS172)		
Communicating		
• Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)		

Appendix D: Geography Inquiry Skills checklists

YEAR 6 GEOGRAPHY INQUIRY SKILLS CHECKLIST

SKILL		
Observing, questioning and planning		
• Develop geographical questions to investigate and plan an inquiry (ACHGS040)		
Collecting, recording, evaluating and representing		
• Collect and record relevant geographical data and information, using ethical protocols, from primary and secondary sources, for example, people, maps, plans, photographs, satellite images, statistical sources and reports (ACHGS041) • Evaluate sources for their usefulness and represent data in different forms, for example, maps, plans, graphs, tables, sketches and diagrams (ACHGS042) • Represent the location and features of places and different types of geographical information by constructing large-scale and small-scale maps that conform to cartographic conventions including border, source, scale, legend, title and north point, using spatial technologies as appropriate (ACHGS043)		
Interpreting, analysing and concluding		
• Interpret geographical data and other information using digital and spatial technologies as appropriate, and identify spatial distributions, patterns and trends, and infer relationships to draw conclusions (ACHGS044)		
Communicating		
• Present findings and ideas in a range of communication forms, for example, written, oral, graphic, tabular, visual and maps, using geographical terminology and digital technologies as appropriate (ACHGS045)		
Reflecting and responding		
• Reflect on their learning to propose individual and collective action in response to a contemporary geographical challenge and describe the expected effects of their proposal on different groups of people (ACHGS046)		

YEARS 7 and 8 GEOGRAPHY INQUIRY SKILLS CHECKLIST

SKILL		
Observing, questioning and planning		
• Develop geographically significant questions and plan an inquiry, using appropriate geographical methodologies and concepts (ACHGS047)(ACHGS055)		
Collecting, recording, evaluating and representing		
• Collect, select and record relevant geographical data and information, using ethical protocols, from appropriate primary and secondary sources (ACHGS048)(ACHGS056) • Evaluate sources for their reliability and usefulness and represent data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies (ACHGS049)(ACHGS057) • Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate (ACHGS050)(ACHGS058)		
Interpreting, analysing and concluding		
• Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends and infer relationships (ACHGS051)(ACHGS059) • Apply geographical concepts to draw conclusions based on the analysis of the data and information collected (ACHGS052)(ACHGS060)		
Communicating		
• Present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose; using geographical terminology and digital technologies as appropriate (ACHGS053)(ACHGS061)		
Reflecting and responding		
• Reflect on their learning to propose individual and collective action in response to a contemporary geographical challenge, taking account of environmental, economic and social considerations, and predict the expected outcomes of their proposal (ACHGS054)(ACHGS062)		

YEAR 9 GEOGRAPHY INQUIRY SKILLS CHECKLIST

SKILL		
Observing, questioning and planning		
• Develop geographically significant questions and plan an inquiry that identifies and applies appropriate geographical methodologies and concepts (ACHGS063)		
Collecting, recording, evaluating and representing		
• Collect, select, record and organise relevant geographical data and information, using ethical protocols, from a range of appropriate primary and secondary sources (ACHGS064) • Evaluate sources for their reliability, bias and usefulness, and represent multi-variable data in a range of appropriate forms, for example, scatter plots, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies (ACHGS065) • Represent the spatial distribution of geographical phenomena by constructing special purpose maps that conform to cartographic conventions, using spatial technologies as appropriate (ACHGS066)		
Interpreting, analysing and concluding		
• Evaluate multi-variable data and other geographical information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to make generalisations and inferences, propose explanations for patterns, trends, relationships and anomalies, and predict outcomes (ACHGS067) • Apply geographical concepts to synthesise information from various sources and draw conclusions based on the analysis of data and information, taking into account alternative points of view (ACHGS068) • Identify how geographical information systems (GIS) might be used to analyse geographical data and make predictions (ACHGS069)		
Communicating		
• Present findings, arguments and explanations in a range of appropriate communication forms, selected for their effectiveness and to suit audience and purpose; using relevant geographical terminology, and digital technologies as appropriate (ACHGS070)		
Reflecting and responding		
• Reflect on and evaluate the findings of the inquiry to propose individual and collective action in response to a contemporary geographical challenge, taking account of environmental, economic and social considerations; and explain the predicted outcomes and consequences of their proposal (ACHGS071)		

Appendix E: Geographic Inquiry Overview

Years 7 and 8

Year 7 Inquiry overview

Topic question: Are wetlands valuable?

