

Going with the

Flow

Teacher's Guide Book

*An education package about energy, water
and waste water efficiency in Western
Australia.*

Acknowledgements

This school education package is one component of an education package designed to promote the efficient use of electricity and water in Indigenous communities.

The development and implementation of this package was supervised and funded by the Aboriginal Communities Essential Services Steering Committee. This group consists of the following agencies:

- Office of Energy;
- Office of Water Regulation;
- Department of Housing and Works;
- Department of Indigenous Affairs; and
- Aboriginal and Torres Strait Islander Services.

The Committee acknowledges the financial support of these government agencies towards the Energy, Water and Wastewater Efficiency Education Package. Financial support has also been received from the Department of Education and Training to sponsor Government schools participating in the program and the Sustainable Energy Development Office to conduct energy audits in schools and communities.

Many people and organisations have contributed invaluable expertise, ideas and/or feedback during the development phase of this package. The project team would particularly like to thank the stakeholders and schools who have reviewed draft material along the way.

Special acknowledgement is extended to Sally Edwards, The Curiosity Company, for developing the contents of the package. The Dingo Crew has come to life through the illustrations of Greg Mitchell, Major Mitchell Productions. Kate Mitchell provided design and layout services. The Steering Committee thanks Sally, Greg and Kate for their enthusiasm and contributions to this education package.

Lastly, thank you to the Office of Energy and the Office of Water Regulation for providing the resources to bring this education package to fruition.

John Filippone, Office of Energy
Chairman
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Disclaimer

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Australian Government
Aboriginal and Torres Strait Islander Services

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Introduction

Hello and welcome to Going with the Flow. This is an energy, water and waste water efficiency education package designed especially for use in schools in regional and remote Western Australia. It has been developed as part of a broad community education program which aims to empower people living in small towns or remote places to manage their energy and water usage, preventing debt and supply problems.

There are unique cultural variations between communities and schools in Western Australia. This package has therefore been designed to be as flexible and versatile as possible. It is designed primarily for students aged 8 to 10 and aims to offer learning value from Levels 1 to 3. The student workbook, for example, requires minimal written skills while the teacher's guide book has a whole section of handouts and prepared worksheets involving more developed literacy skills. The activities themselves have a high 'action' component with plenty of hands-on investigative work, a strong emphasis on students learning about their own environments and built in versatility to allow for different learning styles. There is also plenty of scope for humour and entertainment value in the lesson materials, designed to make them as appealing and engaging as possible for students of middle primary age, regardless of their level of literacy or numeracy.

One of the unique features of this package is the fact that it comes with everything an educator needs to get started - including all student workbooks, experiment, demonstration and activity equipment. All educators need to do is photocopy any supplementary handouts they think suitable for their students. It is also supplied to participating schools at no cost. All schools need to do is commit to teach the package at least once a year for no less than three school years and report regularly on their progress.

For further information about the package as well as the overall community education program it is linked to, contact the Community Branch of the Office of Energy on telephone (08) 9420 5600, fax (08) 9420 5700.

What's in this Package?

This package contains:

- *Student Workbooks* -

3 class sets, more can be provided free of charge as required - simply contact the Office of Energy.

- *Teacher's Guide book* contains copies of the following:

Background

Guidelines

Lesson Plans

Handouts

Extension Handouts

Assessment Guidelines

- *Full kit of activity and experiment equipment*

- *Supply of stickers, posters and other*

incentive/recognition materials for the educator to use.

- *Contact sheet* with details of relevant people in the community/s associated

with your school

- 3 copies of *'Ollie Saves the Planet'* interactive CD

Aims

The package has some very important aims:

- To contribute towards key outcomes of the Curriculum Framework for Western Australia particularly in the Science and Society and Environment Learning Areas with additional value in Mathematics, Technology and Enterprise, English, Health and Physical Education and The Arts.
- To help schools reduce their expenditure on water and energy, freeing funds for other purposes.
- To help students in regional and remote Western Australia develop knowledge, understanding and skills of particular relevance to their community and lifestyles, assisting them to prepare for beneficial decision making and behaviour choice in adolescence and adulthood.

It has been designed with the following features:

- Lessons complement each other but are not necessarily sequential, they are suitable for situations with high student absence rates.
- A student workbook with a unique balance, requiring only formative literacy and numeracy skills complemented by a range of support handouts to develop and reflect later levels of literacy and numeracy.
- Designed to be suitable as a series of twice-weekly lessons in a one-term intensive module or once-weekly lessons over a one-semester format.
- Built in adaptability to variations between remote communities and those located closer to regional towns.
- Does not require or assume any specialist knowledge on the part of the educator.
- All necessary equipment and materials are supplied. Only small amounts of normal classroom supplies such as glue, scissors and pencils are required from the school.

Guidelines for using this Package

Can I have a list of lessons?

We have provided a summary sheet that sets out the lessons in this package. It sets out the overall topic, recommended lesson format and gives an indication of how much preparation is required. The summary also details whether we have suggested a demonstration component and if there are handouts or extension materials provided.

Do I have to teach all of the lessons?

It is not necessary to teach all the lessons but the more the better. It is important to remember, however, that joining this program commits the school to teaching at least 16 of the lessons with each participating class. The lesson summary indicates which lessons are considered 'core' and these must be included in the 16.

Do I have to teach the lessons in a particular order?

You can choose the order that you teach the lessons. We have provided suggestions in the notes for each lesson but you know your students' and school's needs best so this is up to you.

Can I replace or adapt lessons?

Yes, absolutely - educators are always the best judge of what will work with their students. The only condition is that you need to make sure the new lesson matches the messages of the one it is replacing. This is especially important with core lessons (see summary sheet). If you adapt a lesson, we do ask that you let us know what you did, how it went and what you would do differently next time so we can share this with other participating schools (naturally, you would get all the credit for this!).

Getting Started

Here's a useful checklist of things to do before you use this package in your classroom.

- *Find out* how much water and energy the school has been using in recent years.
- *Read this* pack (only 1-2 hours) and the lessons.
- *Check the contents* of your kit.
- *Find out who* the local energy and water contacts are for your community/s (see our contacts sheet for help with this).
- *Contact* and possibly meet relevant people to let them know what you are doing and when. 'Pick their brains' to find out as much as you can about the water and energy systems in your community/s.
- *Make plans* for any excursions or special guests.
- *Check out library* supplies of relevant resources.
- *Talk to other local educators* for their advice, support and any useful resources they might have.

Five Minute Expertise: Educators' Background Notes

Energy and Water in Regional and Remote Western Australia

There are particular challenges and opportunities involved in supplying energy and water to people living in regional and remote Western Australia. The geographical and climatic conditions vary greatly between regions. Communities tend to be small in number and widely distributed which makes infrastructure difficult and expensive to supply and operate. Nonetheless our communities' demand for reliable, safe energy and water supply continues to increase. The Government of Western Australia has for some time been working towards improving services to small communities and has committed to providing these services at the same cost to consumers as those in metropolitan areas, despite the vastly higher costs of supply. Nonetheless this poses some social education challenges. Many members of small or remote communities are not aware of the systems involved, how much energy and water are used for different purposes or, importantly, the new payment systems. This could mean spending a disproportionately high amount of a limited income on energy and water. It could even lead to problems of personal or community debt.

For long term community capacity building and prosperity, it is essential to help students and their families develop clear understandings of the energy and water supply systems - how they work, how they can be used most efficiently and how they are paid for.

Behind the Switch

Energy

Energy can be a challenging concept for anyone to understand, never mind defining it. Science defines it as "the capacity to do work". It can also help to think of energy as 'the ability to cause change'.

Energy exists in several different forms including electromagnetic radiation, sound energy, potential energy (stored energy), kinetic energy (movement), heat energy, nuclear energy, electrical energy and mass.

Energy is never created or destroyed - it is always transformed from one type into another. The total amount of energy in the universe stays the same.

Electricity

Electricity has been a very convenient way for people to use energy: Energy transforms very easily from other types of energy into electricity, and then from electricity back into other types of energy (such as light, heat, sound and mechanical energy). Electrical energy is easier to transport than other types of energy.

For electricity to work it must be able to 'flow'. This means a closed 'circuit' (a continuous loop) of material that is electrically 'conductive'. The fact that a closed circuit is needed means electrical energy is easy to switch off by simply breaking the circuit or switch on by closing it again.

Problems with Electricity

Electrical energy can be dangerous to people because electricity moves very well through water and our bodies are mostly made of water.

Most of the processes we use to generate electrical energy release pollution that can cause environmental problems, especially greenhouse gases.

Moving electricity from one place to another loses a lot of energy along the way (usually as heat).

Electricity has been so easy to generate in the past, we have become wasteful in our use of it. For many years we have taken electricity very much for granted.

Circuits

Electrical energy comes from the movement of negative charged particles (called electrons).

Electrons can move differently in different substances. If electrons move easily through something it is called a good electrical conductor. If it doesn't the substance is called an electrical insulator.

Electricity can only flow if there is a closed circuit of conductive material - like a loop - for the electrons to flow through.

If there is any break in the loop the electricity cannot flow.

You can imagine electricity as a long chain of tiny linked balls moving in a pipe just the right size. Each ball can only move if the balls on either side move in the same direction, too.

If the pipe doesn't fit, the tiny balls cannot move. This is what it is like when electricity tries to flow in something called an electrical 'insulator'.

Instead of real balls, electricity is actually a chain of tiny bundles of energy. The electricity we use flows in thin wires instead of pipes.

