February 2008

To the teacher

Wetlands

This unit of work focuses on wetlands and can be adapted to be used with pond studies, marshes, swamps or even boggy areas within paddocks.

It aims to give children awareness, knowledge, skills and values to take responsibility for this important part of the environment. The information within the unit is aimed at Levels 3 and 4 but can be adapted to suit all class levels.

The material within the unit is sourced from a number of areas with the majority coming from either a document issued by the University of Otago or from Taranaki Regional Council documents and the expertise of council staff. The activities do not need to be completed in any particular order and teachers need to exercise their professional judgement as to what activities best suit the needs of their classes.

- It is hoped that you find this unit of use and we welcome any feedback. Please feel free to photocopy the material within the unit at your discretion. If you would like more assistance or our Education Officer to help with a field trip or class visit please don't hesitate to contact the Taranaki Regional Council.

Yours faithfully
B G Chamberlain
Chief Executive

per: R J Ritchie
Senior Information Officer

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Cross-curricula

Links to the Essential Skills

Communication skills

- Communicate ideas, feelings, experiences and beliefs
- Articulate critical views and judgements

Social and Co-operative skills

- Negotiation
- Develop audience skills, such as listening and view responsively
- Assume a range of responsibilities in group situations

Problem solving skills

- Exercise imagination, initiative, flexibility and judgement
- Plan strategies to meet challenges and resolve problems
- Recognise that there may be multiple solutions to any given problem

Self-management and competitive skills

- Set and achieve realistic goals, individually and in groups
- Evaluate their achievements as individuals or as group members
- Develop constructive attitudes and approaches to personal challenges
- Demonstrate commitment, perseverance and responsibility in contributing to projects and/or activities
- Adapt to new ideas and situations
- Develop skills of self-appraisal

Information skills

- Locate and retrieve information from a variety of sources
- Process and make decisions about information for particular purposes
- Organize and present information effectively and accurately

Numeracy skills

- Use a variety of approaches to measurement
- Use and interpret graphs, charts and tables to plan and undertake activities

Work and Study skills

- Take increasing responsibility for their own learning
- Organise time and meet deadlines
- Develop efficient and effective work habits as independent learners and in group work

Curriculum Links

Mathematics

Statistics

Children will have opportunities to recognize appropriate statistical data for collecting, organizing and analyzing data, and presenting reports and summaries.

Number

Children will have opportunities:

- to develop an understanding of numbers, the way they can be represented and the quantities for which they stand in order to develop accuracy, efficiency and confidence in calculating – mentally, on paper and with a calculator.

Measurement

Children will have opportunities to:

- develop knowledge an understanding of systems of measurement and their use and interpretation.
- develop confidence and competence in using instruments and measuring devices.

Social Studies

Place and Environment: Achievement Objectives

Aims Students will gain and apply knowledge, ideas and skills to understand interactions between people and environments.

Level 1 Using a range of skills, students will demonstrate their understandings of how a natural feature in the local area can affect people and vice versa.

Level 2 Using a range of skills, students will demonstrate their understandings of how and why people perceive their local area differently.

Level 3 Using a range of skills, students will demonstrate their understanding of peoples' perceptions of different environments and the reasons for these perceptions.

Level 4 Using a range of skills, students will demonstrate their understandings of how and why the interactions between people and the environment change over time.

Culture and Heritage: Achievement Objectives

Aim Students will gain and apply knowledge, ideas and skills to understand the bicultural identity and heritage of people in Aotearoa New Zealand.

Science

Making sense of the living world

Achievement Objectives

In their study of the living world, students will use their developing scientific knowledge, skills and attitudes;

- To gain an understanding of the order and pattern in the diversity of living organisms, including the special characteristics of NZ plants and animals.
- To investigate and understand between structure and function in living organisms.
- To investigate and understand how organisms grow, reproduce and change over generations.
- To investigate local ecosystems and understand the interdependence of living organisms, including humans and their relationship with the physical environment.