Key questions:

What is a wetland?

Where do they occur?

How do wetlands interact with water?

What flora and fauna can be found in coastal, freshwater and marine wetlands?

What role do wetlands have in the environment?

How do we use and value/perceive wetlands?

What impact can we have on wetlands?

How are we managing our wetlands?

Year 8 Inquiry overview

Topic question: How do wetlands work?

Key questions:

What is a wetland?

Where do they occur?

How do wetlands form?

What flora and fauna can be found in coastal, freshwater and marine wetlands?

How do different people/groups use and value wetlands?

How do environmental and human processes and connections change wetlands?

What role do wetlands have in the environment?

How can changes to wetlands be managed?

Appendix F: Pre-field trip activity sheets

These activity sheets were adapted from Wow: The Wonders of Wetlands—The watercourse and Environmental Concern Inc. and developed by the Great Barrier Reef Marine Park Authority for the Wetlands Curriculum with the Queensland Wetlands Program.

Where do I Fit

A1_where_do_I_fit.pdf

Potable Water

A2_potable_water.pdf

Runoff Capture

A3_runoff_capture.pdf

Wetland Filter

A4_wetland_filter.pdf

Erosion Filtering

A5_erosion_filtering.pdf

Introducing Wetlands

A6_introducing_wetlands.pdf

Touch Feel Think

A7_touch_feel_think.pdf

Metaphors

A8_metaphors.pdf

Not Right

A9_not_right.pdf

Appendix G: Risk Assessment

Please refer to the Department of Education, Training and Employment Curriculum Activity Risk Management Guidelines and School Policy and Procedures:

http://education.qld.gov.au/curriculum/carmg/index.html

Appendix H: Field trip activity sheets

Find monitoring record sheets for beginners at:

http://nrmeducation.net.au/index.php?page=monitoring-activities

Appendix I: Water quality testing information

Tools will vary for freshwater, marine and rainfall events.

Greening Australia has an excellent, yet basic, water quality testing manual at:
http://www.greeningaustralia.org.au/uploads/Our%20Solutions%20-%20Toolkit%20pdfs/NT_14_Water_Tests_Web.pdf

or

Download instructions for testing turbidity from the World Health organization at:
http://www.who.int/water_sanitation_health/hygiene/emergencies/fs2_33.pdf

or

Find test information for water quality testing methods
at: http://nrmonline.nrm.gov.au/catalog/mql:2880

Appendix J: Aquatic macro-invertebrates identification guide

http://www.qld.waterwatch.org.au/resources/pdf/bug_id_partb_web.pdf
and recording sheet
http://www.qld.waterwatch.org.au/resources/pdf/bug_id_record_sheet_basic.pdf

Greening Australia has an excellent, yet basic macro-invertebrates water manual at:
http://www.greeningaustralia.org.au/uploads/Our%20Solutions%20-%20Toolkit%20pdfs/NT_14_Water_Tests_Web.pdf

or
Use the resource sheet on the following page.

Conducting a waterbug survey

Resource sheet 8 (for students)

The number and variety of waterbugs found in a stream can give an indication of the relative levels of water pollution. (Note that the term 'waterbugs' is a common name used to refer to macro-invertebrates — animals without backbones that are large enough to be seen with the naked eye. The term includes animals that are not true 'bugs' — a type of insect.)

Materials

- Dip nets—either commercially bought nets from aquarium suppliers (6 inch, fine mesh) or homemade nets prepared beforehand (see Resource Sheet 6)
- Small buckets (large yoghurt containers)
- Small paint brushes
- White ice-cube trays
- Forceps
- Hand lens
- A large white shallow tray (e.g. a tote-box)

Method

1. Half-fill a small bucket with water from the waterway. Use it immediately to hold any waterbugs you catch.
1. Gently run the dip net through the waterplants along the edge of the waterway.
2. Overturn rocks and check to see if there are any waterbugs underneath them.
3. Remember to replace the rocks as you found them.
4. See if you can catch any waterbugs swimming near the edge.
5. Once you have caught some waterbugs, put some water in the ice-cube trays and sort the waterbugs into each compartment.
6. Now use the identification sheet to work out what each one is. List the names of the waterbugs in the table below. List each name only once.
7. When you have finished collecting, pour your waterbugs into the large tote-box so that the other groups can see what you have caught.
8. Each waterbug illustrated in the identification chart has a sensitivity number next to it in brackets. Note the numbers for each of the water-bugs in your list. Add the numbers together and you have got a 'stream pollution index'. The higher the total, the cleaner is the water.