The Wet Stuff

Water is the most abundant substance on Earth, but is actually very rare in the universe. It appears to be a relatively simple substance - being made up of just one atom of hydrogen and two of oxygen atoms - but it actually has many surprisingly complex characteristics. It is these characteristics that make life possible.

Perhaps the single most important thing for each of us to know about water is the sobering fact that there is actually very little of it we can use. There may seem to be plenty of water on Earth but the overwhelming amount of water is either not suitable or not available for human use. Only a tiny proportion, 1% of the Earth's water is suitable for human use. Although technology can help a little, the Earth's supply of water is fixed and does not get re-supplied from the sun like our energy supply. It is sobering to remember that when humans first created water supply systems (plumbing as we know it today, dating back to the Roman Empire) there were only a few million people on Earth. There will soon be six billion humans alive - but the amount of water available has not changed one drop over time.

Access to clean water remains one of the world's most challenging social, environmental and public health issues. In Western Australia different communities face different water supply problems. The most pressing issues for regional and remote communities are discussed below. It is important for us all to remember these issues are interconnected so improving our results in one issue usually makes it easier to improve our results in another.

Reducing Consumption

As well as reducing the cost to consumers, reducing our water use means that we can postpone or avoid developing new water sources and supply systems. This saves a lot of public money and even more importantly it prevents a lot of environmental damage.

Ensuring Safety and Quality

The cleanliness of our water is crucial for public health and it is also very difficult to maintain for regional towns or more remote communities.

Minimising Sewage Input

Sewage and wastewater treatment systems are expensive, difficult to build and maintain. If they are overloaded or damaged there can be leaks or even overflows. This can be dangerous for both public and environmental health.

Reducing Pollution in Waste Water System

The water system is not designed as a disposal system for dangerous or problem wastes. When we flush or wash away things that should not be in the water system we can accidentally cause serious problems for public health or the environment. Nappies, oils and paints are just a few examples of things that should not be disposed of in the water system (but they often are).

The Big E Word: Efficiency

It is all too easy to waste energy and water. Every time we use more electricity or water than is necessary to perform a task, we do something that doesn't really need to be done at all - we have wasted a resource and money that could have been better used for something else. Becoming energy and water efficient must be a community-wide change process but it offers enormous benefits; reduced private and public costs, less pollution, global warming stopped/slowed, health benefits and more reliable supply.

Being efficient means:

- *Designing*, building and buying products that use less energy and water.
- *Designing and constructing* buildings and community facilities to reduce the need for electricity and water consumption.
- *Maintaining* buildings and other community facilities to reduce the need for energy or water consumption.
- *Using devices* in ways that reduce energy and water consumption.
- *Turning (and leaving) devices off* whenever possible.

LESSON PLAN CHART

#	Name	Core	Energy/ water	Format	Demon- strations	Extra Handout	Concepts	Learning Areas	Home Component	Extension Handout
1	Op. Light Globe	C	E	Classroom - based	✓		Electrical circuit	S T&E S&E	✓	✓
2	Op. Up-Down, On-Off	C	E	Classroom - based	✓		Circuitry & energy consumption	S T&E S&E	✓	✓
3	Op. Generator	NC	E	Classroom - based	✓		Consumption	S T&E S&E	✓	
4	Op. Count Everything	C	E	Classroom - based	✓		Consumption	S T&E S&E M	✓	
5	Op. Greenhouse	NC	E	Classroom - based	✓		Greenhouse effect	S S&E M		✓
6	Op. Hot Boxes	C	E	Classroom - based	✓		Insulation	S S&E M		✓
7	Op. Easy Breezy	C	E	Classroom - based	✓		Cooling by air	S S&E M		✓
8	Op. Wind Power	NC	E	Classroom - based	✓		Alternate energy sources	S S&E		✓
9	The No-Waste Wish List	C	E	Classroom - based	✓	✓	Financial benefits	S S&E	✓	
10	Op. Safety First	C	E	Classroom - based	✓		Safety	S S&E T&E		✓
11	Op. Rainwater	NC	E&W	Classroom - based	✓		Water cycle awareness	S S&E		✓
12	Op. Terrarium	C	W	Classroom - based	✓		Water cycle awareness	S S&E		✓
13	Op. Dissolve	C	W	Classroom - based	✓	✓	Water cleanliness	S S&E		
14	Op. Drip Drip	C	W	Classroom - based	✓		Water waste	S S&E M	✓	✓
15	Op. E-VAP	C	W	Classroom - based	✓	✓	Water use outside	S S&E M	✓	
16	Op. Pipe It	C	W	Classroom - based	✓		Water waste	S S&E M	✓	
P	Technology Mission	NC	W	Classroom - based			Measuring rainfall	T&E S&E		
Ex1	Power Station Visit		E	Excursion	✓		Source generation	S T&E S&E		
Ex2	Water Facility Visit		W	Excursion	✓		Water source awareness	S S&E		✓

P = Project

C = Core component
 NC = Non-core component
 E = Energy use focus
 W = Water use focus

S Science
 S&E Society & Environment
 T&E Technology & Enterprise
 M Mathematics

Lesson 1:

Operation Light Globe

Overview

This lesson is about the concept of an electrical circuit. It lays the groundwork for developing student's awareness of circuits. It has several components and you can choose from these to suit your own students/classroom context:

- Demonstration (equipment supplied in the kit).
- Hands-on activity to be done in groups (equipment supplied in the kit).
- Investigative follow-up project to be done in groups.
- Investigative follow-up project to be done individually at home.
- One optional project (equipment supplied in the kit).

Equipment Required From the Kit

- 6 Volt batteries (1 per group)
- Crocodile Clip Cables (2 per group)
- Light globe and globe holder (1 per group)
- Multimeter
- Optional: 2 metal plates - one zinc or aluminium, one copper

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- Electricity can only be used in special loops called circuits.
- We use switches to turn the electricity off or on.
- Electricity can flow through some things (electrical conductors) but not through others (called electrical insulators).
- Electricity flows very easily in water and our bodies contain lots of water. This means electricity can flow in our bodies and hurt us so we must always be careful around anything electrical.

Key Vocabulary

Conductors Insulators Circuits Energy

Demonstration 1

Before the Lesson

Provide the following equipment for each group of students:

- 2 crocodile wires,
- 6 Volt battery
- light globe and globe holder

Have another set of the equipment as well as a multimeter ready for demonstration purposes.

If necessary for your school, warn other members of staff that your students will need to conduct a survey of electrical devices as part of this lesson.

During the Lesson

Challenge your students to get the globe to light up using only the material provided.

There is a worksheet in the student's workbook to guide their efforts.

Bring the class together, ask the same questions as above, then perform and reinforce the demonstration before repeating with the multimeter connected.

Suggested Demonstration & Discussion

- Ask for a volunteer and invite them to use the wires and battery to turn the globe on and off.
- Ask the class what needs to be done to turn the globe on and what needs to be done to turn the globe off.
- Ask how real lights and other electrical devices are turned on or off. What do we think switches do to electrical circuits?
- Repeat this demonstration again with the multimeter connected to the circuit (see the diagram). The multimeter will register a current, introducing your students to the idea that a meter can detect the flow of electricity.
- Discuss why we would need to record if electricity was being used. It may be appropriate for your students to introduce the concept of electricity meters at this stage - or you may choose to wait until another lesson.

Discussion Points

- Electricity can flow through all these pieces of equipment.
- The battery contains stored electrical energy that is only released if the battery is part of a closed loop of electrical conductors.

- This special type of loop is called a circuit. Closing the loop turns the light on, opening the loop turns it off.

Student Tasks

Task 1

Create a drawing with instructions to help someone else know how to make the globe glow.

Tasks 2 & 3

Two survey activities are provided in the student workbook: one school based and one home-based. These use observational skills to develop awareness of the prevalence of electrical equipment in their everyday lives. They should both be completed and not seen as alternatives.

An extension handout is provided for you to give students learning at other levels.

Demonstration 2

This is optional - it can be used with another lesson or by itself.

This demonstration is designed to introduce your students to the concept that people are electrical conductors. Only carry it out if you have enough time to adequately discuss safety issues.

- Have a wet towel sitting on a dish nearby.
- Lay the two pieces of metal (one copper and one zinc or aluminium) on a desk positioned so everyone can see. Clip each metal plate to one terminal on the multimeter.
- Ask for a volunteer. Ask your volunteer to wet their hands by wiping them on the towel then press one hand down firmly on each metal plate.
- The multimeter will register a current, showing that your volunteer is acting as a wire. (The water is often not necessary but helps make this demonstration more reliable and the results more dramatic).
- Sometimes no battery is required - humans are such good conductors that just forming the circuit is enough to allow a detectable flow of electrons.

Hint

If the plates have become tarnished it is a good idea to clean or sand them lightly before class.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 2:

Operation Up-Down, On-Off

Overview

This lesson is intended to be carried out in groups - ideally but not necessarily after completion of Lesson 1. It:

- Reinforces the concept of an electrical circuit.
- Introduces the concept of variability in electrical flow (ie turning things up and down).
- Introduces the concept of wasted electricity (through heat).

Equipment Required From the Kit

- Piece of dowel
- 1 metre piece of nichrome wire
- Light globe and globe holder
- 6 Volt battery
- Two crocodile wires
- Multimeter

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from this Activity

- We can turn our use of electricity up and down, as well as on or off.
- Some of the ways we use electrical devices takes up more electrical energy than others.
- Electrical energy can be wasted.