Making sense of planet Earth and beyond

- Investigate how people's decisions and activities change planet Earth's physical environment, and develop a responsibility for the guardianship of planet Earth and its resources.
- Investigate Earth science features of local and national significance.

Making sense of the physical world

In their study of the physical world students will use their developing scientific knowledge, skills, and attitudes :

- To gain an understanding of the nature of physical phenomena from practical investigation.
- To explore and establish trends, relationships, and patterns involving physical phenomena.

Technology

Contents: Environmental: Community

Technological knowledge and understanding

- Students investigate an environment eg a pond on a farm.
- Teacher arranges for an expert to talk about a pond based ecological community.
- Students visit the pond to view the environment and the interaction that takes place.

Technological capability

- Students consider the needs of specific animals in terms of water quality, temperature, protection from predators and access to food.
- Students in groups devise and apply methods for capturing, identifying and releasing animals for study purposes.
- Students compare findings from one site to another.

Technology and society

- Students investigate how wetlands have been used by society for many purposes.
- Students survey people to see how what they know about wetland areas and their attitude towards retaining them.

Assessment

- Students write a report on their findings.

Introduction

Wonderful Wetlands

Wetlands - the indistinct boundaries between water and land. They come in various sizes, they are partly wet and partly dry. Some dry up completely during dry times but most of them retain water because the water table below them is nearly always high. However the water in them is nearly always shallow. Some are only fed by rainwater and these ones are called bogs or tarns. Others have fresh water flowing through them and some have both fresh and sea water flowing in and out with the tides.

NZ has some important wetland areas such as the Kaimaumau Swamp(Northland), Whangamarino Swamp (Hauraki Plains), Kopuatai Peat Dome (Hauraki Plains), Lake Wairarapa, and the Waituna wetlands (Southland).

Over 90% of NZ's wetlands have been destroyed.

Early Polynesians found not only mountains and trees but huge areas of wetland. Early Maori used these wetlands as we use roads, they were an important way to travel.

They were a huge resource to Maori as a food source-eels, birds, fish. But no resource is endless if it isn't looked after properly eg the Moa, NZ swan, NZ Flightless Goose have became extinct. But in the main Maori used wetlands well. They came to regard the wetland as a sort of seasonal takeaway place.

Early Europeans were different, they thought they didn't need the swamps. So they changed them into farmlands by cutting down the trees, draining the swamps, planting their crops or grazing them with sheep and cattle. But some areas were so wet they were very difficult to drain so they came up with special water pumps which had the same effect on the wetlands as we would feel if we had our blood away removed.

Huge numbers of our native Kahikatea were cut down and used to make boxes to package butter from the farms for export.

So many wetlands were destroyed and worse still houses and towns were then built upon the new land. Not too long ago some farmers were forced by law to drain their wetland areas whether they wanted to or not. How stupid is that?

Some modern wetlands are now preserved by a Queen Elizabeth 11 covenant which is a legal document attached to the land protecting it from being developed or drained. Others are protected because they are situated within one of NZ's 13 National Parks.

But some of our wetlands are still used as dumping places for all sorts of unwanted material including poisons and sadly less than 10% now remains. However all is not lost as the numbers are starting to increase again and some farmland is now being returned to its natural state.

Wetland facts

If you think of the land as a living body then the land needs the wetland to stay healthy. Wetlands act as our kidneys do. They filter out impurities such as fertilizers and soil that gets washed off the land, and the wetland plants also assist by slowing the erosion process.

Water often enters a wetland in a degraded condition and emerges from it in a cleaner condition. In fact in North Canterbury they are starting to use wetlands as part of their treatment of waste water.

In NZ, floods are becoming more common. Why is this? The main reasons are the amount of tree cutting that has occurred and the draining of our wetlands. Floods cause damage to everything including humans. Wetlands are like giant sponges, the greater the area of the wetlands, the bigger the sponge and the less likelihood of the total area flooding.