After the activity, return animals to the place where they were found in the water.

Waterbug	*Sensitivity number*
Stream pollution index:	

(The 'Conducting a waterbug survey' activity is adapted from Foster 1994, *Waterwatch Queensland Technical Manual* and Hauenschild 1999, *Forest Waterways*.)

Identification chart

Sensitive

(8) Stonefly nymph–30 mm 

(7) Mayfly nymph–30 mm 

(6) Caddisfly larva–20 mm 

(6) Dragonfly nymph–40 mm 

(5) Water mite–4 mm 

Tolerant

(4) Yabby–200 mm 

(4) Freshwater mussel–50 mm 

(3) Water flea–8 mm 

(3) Fairy shrimp–30 mm 

(3) Planarian–15 mm 

(3) Pond snail–25 mm 

(3) Leech–100 mm 

(3) Lesser water boatman–15 mm 

(3) Water strider–8–12 mm 

(3) Whirligig beetle–12 mm 

(3) Water tiger beetle–30 mm 

Very tolerant

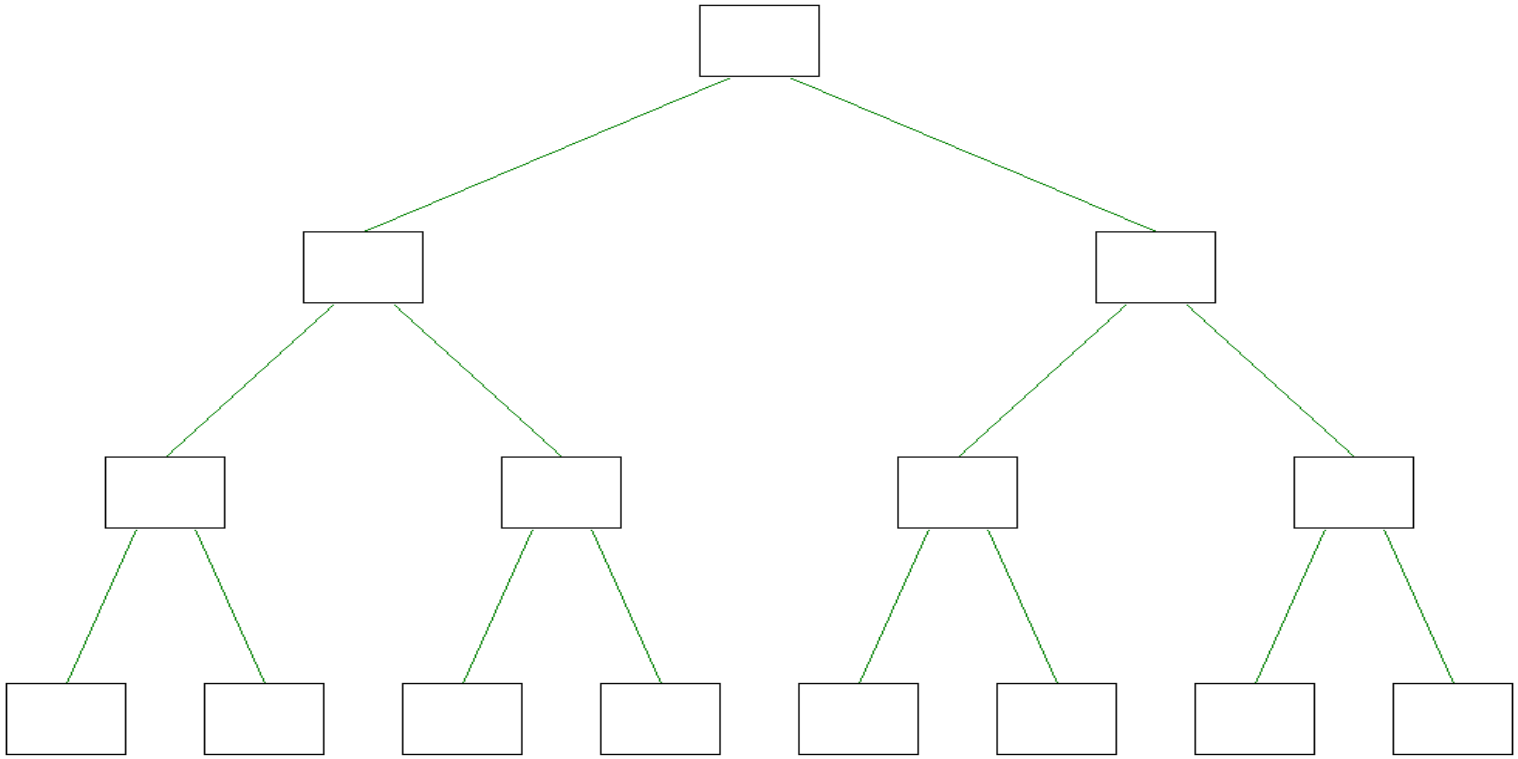
(2) Midge larva–12–14 mm 

(2) Mosquito larva–12 mm 

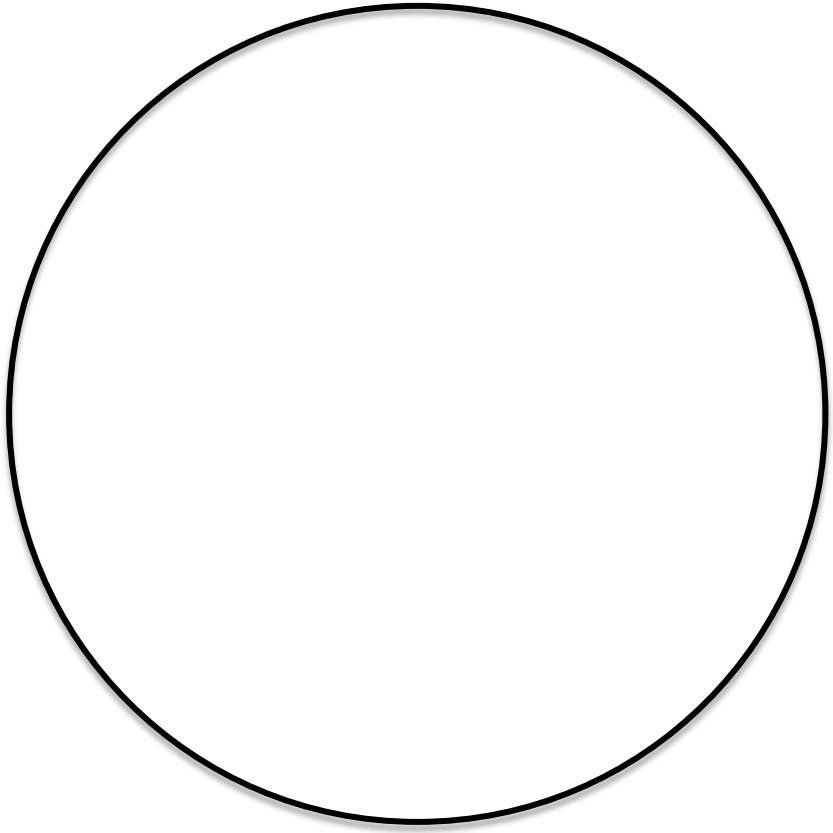
Illustrations from *Ponding*, Gould League of Victoria, 1992