Key Vocabulary

Waste
Efficiency
Heat energy
Light energy

Extension

Current - the amount of electricity flowing in a circuit.

Resistance - how much a substance resists the flow of electricity. Poor conductors have high resistance, good conductors have low resistance.

Before the Lesson

Prepare one set of equipment per group and set up a mini radio. Place the multimeter nearby.

During the Lesson

- Gather your students together and compile a class list of electrical appliances found at school and home.
- Turn the radio on and revise the concepts of an open circuit being off and a closed circuit being on.
- Question: How else do we control the electrical things in our homes and schools? Introduce the concept that we can turn things up and down as well as on and off.
- Ask for a prediction about what would happen if we put less energy into the radio? What about more energy?
- Turn the volume down and ask your students if they think more or less electrical energy is going through the radio. Turn the volume up and ask again.
- Ask "How could we check to see if we are correct? Bring out multimeter and introduce/revise the concept that a meter can be used to measure electricity flow. Connect the multimeter to the radio circuit.
- Ask your students to observe the multimeter when the volume is turned low, medium and then high. Invite volunteers to record readings on the board in a simple table of 2 columns by 3 rows.
- Arrange your students into groups and ask them to carry out the activity as set out in the student workbook which provides directions and guide questions.

Suggested Demonstration & Discussion

- Review results.
- Repeat activity as demonstration. Link multimeter to the circuit (between the coil and the light globe) to show difference in electrical *current* (amount of energy being received by the globe).
- Introduce the idea that energy can never be destroyed, but it can be lost.
- When energy seems to have disappeared, it has really only been transformed into another type of energy.
- How did the coil of wire feel when we touched it? Where do we think some of the energy has gone? (Warm, because some energy was being 'lost' as heat).
- Introduce the idea that we can waste energy. (In this experiment, energy was being wasted in the coil.)

- Start a class list of other ways we can waste energy.

Student Tasks

Task 1

Students are asked to observe the controls of everyday devices. This can be done during class or as homework and is suitable for either group or individual work. You can extend the task by asking your students to think of other examples of devices that can be turned up and down and other examples that are only on-off.

Supplementary Tasks (optional)

Ask your students to draw their equipment set-up and use arrows to explain to someone else where the energy came from and where it went, showing where the useful energy was and where the energy was being wasted.

An extension handout is provided for you to give students learning at other levels.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 3:

Operation Generator

Overview

This lesson is best conducted after Missions 1 & 2 and, ideally, after a visit to a power station. The activities are non-core and can be carried out as a teacher-led demonstration - (but they lots of fun)! In either case, we strongly recommend doing the follow-up work.

Equipment Required From the Kit (one set for each group)

- Piece of silk or wool fabric (silk from the kit, but you can substitute felt)
- Small amount of confetti
- Few inflated balloons
- Plastic comb (*If head lice are a problem, ask your students to only use the comb on one person's hair.*)
- Few balloons
- mixture of salt and pepper on a plate

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

Electrons are tiny particles (of electromagnetic charge). We can generate electricity by making electrons move. Static electricity is the type of electricity that builds up in one place. Current electricity is the form of electricity that flows. We use current electricity to make appliances work but static electricity can be found all around us (eg lightening).

Key Vocabulary

Energy Electricity Electrons Generation

Suggested Demonstration & Discussion

- Mix some salt and pepper granules together on a plate and ask your students how you can separate them using a plastic comb. The trick is to give the comb a static

charge by rubbing it with a piece of silk or wool fabric first (you could also just run it through your hair a few times). Then wave the comb slowly just above the salt and pepper mixture. The pepper will jump up onto the comb.

- Introduce the concept of electrons as tiny packages of energy - way too small to be seen even by the world's most powerful microscopes. Usually electrons are distributed evenly - in balance, but sometimes electrons build up more in one place. This is called static electricity. This is the type of electricity that causes sparks - everything from the tiny tingle when you touch a door handle to the biggest form of lightning.
- Try passing a battery over the top of the salt and pepper - nothing will happen. (Static electricity and current electricity are generated different ways and do different things, even though they are both created by the behaviour of electrons.)
- Discuss with your students that current electricity is the type of energy generated in power stations because, as you discovered in Missions 1 & 2, it is the flow of electrons that is needed to make machines work.

Optional Extra Demonstration

To introduce/reinforce the link between electricity and magnetism (after a power station visit). Best used with students learning at Levels 2 or above. You'll need these from the equipment kit: paper clips, a 6 Volt battery, 2 crocodile clip wires, a long piece of copper wire and a steel rod.

Show the equipment to your students, demonstrating that the steel rod is not magnetic. Connect the circuit as shown and the steel rod will suddenly become a magnet strong enough to pick up a whole string of paperclips!

Student Task

A chart is provided in the student workbook to engage students in considering the types of energy 'produced' by different electrical devices.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 4:

Operation Count Everything!

Overview

This lesson introduces the concept of saving energy and to begin creating awareness of energy efficient alternatives. It has a demonstration and discussion component at the beginning, with a survey activity to increase awareness of electrical light use. A table is provided to assist students with emerging numeracy skills to develop an understanding of monetary savings from energy reduction.

Equipment Required From the Kit

- Incandescent globe display unit
- Low energy globe display unit
- Power board/extension cord
- Multimeter

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- We can make choices about how much energy to use.
- Low energy globes give the same amount of light but use less electricity than normal globes.

Key Vocabulary

Energy
Efficiency
Waste

Before the Lesson

Connect both display units to mains power.

Suggested Demonstration & Discussion

- Start the lesson with a discussion of how we can reduce energy use by turning things off or by turning them down. Introduce the ideas that what we buy can also reduce our energy use and that energy costs money.
- Turn both the normal light globe and the low energy globe on. Lead your students to observe that both globes give off the same amount of light. The lead students to observe the difference in current readings on the multimeters: the low energy globe is using much less electricity.
- Use a student volunteer to hold their hand near each globe in turn. Emphasise the importance of not touching any globe to avoid burns. The student will feel much more warmth from the incandescent globe as more energy is being wasted as heat.

Student Tasks

The chart in the student workbook guides students to survey the number and type of lights used in various locations and to translate this into savings.

These tasks could be done as a class, in groups or as individuals according to your students' literacy and numeracy levels.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Mathematics

Lesson 5:

Operation Greenhouse

Overview

This lesson introduces the most fundamental principle of the Greenhouse Effect and relates it to housing.

Equipment Required From the Kit

- 2 thermometers for each group
- 2 pieces of folded aluminium foil for each group
- 2 clear plastic containers (one with a lid) for each group
- Greenhouse Effect Educator Display Boards
- Watch or clock

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- The Greenhouse Effect is when heat energy can get into something more easily than it can get out.
- Allowing air to move allows heat out.
- Opening windows will help cool a building down.

Extension

Using too much energy can increase pollution in the atmosphere. This can make the Earth's Greenhouse effect stronger, keeping more of the sun's heat in and changing the environment.

Before the Lesson

Prepare the equipment for each group.

During the Lesson

- Start the lesson with discussion of energy use. Ask students where they think most electricity is used: cooking, lighting, fridges & freezers, water heating, and room heating/cooling.
- Use the display boards provided in the kit and discuss the difference in how the north-west uses much more energy for room heating and cooling than the south-west and how most of this is in the summer months for air-conditioning.
- Emphasise how important it is for north-west communities to find other ways to help keep cool.
- Discuss with your students their experience of getting into cars that have been parked in the sun. Discuss their experiences of the difference it can make if the windows are open even a little.
- Follow-up with the experiment using open and closed boxes.

Suggested Discussion

- What have we learnt about the difference between how things heat up when they are open and when they are closed?
- How can this help us stop buildings from getting too hot?
- Lead your students to the message that we should open windows as much as possible - only closing them when refrigerated air conditioning systems are on.
- If appropriate for your students, you can introduce and discuss the term 'Greenhouse Effect'.

Student Tasks

The student workbook guides students through reporting activities.

If it suits your timetable, you can ask students to design a poster to remind their family to use open windows and reduce the time air conditioners are on.

An extension handout is provided for you to give students learning at other levels.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 6:

Operation Hot Boxes

Overview

This lesson introduces the concepts of insulation and differences between light and dark colours in reflecting/absorbing heat. The hands-on component is designed to be carried out in groups. If it suits your class structure, you can assign different groups to perform the two different parts of the experiment.

Equipment Required From the Kit

For each group:

- 3 matching plastic boxes
- Piece of foam
- Piece of cotton towel
- Large piece of black paper
- Large piece of white paper
- Large piece of light coloured paper
- Large piece of dark coloured paper
- 3 thermometers
- Washers
- Desk lamp

For the Demonstration:

- Small glass jar
- Piece of plastic larger than the jar neck
- Transparent tank
- Food colouring

Supplementary Materials Required

Student Workbooks (1 each)
 Writing/drawing implements
 Cold and hot water

Key Understandings from This Activity

- Insulation can slow down heating.
- Some insulation works better than others but any type is better than no insulation.
- Light colours reflect more heat so they stay cooler than dark colours.

Key Vocabulary

Insulation
Reflection
Absorption
Heat energy

Before the Lesson

Prepare the activity materials for each group. Prepare and practice the demonstration.

Demonstration:

- Fill the tank with cold water beforehand. In front of the students, fill the small jar with hot water and add a few drops of food colouring. Hold the plastic over the jar neck to prevent leaks and lower the jar to the bottom of the tank. When the jar is resting on the bottom ask the students to watch closely and then remove the plastic 'lid' to allow the hot and cold water to mix. The student will clearly see that the hot water comes out of the jar, demonstrating that heat energy always flows from hot to cold.
- Explain, that this means cold doesn't disperse because the heat molecules are lighter. In fact 'cold' is actually just a lack of heat! For buildings, this means that in summer we are trying to keep heat out and in winter we are trying to keep it in. Insulation can help with both.