Wetlands help also when everything turns dry, they release water slowly into streams and rivers and stop them from drying up. Why is this a good thing?

Wetlands can be treasure troves. Ten thousand moa bones were recently discovered in one North Canterbury swamp.

They are great places to visit for bird watching, fishing, boating, shooting and even windsurfing.

Continents with large wetland areas

Asia

- India, Bangla Desh, Burma, Thailand, Indonesia,

North America

- USA,

South America

- Chile, Brazil, Ecuador and Venezuela

Africa

- Sudan, Zaire, Congo and Mozambique

Europe

- Norway, Sweden, Finland, Denmark, Holland, Great Britain, Iceland

Famous wetlands

- Florida Everglades (USA)
- Amazon Floodplains (Brazil)
- Mississippi River delta (USA)
- Fens of Eastern England
- Okavango Delta of Botswana
- Kakadu National Park (Australia)
- The Billabongs (Australia)

Extinct birds

- For such a young country NZ has a long list of extinct birds. There are in fact 57 of them, 16 became exist before human beings arrived leaving 41 that have been lost forever since human beings first set foot in NZ. Included among them is the moa, the tallest bird ever known.

Activity 1: Class discussion

On a whiteboard or large piece of paper discuss

1. What is a wetland?

Possible answer An area where land and water meet. They have many types including swamps, tarns, bogs, marshes, ponds.

2. Where does a wetland form?

Possible answer In an area that is lower than the surrounding land and is usually rather flat.

3. Where does a wetland end ?

Possible answer Where there is sufficient slope for the water within the wetland to drain away slowly.

4. Where does the water come from to form a wetland?

Possible answer From rainwater, groundwater, from streams that flow into it, from water running off from the land surrounding the wetland.

5. Why do we have less than 10% of our wetlands left?

Possible answers Because they have been drained away by farmers who wanted to use the land for farming purposes, or the land has been developed and is now used as sites for some of our towns and cities.

6. Why do many people think it is important for us to retain our wetlands?

Possible answers Because they are an important natural resource which once taken away will be difficult to get back. Because they are an important recreational area. Because much of our bird and fish life use wetlands as their habitats.

How many of us have been to a wetland area recently?

- □ Have you ever seen birds in the area?
- □ Have you ever seen evidence of shooting, fishing or boating?

Activity 2: Mapping and diagram of wetland terms

Cross section of a pond

Sketch your wetland area. Identify the different physical structures that assist in the formation of the wetland, try to show the depth of the wetland and the vegetation on the banks and within the wetland area.

Activity 3: How wetlands are made

Water flows from higher ground into the flattish, wetland area and takes a long time to move away. This causes the water to gradually sink into the ground to produce a very high water table unlike a river system where the water moves rapidly downstream because of the natural slope of the land.

Experiment 1

- Lie several layers of newspaper flat on the ground or concrete.
- Make up to 10 rolls of newspaper, balls of newspaper and place on top to resemble the bottom of a pond
- Make a very slight border around the perimeter, it will not matter if some of balls and rolls of newspaper are above the rim. They can be the islands within the pond.
- Gently spray water onto the cardboard until the water level is nearly level with the border.
- Make a small gap in the border.
- Observe and time how long the water takes to drain away.
- Before it completely drains away, replace the gaps with newspaper and refill as before.
- Again open two small gaps and observe and time how long it takes for the water to nearly drain completely away.

You could repeat this process three or four times to see if the process of draining away gets

- Slower
- Quicker
- Always the same

If the time for draining either increases or decreases try to work out why this is so?

Note - It is very important that you have your newspaper is placed on a flat area such as a netball court and you do not allow the newspaper to dry out while you carry out this investigation.

Activity 4: Pollution

Because most wetland areas receive water directly from the land much of the water in them can be quite polluted on its arrival. But the wetlands act as a cleaning agent in much the same way as our kidneys purify our blood, allowing waste products to be removed.