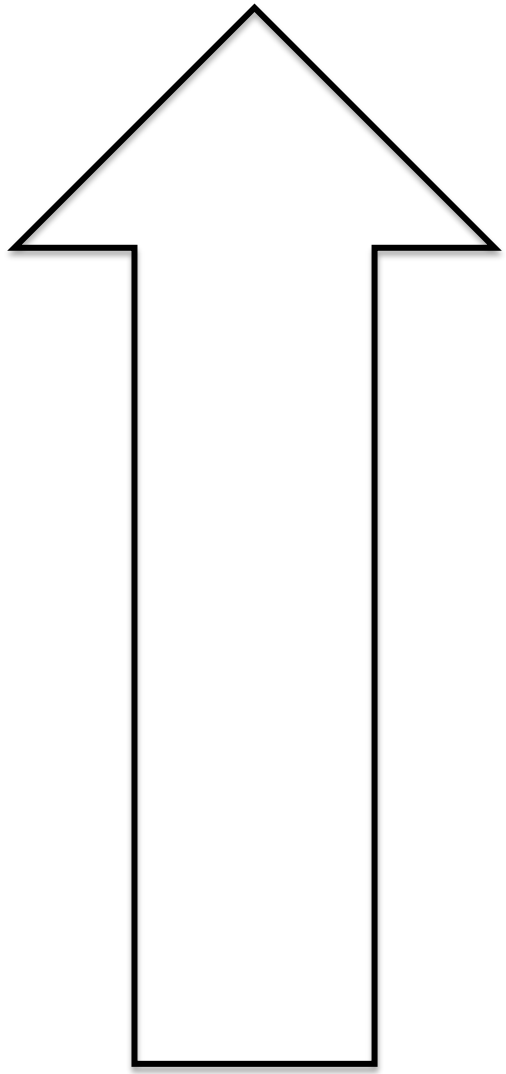
NAME: ……..

Appendix K: Branching Database



Appendix L: Concept map template





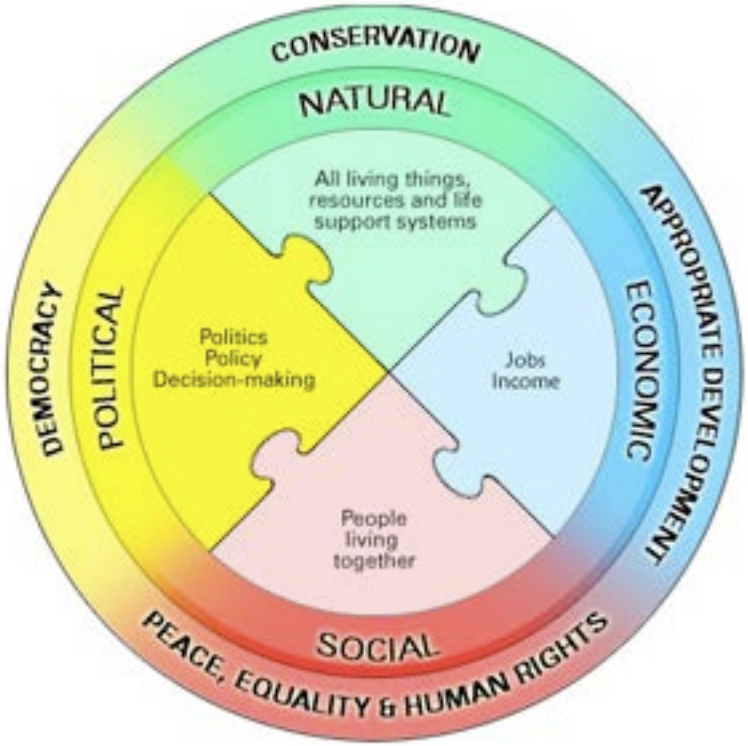
Appendix M: Sustainability compass

Natural systems that provide the resources—air, water, soil, food, etc.—that support all life—human and non-human;

Social and cultural systems that provide family, community and wider support for people to live together in ways that are culturally appropriate.

Economic systems that provide a means of livelihood (jobs and income) for people.

Political systems through which social power is exercised to make policies and decisions about the way social and economic systems use resources in the natural environment.



The 'sustainability compass' is from *Teaching and Learning for a Sustainable Future* (UNESCO)
Retrieved on 26/4/12 from http://www.unesco.org/education/tlsf/mods/theme_a/mod04.html?panel=1#top

Appendix N: K.W.L. chart

What I know, What I want to know, What I have learnt (adapted from Eric Frangenheim's Reflections on classroom thinking strategies see p. 63)

Know *What I know*	Want *What I want to know*	Learnt *What I have learnt*

Frangenheim, E. (2007). *Reflections on classroom thinking strategies,* (9th Ed). Loganholme: Rodin Educational Publishing.

Appendix O: Wetland use T-Bar

Your entity:

Black Hat (disadvantages)	Green Hat (improvements)

Frangenheim, E. (2007). *Reflections on classroom thinking strategies*, (9th Ed). Loganholme: Rodin Educational Publishing.