Student Tasks

The student workbook guides students on recording and reviewing their results.

An extension handout is provided for you to give students learning at other levels.

Extension Ideas

You can easily adapt or extend this activity to suit your class by asking students to test the insulation capacity of different substances.

You could also ask your students to measure how slowly the boxes cool down again.

This same activity could be used with model houses built by the students.

Curriculum Framework Outcomes and Assessment Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 7:

Operation Easy Breezy

Overview

This lesson develops awareness of the potential of air flow to manage temperature. It provides opportunities to reinforce messages about reducing energy use for cooling. You can choose between this and Lesson 5, or carry out both to reinforce and extend/increase understanding.

Equipment Required From the Kit

- Desk fan
- Wet towel
- Desk Lamp
- 2 plastic boxes (1 with holes in the side)
- 2 thermometers
- 2 x 30 cm pieces of aluminium foil folded to small rectangles

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- Moving air makes things cooler than still air.
- If there is a breeze outside, opening windows can help cool a room down.

Extension

Moving air takes heat energy away faster than still air. This means it is better at cooling things down.

Opening windows for a while to let the breeze in before turning on air conditioning is a good way to save energy and money.

Key Vocabulary

Energy

Heat

Cooling

Before the Lesson

Prepare the equipment for each group.
Demonstrate the equipment and the question to be investigated.

Suggested Demonstration & Discussion

- Repeat the experiment for the class and discuss the groups' results.
- Which box had most heat energy? Why? Where had the heat energy for the other box gone?
- Reinforce awareness that cooling is the greatest use of energy for North-West households.
- Link the difference between the wet and dry hands to human sweating as a means of cooling down.

Student Tasks

The student workbook guides students through reporting tasks. This includes drawing a diagram of what they think happened. You may feel it best to create a group diagram on a board to aid students in their thinking.

An extension handout is provided for you to give students learning at other levels.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 8:

Operation Wind Power

Overview

This lesson builds awareness of the concept of renewable energy. It can also introduce the potential environmental benefits of these energy sources. This lesson can be scheduled very flexibly and can work equally well linked to Excursion 1 or much later in the program.

Equipment Required From the Kit

- Piece of cardboard with turbine drawings
- Scissors
- Straw
- Sticky tape
- Wooden skewer
- Small plastic bags
- Small weights (washers)

Supplementary Materials Required

Student Workbooks (1 each)
 Writing/drawing implements
 Scissors for each student

Key Understandings from This Activity

- Most of our electricity comes from burning fuels like coal, oil and gas. These produce pollution and can run out.
- New energy sources are being developed that don't create pollution and won't run out. The sun, wind and tides are some of the new energy sources. They are called renewable because we can use them without using them up. They also create little or no pollution.

Key Vocabulary

Renewable Energy
 Solar
 Tidal
 Pollution

Before the Lesson

Put pictures of renewable energy sources around the classroom (supplied in the equipment kit).

Prepare the materials for each student.

Arrange a desk fan for the demonstration.

Prepare one of the turbines for demonstration.

During the Lesson

- You might like to start the lesson by turning on a desk fan where all the students can see it. Guide students to observe how the blades of the fan are used to move air. Encourage them to notice the design of the fan blades.
- Introduce the idea that, as well as making air move, blades like these can be used to capture the energy from moving air.
- Demonstrate one of the paper turbines.
- This activity offers plenty of scope for further investigation of turbine designs and even the use of different materials. You can choose the extent of investigation that best suits your student's needs and your class schedule.

Suggested Discussion

- Review the experiment and discuss results. You may like to involve students in demonstrating their own turbines, especially if they have experimented with different designs.
- Lead the discussion to focus on the turbine's ability to capture energy and use it to do something. Introduce the idea that if a wind turbine is big enough it can create electricity.
- Emphasise that wind turbines allow us to capture energy from the environment and create electricity. Introduce the concept that wind power is suitable where there is lots of wind most of the time and that solar power is suitable where there is sunshine most of the time.

Student Tasks

The student workbook guides students through review and reporting tasks.

An extension handout is provided for you to give students learning at other levels.

Curriculum Framework Outcomes and Assessment Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science Society and Environment Technology and Enterprise Mathematics

Lesson 9:

The No-Waste Wish List

Overview

This lesson builds awareness of the financial benefits of energy reduction. It requires very little preparation so it is ideal to be used at any stage of the program. For example, you may like to do it at the end of the program when you have done the water-use lessons as well. Group work is ideal but it can also be carried out as an individual task. For some students, it may be more appropriate to focus attention on savings in their community or at their school rather than in the home.

Equipment Required From the Kit

None

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements
Scissors
Glue

Key Understandings from This Activity

- Money saved by reducing water and energy consumption can be used for much more enjoyable things.

Key Vocabulary

Energy Use
Money

Before the Lesson

You may like to collect old catalogues, magazines and newspapers to give your students some ideas for ways the money could be used, but this is not essential.

Student Tasks

The student workbook has a chart to guide students through compiling a list of their ideas. You can choose whether students write or draw their ideas.

Supplementary Tasks (optional)

You might like to engage your students in the creation of a Wish List collage of all their ideas for how else money could be used. This can be done as individuals, in groups or even a whole class artwork.

Curriculum Framework Outcomes and Assessment Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 10:

Operation Safety First

Overview

This lesson is essential as it introduces and reinforces crucial safety understandings regarding energy and water. It can be used to link this program with other safety awareness initiatives. It does not have a hands-on demonstration component to discourage experimentation so the format can be modified to suit. Very little preparation is required so it can be scheduled flexibly. It can also be set as homework - wholly or in part.

Equipment

Student Workbooks
Pens
Pencils

Key Messages in This Activity

- Water and electricity don't mix.
- Don't swim in dirty water.
- Don't touch wires.
- Stay away from power lines.

Key Vocabulary

Safety
Water
Electricity
Power Lines

Before the Lesson

Prepare the materials.
Display the safety posters in your classroom.

Student Tasks

Students are asked to complete a matching exercise linking warning symbols to their message. They are then invited to complete one or more of four safety posters. For two the message is missing, for two the image is missing.

An extension handout is provided for you to give students learning at other levels.

Curriculum Framework Outcomes and Assessment Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science
Technology and Enterprise

Society and Environment
Health and Physical Education

Lesson 11:

Operation Rainwater

Equipment Required From the Kit

Demonstration

Table positioned so that the whole class can see.

1 litre each of four different salt solutions varying between 0 and 8 teaspoons per litre.

1 plastic tasting cup per student.

Student Group Activity

- Pieces of plastic sheet
- Plastic tubs
- Small jars (no lid)
- Rubber bands
- Small weights
- Water (as hot as you can without risking skin burns)
- Salt
- Spoons

Supplementary Materials Required

Student Workbooks (1 each)

Writing/drawing implements

Key Understandings from This Activity

- Water is always moving around the world in a system called 'The Water Cycle'.
- Most of the world's water is salty and not good for people to drink.
- Fresh water is very precious.

Key Vocabulary

Evaporation

Rain

Water Cycle

Salt water

Fresh water

Before the Lesson

Prepare and arrange the materials for the student group activity. Make up your salt solutions, stirring or shaking well to make sure the salt has dissolved. You might prefer to involve your students in making the solutions. You might like to have a bucket and an eyedropper handy for the demonstration-and-discussion component.

Suggested Demonstration & Discussion

- Involve your students in taste-testing the different salt solutions then lead a discussion of their responses.
- Introduce the concept that 8 teaspoons of salt per litre approximates the amount of salt in most of the world's water.
- Discuss that this is not suitable for humans to drink, emphasising the fact that land animals need fresh water, drinking only salt water can actually be deadly. If appropriate for your class, you could use a bucket and an eyedropper to give your students visual representations of the amount of salt water in the world (a full bucket) compared to the amount of fresh water in the world (one drop from the eyedropper).

Student Tasks

Task 1

The student group activity models evaporation and condensation, introducing students to the concept that water evaporates from one place and then turns back into liquid elsewhere. Importantly, salt and most other substances which dissolve easily in water are left behind during evaporation.

While the activity is underway, the students should complete the workbook's task on the Water Cycle. Alternatively, you could discuss the water cycle beforehand and involve your students in creating artworks or models to explain the water cycle.

An extension handout is provided for you to give students learning at other levels.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Lesson 12:

Operation Terrarium

Overview

This lesson is intended to reinforce understanding of the important concepts that water moves around the earth in a continuous cycle and is essential for all life. It involves students in growing grass seedlings inside DIY terrariums and is the only activity in this program that operates over an extended period (several days). It is recommended, but not necessary, that this lesson be carried out after the water cycle concept has already been introduced either by Lesson 11 or a similar lesson.

Equipment Required From the Kit

- Jars
- Grass Seeds
- Potting Mix
- Water

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- Water moves through the environment in a constant cycle.
- Water is needed by plants and all other living things.

Key Vocabulary

Evaporation
Transpiration
Roots
Seed
Seedling

Before the Lesson

Prepare the equipment.

During the Lesson

You might like to begin the lesson with a brief discussion reviewing or introducing the concept of the water cycle, emphasising how water changes state (from gas to liquid to solid) as well as location.