Experiment 2

- Create an artificial landscape as you did in experiment 1. You could use the same structure if it is possible.
- Before you start make sure you have a saucer handy and five glasses labeled 1-5.
- Spray water into your pond until it is at a reasonable level.
- Gently add some detergent into the water.
- Mix the detergent into the water and leave for 10 minutes.
- Fill the glass labeled 1 with water from the pond you have made.
- Open the small gaps as in experiment 1.
- As water drains away try and collect some of the water in a saucer.
- Transfer the water into a glass which is labeled 2.
- Repeat this process every 3 minutes, making sure you collect the second sample in glass number 2 ,the third sample in glass number three etc.
- Line the glasses up from 1 to 5 and see if you can detect any slight improvement in the clarity of the water.

As already mentioned wetlands generally release water in a better condition than when it enters. This is a result of several factors with slow release being one of them. Others include the vegetation soaking up some of the material and the sinking of some of the polluted material to the bottom of the wetland.

If you did this experiment using oil and water what would the results show?

Activity 5: Water temperature

The temperature of the water in wetlands is generally warmer than is found in nearby steams and rivers particularly in summer.
Scientists monitor water temperatures as this can have quite an effect on pond life especially in summer when air temperature is higher and the depth of the pond is lower.

Wetlands generally have little shade and are particularly vulnerable to increased water temperature.

Warm water temperature can affect wetlands water temperature in the following ways

1. Less dissolved oxygen in the water

Warm water holds less dissolved oxygen than cooler water. Some species eg trout cannot tolerate warm water temperatures. Some organisms such as fish and invertebrates use more oxygen in warmer conditions as their metabolism increases.

2. More plant and algae growth

Warmer temperatures enable plants to grow more vigorously and can lead to more algae and plants clogging waterways. This plant life uses oxygen from the water during the night.

3. Greater sensitivity to toxic waste, parasites and diseases

Warmer temperatures badly affect most aquatic organisms and make them more prone to other stress. The larvae of some fish are even less tolerant of extreme temperatures.

4. Decreased invertebrate communities

- Stonefly numbers decreased markedly if temperature reaches 19 degrees C
- Temperatures between 21-24 degrees C may be lethal to many invertebrates.
- Certain undesirable life may flourish in high temperatures eg sewage fungus.

What causes increased water temperature?

1. Warm water being put into the waterway. In ponds this is usually from surface run-off.
2. Low flow conditions allowing shallow waterways to heat up more easily due to increased surface area.
3. Sediments which absorb more heat and actually decrease the depth of the water even further.

4. Removal of vegetation around waterways allowing the sun to shine directly onto the water.

Riparian Planting

The word riparian means 'alongside a waterway'
One of the best ways to reduce water temperatures and to increase water quality is to plant trees and other vegetation along the sides of waterways.
The Taranaki Regional Council Education Officer can take a riparian planting lesson for your class. The lesson involves a short talk on riparian management, a video presentation and a group activity.

In addition to keeping the water cooler, riparian planting also has the following benefits

- Reducing the run-off of pollutants into waterways
- Reducing the impact of flooding
- Providing habitat for wildlife
- Providing shelter
- Reducing erosion
- Reducing algal growth

Activity

- Practise using a thermometer correctly.
- Using the same thermometer, ask several children to read it and write down as accurately as possible their readings.
- Compare the differences in different children's readings. This emphasises the need to be accurate and provides a more accurate measurement.
- Ensure children are aware of the scale of the thermometer and what each incremental line means.
- Practise taking the temperature in different water bodies in the environment. It is important to keep the thermometer in the water when actually reading the temperature.
- For example, a puddle, the school pool, a goldfish bowl, the local stream or river.
- Also measure air temperature comparing full sun with shade.

Experiment

Measure the water temperature in a tray of water that has been in direct sun all day and compare the measurement with a tray of water that has had shade over it.

Ask children to say which result is more likely to represent a pond rather than a stream and why this is so.

