Wetlands education toolkit

A field study and classroom teaching guide for Middle years–

National Curriculum Science and Geography.

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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).

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 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.