Another good starting point for this lesson is a short class discussion about water in living things. Fruits and vegetables make good demonstration materials for this - just use a mixture of whatever you have available. Dried fruits and vegetables make great contrasts for example sultanas are very visual (and tasty) ways to get across how much water is in a single grape, dried apricots are a clear contrast to fresh (or tinned is fine, too).

The student workbook has instructions and diagrams for your students to follow in creating their terrarium.

Demonstration Idea

Although not directly about water efficiency, here are two quick and easy ideas to add extra impact to this lesson.

Water Magic

One of water's unique characteristics is its polar nature - each molecule of water acts like a tiny magnet, hanging onto other water molecules around it. This allows liquid water to do many things that other liquids can't. Why not try having a competition between student volunteers: give each child a 20c coin, an eyedropper and a glass of clean water. Ask the class to guess how many drops of water can fit on to the coin without spilling. Your students will be amazed at how many drops can be added - the water will bulge very high before finally spilling.

Colour Change Celery

Another great demonstration of plants transporting water needs just a stick of celery and a glass of water with a drop or two of food colouring added. In just a couple of hours, the celery will have taken up the water. Cutting the stalk will show the colour in the 'strings' and soon the leaves will start to change colour, too.

Student Tasks

The review and consolidation tasks for this activity are in the student workbook: students are asked to use diagrams to show what they observed and indicate what they think happened.

Supplementary Tasks (optional)

We recommend student research tasks as an ideal extension task for this activity as further information is readily available. Students requiring additional work could be asked to research the water cycle (or one aspect of it, such as rain, groundwater or cyclones).

Curriculum Framework Outcomes and Assessment Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Technology and Enterprise

Lesson 13:

Operation Dissolve

Overview

This lesson develops students' awareness about not all water being safe to drink and that clean water is hard to get and so very precious. It introduces the concept of water's ability to dissolve/carry other substances. This is one of the reasons water is so important for life on Earth but it also means water is very easily polluted.

This lesson could be supplemented or replaced with an excursion-format lesson in which students collect and observe samples of water from various sources such as local water features. Careful safety rules need to be followed to prevent accidents while collecting the samples.

Students must not be permitted to drink any samples that did not come from safe drinking water sources.

Equipment Required From the Kit

- Empty soft drink bottle cut into two pieces
- Coffee filter
- Crushed charcoal
- Fine sand
- Cotton wadding
- Bottle of dirty water

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- Fresh water is scarce and very important.
- Is it difficult to make dirty water clean again.

Key Vocabulary

Fresh water

Water quality

Water Safety

Filter

Before the Lesson

Prepare the equipment and any demonstrations materials you wish to use.

During the Lesson

You might like to start this lesson with a blindfold taste test in which one or more student volunteers tastes water from different glasses. For example, one could be coloured with a teabag, one coloured with several food colours until it looks revolting, one with a small amount of white vinegar added so it looks clear but tastes horrible.

Discuss with your students that water is usually safe to drink but we should always check. Discuss the reasons for being careful (eg we need water to live but so do other living things, including disease-causing creatures) and then the ways we could be careful. For example:

Do we drink water straight from the creek?
What about the drain or the sewer? Why not?

Revise the information about the scarcity (and therefore the value) of fresh water.

Student Tasks

The student workbook has full instructions to guide your students in making and using a filter that will improve the water quality but will not make it safe to drink.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Health and Physical Education

Lesson 14:

Operation Drip-Drip

Overview

- This lesson raises students' awareness of the concept of wasted water (as opposed to waste water) and of the social systems involved in providing essential services such as water supply. It is a very easy lesson to prepare and carry out.

Equipment Required From the Kit

- Measuring cup
- Tap
- Timer
- Plastic Container

Supplementary Materials Required

Student Workbooks (1 each)
 Writing/drawing implements
 Scissors and glue
 Plastic bucket

Key Understandings from This Activity

- Water can easily be wasted.
- Taps that drip or pipes that leak can waste a lot of precious water.
- Anyone can help stop water being wasted.
- There are people in your community who will fix things like dripping taps.

Key Vocabulary

Waste
 Tap
 Pipes
 Repair

Before the Lesson

Prepare the materials and copy the handout. Speak to relevant people in your school and the local community to let them know what the students will be learning about (check out the contacts sheet in this kit if you need help knowing who to speak to in the community).

You can also introduce the lesson the day before (see below).

At the end of the day before, hold a class discussion about the next day's lesson. Tell students you will gather the water from a dripping tap overnight and the class can see how much there is tomorrow. Ask for their predictions about how much water there will be. Record the predictions: on the board works fine, but secret guesses can be fun, too.

If the tap was dripping once every second or two, you should have between half a bucket and a full bucket of water in 24 hours.

Student Tasks

The student workbook sets out observe-and-record tasks for the students to carry out at school or at home.

An extension handout is provided for you to give students learning at other levels.

Supplementary Tasks (optional)

If time permits, involve your students in creating 'Who to Contact' signs for their homes using the information from *Mission Report from Your Place* in the student workbook.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Mathematics

Lesson 15:

Operation E-VAP

Overview

This lesson increases awareness of evaporation and builds understanding that efficiency can be achieved simply by changing the time you do something.

It is based around an easy-to-prepare hands-on activity in which students compare rates of evaporation under different conditions.

Equipment Required From the Kit

- Dish
- Measuring Cup
- Water
- A hot, dry day (or a fan forced heater)
- Ceiling or desk fans (optional)
- Kettle, metal plate and oven gloves (optional for demonstration purposes only)

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- Evaporation is how water goes from being a liquid to being vapour.

Key Vocabulary

Liquid
Vapour
Gas
Evaporation
Efficient
Waste

Before the Lesson

It can be a good idea to introduce this activity the day before. Show the class a damp cloth and a dish of water you will be leaving out overnight. In front of your students, measure the amount of water in the dish carefully. You can pass around the damp cloth for students to feel themselves. Ask them to predict what will happen - will there be any change and if so, what will it be?

Other than that, simply prepare the equipment.

During the Lesson

You might like to start the lesson with a demonstration. Gather the class together for a discussion and in front of them but at a safe distance, boil a kettle (use already warm water so it boils faster). Discuss what is happening to the water. (We are adding energy and making the water hotter. Some of the water gets so hot it turns into a vapour or gas.)

Wearing oven gloves, take off the kettle lid and hold a flat piece of metal (eg a baking tray or pot lid) in the path of the steam as it escapes. Show the students the water which condensed back into a liquid again when it touched the cool metal.

Discuss with your students that boiling water just speeds up a process that happens to water anyway - evaporation. Pass around the cloth you left out the night before so students can feel how much drier it is. Measure the amount of water in the dish and discuss with your students where the rest of the water has gone.

Introduce and begin the experiment.

Student Tasks

The student workbook has instructions to guide your students in carrying out this experiment.

Supplementary Tasks (optional)

This experiment could be extended by asking students to compare the difference that air flow makes to evaporation rates. Desk or ceiling fans can be used easily to create a 'windier' environment.

Curriculum Framework Outcomes and Assessment Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

Mathematics

Lesson 16:

Operation Pipe It

Overview

This lesson increases awareness of water use patterns in students' everyday lives and of the infrastructure involved in water supply.

This activity is easy to prepare and can be carried out with almost no notice at any stage in the program. The important key idea behind the lesson is very straightforward and can be adapted to group work in visual arts such as creating a class mural.

Equipment Required From the Kit

None

Supplementary Materials Required

Student Workbooks (1 each)
Writing/drawing implements

Key Understandings from This Activity

- We use water in many different ways every day.
- Different tasks can be done with different sorts of water.
- Our community has a special system for providing water to the right place at the right time.
- Taking used water away safely is an important part of this system.

Key Vocabulary

Drinking water
Waste water
Grey water
Sewage

Before the Lesson

Gather the writing and drawing materials together. Copy the handout.

During the Lesson

- It is a good idea to start this lesson by leading a class discussion of how water is used and why different levels of water quality are needed for different purposes. You could begin by compiling a class list of water uses at different places in the community. Here are some suggested discussion points:
- How clean does the water in a health centre or hospital need to be? Why?
- What sort of water do we need in kitchen taps?
- What happens to water once it has been used in the shower? Could we use this water again? What for?
- What happens to water when it is flushed through a toilet? Could we use this water again?
- What sort of water could we use on the garden? Which should we use cleaner water for - lawn and flowers or vegetables and fruit? Why?

Student Tasks

The student workbook guides students in creating their own diagrams of water uses and supply systems.

As a follow-up and consolidation task linking this lesson with *Operation Drip Drip*, we recommend you ask your students to carry out an audit of a water supply system and then prepare a letter reporting what they found to the relevant people. The audit can be of the school, at their home or at a community facility of some kind - this is best decided by the teacher according to the circumstances for each class/student.

You can set this task at whatever level you think appropriate. For students with beginning literacy skills a pro forma is provided that will introduce the students to letter writing conventions. Simply copy and distribute. If you prefer, you can involve the students in a class discussion to plan the letter together. Students with more developed literacy can write their own letter.

Extension handouts for students requiring additional work are provided in the resource materials.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Society and Environment

English

Technology Mission: Operation How Wet is Wet?

Overview

Depending on the time of year and your location, you could consider replacing an activity with this project in which your students make and use their own rain gauge.

It is recommended, but not necessary, that this lesson be carried out after the water cycle concept has already been introduced either by Lesson 11 or a similar lesson.