Activity 6: Chemistry-ph

Wetlands have all sorts of pollutants in them, some of them naturally occurring, many of them caused by humans.

One of the tests that scientists do to see if there is pollution in water is a ph test. A ph test tells us if the water is acidic or alkaline.

The scale goes from 0-very acidic to 14 –very alkaline.
Each ph step away from neutral is a ten fold increase in acidity or alkalinity eg ph 3 is ten times more acidic than ph 4.

Most rivers and streams in Taranaki are slightly alkaline eg they have a ph reading from 7 to 8.

Acidity in water can be caused by an acid spill into the water such as an accidental spill of trade waste. Acidic water can kill fish living in the water and in turn this helps to make the water become very toxic. Conversely some water is very alkaline. This can be caused by fertilizers/detergents being put into the water resulting in excessive plant growth which can use up valuable oxygen from the water.

Experiment

You will need
- 3 beakers or jars,
- ph indicators and colour match sheets
- an acid solution such as vinegar dissolved 50-50 in water
- an alkaline solution such as baking soda or bleach mixed with water (10 mil of bleach in 50 ml of water makes a good alkaline solution
- a sample of pond water

Mix each solution and place the indicator sticks in each one, match the sticks against a colour chart to determine the ph level of your samples.

If you require more ph indicator sticks please contact the Taranaki Regional Council Education Officer.

Discussion

Which of the results is closest to the results from the pond water?
Discuss why you think this is so and would the same results be found if you used fast flowing river water or water straight from your drinking tap?

Activity 7: Turbidity

Turbidity is a measure of water clarity. Lack of clarity is usually caused by sediments being mixed up with the water.

Very turbid water looks dirty and can affect the quality of life of the animals living in it.

High turbidity causes some fish to have difficulty feeding as they cannot easily see their prey.

Activity

Think about the things that could make water more turbid eg rain washing over muddy ground with no plants. Design and make your own turbidity device by filling a glass jar with pond water and see if you can easily see through it.

Do this again by stirring up the water from the bottom of the pond and then noting the difference.

Activity 8: Pond life

Invertebrates are animals without backbones and some of them live in our wetlands. There are many varieties and they are an important part of the food chains of birds and fish. Ponds are the habitat for many common invertebrates in their larval stage including some mayflies, caddisflies and midges.

These larvae feed on plant debris and algae in the water, some also feed on other insect larvae.

Fish feed on these invertebrates. Bigger fish such as eels and trout feed on these smaller fish as well as some of invertebrates. Birds also may feed on the smaller fish. Humans sometimes eat eels and large fish like trout to end the food chain-aren't we the lucky ones?

Life Cycles

Insects are probably the most successful creatures living in our wetland areas. These wetland insects have adapted from living on land and spend much of their life in the water. They have modified their breathing systems by having gills which take in oxygen from the water.

These insects have a good supply of food from the wetlands, living off tiny plant and animal matter.

Most of the adults leave the water and return to the air. Why?

Moving away from the water enables the adults to lay their eggs in other areas. The larvae spend their time feeding and growing, while the adults purpose is to breed and ensure their eggs are dispersed.

Many adults have a very short life.

Activity

Decide on two invertebrates and carry out an investigation of each. You could focus on the life cycle of each.

Water quality indicators

As well as being part of the food chain and having interesting life cycles these invertebrates tell us how healthy a waterway is.

Some invertebrates can live only in the cleanest water but many can live comfortably in water that is of poorer quality.

Scientists choose various sites and collect invertebrates in a net and then identify the creatures.

Each creature is given a grade from 1 to 10, 1 being very tolerant to polluted water, 10 being very sensitive to polluted water.

For example most mayflies have a score between 7-10, this means they usually live in quite high quality water.

Caddisfly species scores are generally around 5-8 but some can be as low as 2 and as high as 10.

Worms tend to be in the 1-3 suggesting they enjoy rather polluted water

Activity

Invertebrate sampling

Equipment - sieve or net, brush, white sorting tray, magnifying glass, identification sensitivity score sheet (available from Taranaki Regional Council).