This lesson is very easy to prepare but it does need to be planned well in advance to allow enough materials to be gathered. Collect an assortment of empty disposable containers (such as plastic tubs, cartons, bottles, aluminium dishes) etc in the weeks beforehand. Supplement this with construction supplies such as rubber bands, tape, popsticks, (provided in this kit) textas and glues. Discuss with your students that rain is measured, who measures it and why. Then, in groups, challenge them to use the 'recycled' equipment you have provided to construct a device that will measure how much rain has fallen.

The level of work involved in this activity is entirely up to you. It can be a single lesson or a series of lessons depending on which/how much of the four key elements of a technology process you wish to incorporate: Investigating, Devising, Producing and Evaluating.

Here are some guide questions you might like to use:

What do we want the gauge to do?

Where are we going to use our gauge?

What does our gauge need to be like? (eg how heavy to avoid being blown or washed away)

What have we got to use?

What else might we need?

What problems might we find?

How will we know how well we have done?

How will we know how to improve our gauge?

Equipment Required

- Assortment of clean, old packaging items such a margarine tubs, ice cream tubs, plastic bottles, pie dishes, cardboard, polystyrene, pieces of plastic
- Glue and Tape (masking and insulation)
- Popsticks
- Textas

- Rubber bands
- Stiff card
- Whatever other construction materials you have available

Key Understandings from This Activity

- Fresh water is very precious.
- Rain is very important because it brings fresh water which plants and animals need to live.
- Our community measures rain to help us know how much is falling, where and when.

Key Vocabulary

Plan

Design

Measure

Rain

Fresh water

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Technology and Enterprise

Society and Environment

MISSION REPORT

Where do you think energy is being used?

Where is the energy coming from?

How do you think it is moving?

Feel the globe. Where do you think the energy is going?

MISSION₂ REPORT

Which do you think uses more or less energy: the light glowing brightly or the light glowing dimly?

If less energy is being turned into light - where do you think the leftover energy goes?

HINT: Feel the coil of wire.

MISSION REPORT

Where do you think the heat came from?

Why do you think the open box was a different temperature than the closed box?

What do you think makes cars get hot if they are left outside?

Why do you think plants are sometimes grown in glasshouses?

WOW

The layer of air around the Earth is called the **atmosphere**. It works like a blanket around the earth to keep the warmth in. If we use too much energy, we put more pollution into the atmosphere so it traps more heat

energy. This could make the world heat up too much. Saving energy means saving the world as well as saving money.

MISSION REPORT

Which box warmed up most?

Which box warmed up least?

Why do you think there was a difference?

How could this idea help us keep our house cool?

MISSION, REPORT

Which box is warmest?

How do you think you could cool your house down in a breeze?

When is it a good idea to open your windows?

When is it not a good idea to open windows?

MISSION: REPORT

How can we get energy from the wind?

What sorts of places should we use wind power?

What sorts of places should we use energy from the sun, called solar power?

What sorts of places should we use energy from the ocean?

MISSION REPORT

Make a collage of pictures for things your family, school or community could do with the money they save from energy and water use.

MISSION REPORT

Where do you think the water in the jar came from?

How do you think it got there?

How does the water left in the tub taste?

How does the water in the jar taste?

Why do you think rainwater is not salty?

MISSION₁₂ REPORT

What can you see on the insides of the jar?

What happens to the seeds?

MISSION 14 REPORT

Turn on your kitchen tap. Put the plug in and count how many seconds it takes to fill the kitchen sink.

How long does it take to wash a few dishes under a running tap?

Why do you think we should always plug the sink?

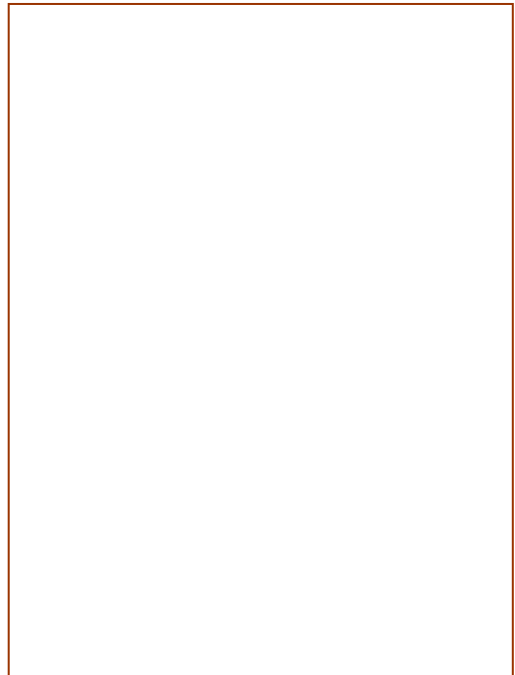
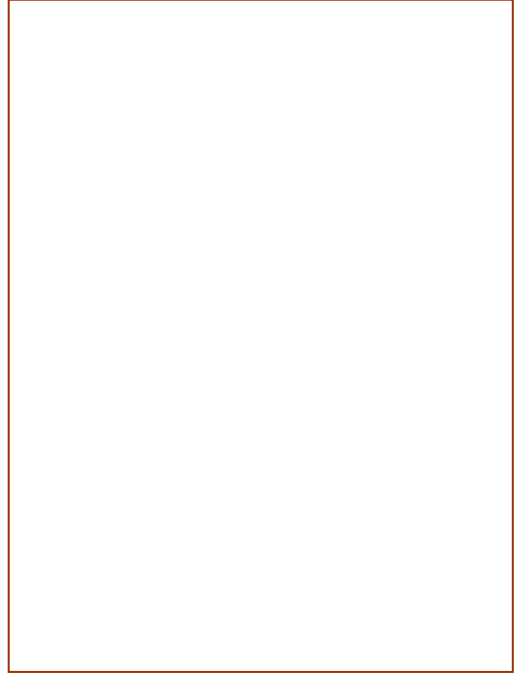
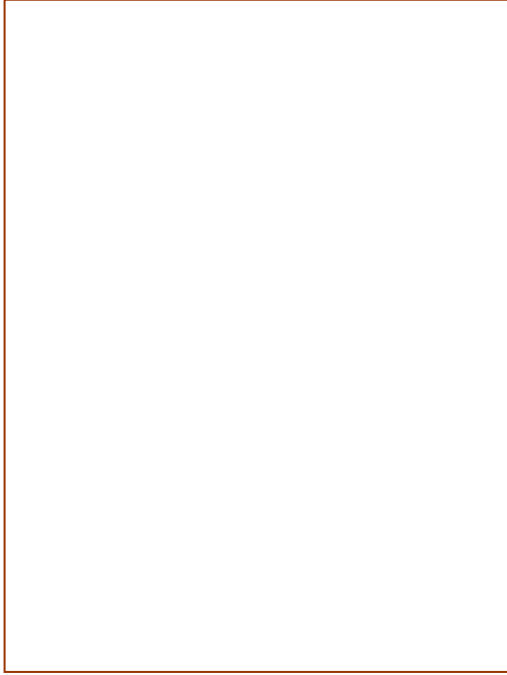
Put a container under the bathroom tap. Brush your teeth with the tap running.

Next time you brush your teeth, put the container under the tap again but this time only turn the tap on to wet the brush at the beginning and wash it at the end.

Fill in this table to show how much

	Tap left running	Tap only on at start and end
How much water?		

MISSION, HANDOUT



MISSION 16 HANDOUT

Cut out these messages and glue them underneath the correct pictures in your workbook.

Fix leaks & drips	Fix leaks & drips
Fix leaks & drips	Fix leaks & drips
Have a shower instead	Have a shorter shower
Only use when full	Always use the plug
Only water at night or early mornings	Only use twice a week
Wash with bucket, not a hose	Turn tap off when you brush your teeth
Wash clothes with cold water	Use leftover water on the garden
Don't flush anything	Use the half-flush button

HOME MISSION

Look at the Dingo Crew's water use check up chart below, then fill in the one on the next page for your place.

Location of taps	Hot & cold or just cold	Times used each day	How long is it used each time	Does it leak?	How could you use less	Check with the adults at home
Toilet	Cold	15	One flush	Yes	Get it fixed, use the small flush button more often	
Shower	Both	5	10 minutes	No	Shorter showers	
Bathroom sink	Both	12	2 minutes	Yes	Fix drip and don't leave it running when we brush our teeth	
Garden Tap	Just Cold	Once	Depends on what for	No	Only use it twice a week at dry times	

--	--	--	--	--	--	--

FROM:

TO:

Dear

We have been learning about water and energy efficiency at school.

As part of my work, I carried out a check at

I found

.....

.....

.....

I thought you might want to know. I hope this is useful information.

Yours sincerely

Signed.....

Date:

Excursion 1:

Power Station Visit

Overview

This lesson is intended to develop student's awareness of the power supply system and its role in their lives. The timing of this excursion is best decided by the educator but there is value in scheduling it after a few initial lessons have been completed (especially those relating to electrical circuits and initial awareness of electrical devices).

Key Understandings from This Excursion

- The electricity we use is generated by a power station (and then sent to our homes and schools by power lines).
- Electricity can be dangerous so power stations have very strict safety rules and we should all stay away from power lines.

Before the Excursion

You might like to:

- Discuss/revise the concept that electricity flows in circuits. Emphasise awareness of electrical cords, wires and power lines as examples of how electricity gets from one place to another.
- Discuss/revise the variety of ways electricity is used by the students and their families, schools and communities.
- Compile a list of safety rules about electricity based on students' existing knowledge (for comparison after the excursion).