Method

- Find a safe area of a pond where all children can be viewed.
- Holding the net or sieve close whilst you brush the under-surface of the submerged vegetation on the edge of the pond so the invertebrates float into the net or sieve.
- Empty the sieve or net into the sorting tray and identify them using the guide.
- Do not be alarmed if you cannot identify all of the species.
- Average the sample and multiply by 20 to give your site a score.
- Try the procedure at several sites for comparison.

Scores for your interest

120 -140 represents water in very healthy condition.

90-120 represents water in healthy condition.

Less than 90 represents water than is in fair or poor condition depending on the nearness of the score to 90.

Activity 9: Art - illustration

This is a method of evaluation to help children express what they have learned about pond life and other issues.

This art activity could be done across two pages of an exercise book or on a piece of paper horizontally.

Ideally it could be done across a long, classroom wall.

- The first task is to represent the pond area with a section across the entire length of the wall coloured blue to represent the water. This can be done with paint or crayon or dye. It could be done on the floor or directly onto the paper attached to the wall.

- The next step is to add to the wall illustrations of islands, rushes, animals, rocks etc.

- Above the water children can place trees and other plants, people fishing, canoeing, houses, discharges and intakes.

- It would be easier if the children choose to do their pictures separately and then add them to the mural as they finish them.

- The pictures can also have captions or speech bubbles with them to show knowledge they have gained.

- eg,' the dragonfly swoops to capture its prey in flight and under its wings'

- I am a long finned eel. I am the largest freshwater fish in NZ. I started my life as an egg somewhere near Tonga or Fiji and as a baby eel (elver) I swam all the way to a river mouth in NZ. I spend all of my adult life in streams, lakes, ponds or rivers until I reach at least 20 years of age when I decide I must go back to where I was born or somewhere near there. When I arrive I lay my eggs and quickly die.

- Children can also use collage or prints on the mural.

Activity 10: Evaluation-Knowledge Test

Question Page

1. How did the early Maori travel through the wetlands?
2. What animals did the Maori harvest from the wetlands?
3. Did harvest by the Maori have any long-term harm to any wildlife species?
4. What did the early European settlers use the wetlands for?
5. What technology did the Europeans bring to NZ that they used to remove water from even the wettest areas of land?
6. A wetland is sometimes compared to what organ of the human body because of the way it cleans water just as the way the organ purifies blood?
7. What percentage of NZ's original natural wetlands is left today?
8. You don't have to drain the water out of a wetland to destroy it. What are two ways in which wetlands can be destroyed without draining them?
9. What is an invertebrate?
10. How many different species of native fish are there in NZ?
11. How many different types of eel are there in NZ?
12. Where do eels go to breed?
13. What are whitebait?
14. What does a water turbidity measurement show?
15. Are trout a native species?
16. Why are trout not found in many wetlands?
17. How do dragonflies get their food?
18. What do koura eat?
19. How long do some dragonflies stay as nymphs?
20. Can a water boatman fly?

Answers

1. In their canoes both large and small.
2. Eels, other native fish, wetland birds of various types.
3. Yes at least three birds became extinct.
4. By draining them and turning them into farmland.
5. Pumps.
6. The kidney.
7. Less than 10%.
8. They use it as a rubbish dump or they pour poisons into them.
9. An animal that does not have a backbone.
10. 34 - only one the grayling was so overfished it is now extinct.
11. 3, the long and short finned varieties and the spotted eel.
12. Close to the equator near Tonga and Fiji in the Pacific Ocean.
13. Juvenile forms of 5 native fish.
14. It shows the amount of suspended solids in the water and how clear the water is.
15 No they were introduced here from Britain and USA mainly as recreational game fishes.
16. They prefer streams and rivers where the water contains more oxygen.
17 By catching their prey in mid flight under their wings.
18. Just about anything, they are scavengers.
19. Up to 6 years.
20. Yes.