Suggested Follow-up Discussion

- What new safety rules have we learnt?
- What surprised or amazed us most about the power station?
- What would be the consequences if the power supply system was not looked after and broke down?
- What if the power system was not kept safe?
- What would happen in our community if the power stopped working?

Student Follow-up Tasks

Provide your students with the Power and People worksheets (1&2), glue and scissors. Ask them to cut out all the pictures and all the labels then glue these in place on the *Our Power* worksheet to create a visual concept map of the power system for their community. Alternatively, ask your students to draw or list the places that power is used. A class list can be developed beforehand and listed on the board if this is more suitable for your students.

Optional

Ask your students to write a letter or draw a picture to send as a thank you to the excursion host.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

POWER & PEOPLE

Draw pictures of the following. Cut out the pictures and glue them in the correct place on the *Our Power* worksheet.

Power station	Local generator	Large power pylons & cables
Regular power poles & lines	Community centre	School
Shop	Hospital	Home

OUR POWER

Glue the pictures from your *Power & Peoplesheet* in the correct column

MAKING POWER Our electricity is made here	MOVING POWER This is how our electricity travels	USING POWER This is where we use electricity

Draw or name two other places that use electricity in your community.

Excursion 2:

Water Facility Visit

Overview

This lesson is intended to broaden students' conceptual understanding of the water supply system and its role in their lives.

Key Understandings From This Excursion

- The water we use in our homes and schools comes from a supply system.
- The supply system makes sure our water is clean, safe and always available.
- The water supply system needs to be looked after.
- We can all help the water supply system work well.

Before the Excursion

You might like to:

- Discuss the concept and key parts of the water cycle using local geographical features as examples.
- Ask students to guess how much of the world's water is salty and how much is fresh. (If you represented the world's water with just one litre, less than half of one teaspoonful would be fresh water available for human use!).

Suggested Follow-up Discussion

Choose from these discussion questions or use your own.

- What surprised us most about the water supply system?
- Why was the water system so amazing?
- What would happen to our Town/Shire if the water supply system was not working?
- What if the water was not clean enough to drink?
- If there were times when the water was not available/supplied what would happen?

Student Follow-up Tasks

Provide your students with the *Water Works* sheet and ask them to draw a visual concept map showing the different ways water is used in their community (eg houses, swimming pools, recreation centres, meeting rooms, shops, health centres, schools, parks

and fire hydrants). These concept maps do not need to be to scale and can be as artistic as you and your students like. Equally they can simply be names of places such as "community centre", "sports oval", "school", "homes", laid out in the space provided and linked together with arrows to help remind the students of the idea that community water supply operates as a whole system.

Optional

Ask your students to write a letter or draw a picture to send as a thank you to the excursion host.

Curriculum Framework Outcomes and Assessment

Guidelines

We recommend you assess your students' progress according to the following outcomes in the Curriculum Framework. You might like to use the pro forma Progress Map sheet provided or develop your own.

Science

Society and Environment

WATERWORKS

Draw a map of all the places your community uses water.

Where do we use water?

How many places did you think of?

EXCURSION REPORT

Why do you think we should only drink clean water?

How can you tell if water is safe to drink?

Fact Sheets

Water

- Earth is the only planet with liquid water (as far as we know!)
- Australia is the driest continent on Earth.
- In Australia we use about 1 million litres of water for each person every year.
- Earth has enough water to cover the whole planet in a layer 2.5km deep.
- Nearly all of the world's water is too salty to drink or grow food.
- Most of the world's fresh water is frozen at the north and south poles.
- Only a tiny amount of fresh water is available for people to use.
- There is the same amount of water on Earth as there was when the Earth was formed.
- We can survive about a month without food but less than a week without fresh water.
- One leaking toilet can waste enough water every day to fill three baths.
- Water is very good at dissolving things so it's great for cleaning. But if too much stuff gets dissolved in water it becomes polluted so it is not safe for plants or animals (including us) to drink.
- Just because water looks clear doesn't make it safe to drink.

Energy

- The first battery was invented in 1880 but human beings have only been using electricity to make machines work for about 100 years.
- The first electric light was created by the world's most successful inventor ever, Thomas Edison. He had hundreds of failed attempts before he made a light that worked.
- Electricity can be very dangerous - becoming an electrician is an important job and takes three years of training.
- Electricity moves through wires at the speed of light - about 300 000 kilometres per second.
- Most Australian houses use 8 times more electricity for water heating than for lights - so have short showers!
- TVs and computers use much less electricity than hair dryers and toasters.
- Air conditioners use 15 times more electricity than ceiling fans and eight times more than TVs or fridges
- Leaving things like video recorders and computers on when not in use costs most households around \$100 each year. So switch them off at the plug.
- Most Australian homes create around a tonne of greenhouse gas just by heating and cooling. Insulation can cut this by a third or even a half.
- Lightning is electricity - one bolt of lightning is millions of times more powerful than what comes from a power station.

Assessment Information

This package is aligned with the Curriculum Framework for Western Australia. It contributes to and supports students' achievement of a range of outcomes across different Learning Areas but focuses strong emphasis on particularly relevant outcomes. These are listed below:

Science

- *Investigating*
- *Energy and Change*
- *Earth & Beyond*
- *Science in Daily Life*

Society and Environment

- *Resources* (Focus on Aspect 1: *Use of Resources*)
- *Natural and Social Systems* (Focus on Aspect 1: *Natural systems*)
- *Active Citizenship*

In this section

- Pro forma Progress Charts for tracking class progress
- Assessment guidelines for Relevant Outcomes/sections of Outcomes

Preface

The following pages provide reference material you may find useful in planning and carrying out assessment processes to help monitor and optimize your students' progress regarding these outcomes. The guidelines are constructed from excerpts of the Western Australian Department of Education and Training's online assessment materials as provided in 2003, slightly modified to clarify the relevance of this package.

Details are included about the focus outcomes within *Science* and *Society & Environment* (those which are core through much or all of the package). Particular lessons are also aligned with certain outcomes in the *English, Technology & Enterprise, Health & Physical Education* and/or *Mathematics* Learning Areas. You may choose to formally assess on one or more of these as well as the 'core' assessment outlined but, for the sake of brevity, assessment guidelines are not provided in this package. Please refer to material from the Department of Education and Training t/Curriculum Council for guidance.

Learning Area: Science

Outcome: Investigating

Students investigate to answer questions about the natural and technological world, using reflection and analysis to prepare a plan; to collect, process and interpret data; to communicate conclusions; and to evaluate their plan, procedures and findings.

Aspect 1: Planning

Students plan investigations to test ideas about the natural and technological world.

Aspect 2: Conducting

Students collect and record a variety of information relevant to their investigations.

Aspect 3: Processing Data

Students translate and analyse information to find patterns and draw conclusions to extend their understanding.

Aspect 4: Evaluating

Students reflect on an investigation, evaluate the process and generate further ideas.

Level Assessment Guidelines

IS 1

The student focuses on a problem, and responds to teacher's suggestions to carry out simple activities requiring observation and sharing of observations.

Students are playfully engaged in simple explorations that involve responding to teacher prompts and questions such as 'I wonder what would happen if ...', using their senses to observe and sharing their observations by saying what happened.

Planning

Students focus on a problem and respond to the teacher's suggestions and questions by telling about their own experiences of a phenomenon and contributing to a list of what the class members know about a topic. They respond to the teacher's questions about 'What would we like to know?' 'How can we find out?' Shown pictures of steps in the experiment, they help select a correct sequence.

Conducting

With the teacher's guidance, they carry out activities involving a small number of steps, collect materials, observe and describe.

Processing data

They share observations by telling what they observed and acting out or drawing what they did or what happened.

Evaluating

Students express their feelings and thoughts about the experiment and when asked, they point to a part of the experiment that went well or where they had difficulty.

IS 2

The student, when given a focus question and familiar situation, contributes elementary ideas about variables and procedures, collects and makes limited records of data and can say whether what happened was expected.

Students explore and make comparisons between objects and changes in phenomena in their concrete world. They make simple, unstructured and often incomplete records of their observations.

Planning

Students identify, given a focus question in a familiar context, some of the variables to be considered. They contribute to brainstorming of variables that could influence a change. They recognise which variable is to be the focus of the investigation and the independent variables, which are usually discrete, such as colour, or type of insulation material. They communicate how information will be gathered about the variable.

Conducting

They observe, classify, describe, make simple non-standard measurements and unstructured records of data. They follow instructions for safe practice when doing activities and experiments. They use pictures, words, numbers or simple block graphs to record observations.

Processing data

They make simple comparisons between observed objects or events, such as saying 'The light only went on when the wires were connected' or 'The box under black paper was hotter'.

Evaluating

They comment on what happened and indicate whether what happened was what they expected. They share their experience and read or listen to other students' reports about their experiments.

IS 3

The student shows awareness of the need for fair testing and makes simple predictions; collects and organises numerical data and descriptive information using simple tables, diagrams and graphs; and identifies main features, patterns and difficulties in the investigation.

Learning Area: Science

Outcome: Energy and Change

Students understand the scientific concept of energy and explain that energy is vital to our existence and to our quality of life.

The aspects of this outcomes are:

Students understand the scientific concept of energy, give examples of energy sources and describe patterns of energy use around the home and in the community.

Students understand that energy can be converted from one form into another, and that change involves the transfer of energy.

Level Assessment Guidelines

EC F

The student demonstrates an awareness that energy is present in daily life.

Students participate in and respond to activities involving the use of various forms of energy. They demonstrate an awareness of a range of energy sources, such as looking at lights, dancing to music and standing under fans. They are aware that appliances and machines have functions and purposes. Students use switches to operate appliances to produce a desired effect: for example, they will turn on a computer in order to interact. Students are aware that physical activity results in changes to body temperature and fatigue levels.

EC 1

The student understands that energy is required for different purposes in life.

Students observe and describe what they see, hear and feel. They describe an aspect or property of an object or event they have experienced. They recognise where energy comes from, how it is used and that it can change by focusing on concrete experiences, examples and events in their everyday lives. They demonstrate their learning by describing concrete experiences from explorations of the world around them.

Students identify ways in which they use energy in their daily lives: for example, they are aware that energy is required and used in walking to school and throwing a ball. They identify that energy is involved when a paperclip moves toward a magnet and electricity is required for different purposes in life. Students recognise sources of energy they often use. They are aware that heat comes from different sources: for example, they observe that the sun warms their skin, that globes are used to provide heat for young chickens and that a stove heats soup. Students recognise that energy is required for different purposes in life. They identify sources of electricity they often use. They

know that switching off a battery-operated toy saves energy so that the battery lasts longer. They know that turning on a light switch will allow them to see at night and that electricity is used to operate the TV, radio and other appliances around the home. They know that leaving a light on for long periods is wasteful and that, though useful, electricity can be dangerous.

Students are aware that energy can be changed from one form to another. They recognise that energy moves from one thing to another: for example, electrical energy can be used to create heat energy. They observe that some forms of energy change how they feel: for example, an air conditioner makes their skin feel cold, a heater makes them feel hot and a fan makes their hair move. Students are able to make simple observations relating to the conversion of electrical energy to other forms: for example they describe that a battery-powered toy moves, lights up or make a sound. They understand that the movement, light or sound is due to the battery.

EC 2

The student understands ways that energy is transferred and that people use different types of energy for different purposes.

Students describe the cause and effect related to the phenomena they observe. Students can connect or distinguish between concrete examples in describing some common forms of energy, ways that energy is transferred and how people use energy for particular purposes. They make connections between observations and recognise changes that occur at a real, concrete level.

Students describe how people use energy in their daily lives and list common types of energy, such as heat and wind and light. They describe some types of energy involved when a radio is played or a light is turned on. They can list the types of energy available in their classroom, such as electricity for lighting and for a pump bubbling air to keep fish alive in the tank. Students understand that people use energy in different ways for a variety of purposes. They realise electricity is used in a washing machine, a microwave oven and a toaster and a carpenter uses an electric drill to make a hole in wood. They recognise that electricity can be obtained from batteries or by inserting the plug of an electrical appliance into a power socket.

Students describe how energy can be transferred and understand that energy moves from one thing to another: for example, the electricity, gas or wood used in a stove or fire heats a pan causing food to become hot. Students understand that electricity changed into other forms allows energy to be used for different purposes. They know that turning on an electric heater or stove will produce heat that can warm them or be used to cook food, and sometimes create light.

EC 3

The student understands patterns of energy use and some types of energy transfer.

Students make generalisations based on concrete observations of the physical world. They understand that energy can be transferred and changed and describe their observations relating to these. They make connections between and describe patterns of energy use, sources and receivers of energy. They use these patterns to make

predictions about events and relationships that are beyond their immediate personal experience.

Students classify objects as sources or receivers of energy. They observe that every receiver is accompanied by a source. They observe that dry cells are sources of electrical energy and a globe is a receiver of electrical energy. They also recognise that a globe is a source of heat energy. They classify the sun as a source for different receivers, such as the skin for warmth and solar panels for heating water and propelling solar cars.

Students describe a pattern of energy use at home, at school or in the wider community. They observe and describe how the pattern of electricity use in their homes changes throughout the day and how energy is used, such as electricity for lights, solar heaters to heat water and wood fires to provide warmth. They are able to predict which appliances need the most energy to operate. They understand that homes use more energy in the mornings and in the evenings than in the middle of the day. They describe the relationship between the number of people in the home and the amount of energy that is consumed.

They might conduct a simple energy audit in order to establish the amount of electrical energy consumed in a home or building with a view to recommending how energy can be saved. They can also describe seasonal energy consumption changes between summer and winter. In summer, for example, electricity might be used to cool their homes, whereas in winter it is used for heating

Learning Area: Science

Outcome: Earth and Beyond

Students understand how the physical environment on earth and its position in the universe impact on the way we live.

The relevant aspect of this outcome is:

Students know that the sustainability of life depends on the quality of the air and the availability of water and materials from the ground, and they use these resources wisely.

Level Assessment Guidelines

EB F

The student demonstrates an awareness of local environmental features.

Students demonstrate an awareness of environmental factors that influence their daily lives: for example, adjusting their behaviour according to different environments such as the playground, classroom or bus. They are aware of and respond to different features of the environment, such as water features and buildings.

EB 1

The student understands that easily-observable environmental features, including the sun and moon, may influence life.

Students observe and describe what they see and hear. They describe an aspect or property of an individual object or event that has been experienced. In recognising aspects of the Earth and sky and how these may influence life, students focus on concrete experiences, examples and events in their everyday lives. They demonstrate their learning by describing real concrete experiences from their explorations of the world around them.

Students identify local environmental factors that influence their daily lives such as weather and water supply. They can describe situations where they feel cool and situations where they feel hot. Students observe and describe environmental features in relation to each other such as water features and buildings. They acknowledge that these can change over time.

EB 2

The student understands how some changes in the observable environment, including the sky, influence life.

Students describe cause and effect related to phenomena they observe. They explain the changes, differences or properties of objects or events that have been experienced. They make connections or distinguish between concrete examples in describing changes

in the observable environment and how these influence life. They note changes in the local environment that can influence their daily life such as weather patterns affecting comfort levels and use of heating or cooling appliances. They describe that inside a car feels hotter than outside, that a plant uses sunlight to grow and that demand for water goes up on a hot or dry day. They recognise that choices can be made in responding to environmental changes.

EB 3

The student understands changes and patterns in different environments and space, and relates them to resource use.

Students make generalisations based on concrete observations of the physical world. They make connections between the physical environment and resource use and describe their observations relating to them. They recognise change and patterns in observable environments. They use these patterns to make predictions about events and relationships that are beyond their immediate personal experience.

They use everyday language to describe water as a precious and finite resource. They relate energy supply features to energy supply and their own use of energy in daily life. They link seasonal changes in weather to changes in water and energy use.

Learning Area: Science

Outcome: Science in Daily Life

Students select and apply scientific knowledge, skills and understandings across a range of contexts in daily life.

In demonstrating achievement of this outcome, students will:

- apply their personal scientific knowledge to make sense of their day-to-day activities and use of appliances; and
- integrate their scientific knowledge with a range of other information to solve practical problems.

Assessment Guidelines

This outcome is typically not assessed with reference to 'levels'. It is recommended that teachers assess student progress gradually over an extended period.

Initial progress towards this outcome focuses on interpreting and linking concepts - in this case, concepts related to energy and water. To begin with, students will increase awareness of the supply and use of water and energy. They consider simple relationships between their ideas and why they are important. They recognise relationships between the seasons and human behaviour, that appliances need energy and that the natural environment needs water, too.

As children progress, they tend to become attracted to practical applications of science around them and elsewhere. Independently or together they explore the environment and are excited by the world beyond. They look to find out how mechanical things work but struggle to go beyond the 'black box' explanation for devices such as electronic watches and microwaves. They use ideas about materials to design and make devices for special purposes, such as the rain gauge. They consider scientific ideas that underpin quality-of-life issues, such as water pollution and the cost of energy use.

As they progress further, they typically have a diverse range of interests that involve consideration of phenomena and problems that arise from personal experience in the wider community. They are also interested in opinions and values about the way that science is applied. Students are able to reflect on and evaluate procedures and activities that are based on scientific understanding. They can identify scientific concepts that underpin the safe supply of water and energy and future prospects such as renewable energy technologies and sustainable design principles.

Learning Area: Society and Environment

Outcome: Resources

Students understand that people attempt to meet their needs and wants by making optimum use of limited resources in enterprising ways.

Focus on Aspect 1 *Use of Resources*

As people strive to satisfy unlimited needs and wants, there is increasing pressure on available resources

(NB: There is also direct relevance to Aspect 2: *Management and Enterprise*)

Level Assessment Guidelines

R 1

The student understands that people use resources in various ways to satisfy their needs and wants.

Students understand such basic concepts as needs and wants, resources and work. Their understanding of these concepts is discrete and separate, without connection or interpretation. They see the need for management of how they use resources in isolation, almost like routines that they need to follow in everyday contexts.

R 2

The student understands that people cooperate to utilise resources in an effort to produce goods that satisfy needs and wants.

Students can identify some resources to make goods and services. Their understanding is discrete and isolated and within a perspective that tends to remain personal. They understand that people chose how they use water and energy and that these choices have consequences.

R 3

The student understands that resources are limited and so choices need to be made about how they will be used.

Students are able to categorise resources into types and understand that different people place different values on resources. They understand that resources are limited and they can be used in various ways so choices between alternatives are made. Their understandings are developed within specific contexts and they have yet to generalise beyond these contexts on a regular basis. They begin to understand how water and energy use can be managed to decrease waste and increase community benefit. They may identify resources as renewable or non-renewable and consider the location relevance of these.

Learning Area: Society and Environment

Outcome: Natural and Social Systems

Students understand that systems provide order to the dynamic natural and social relationships occurring in the world.

Focus on Aspect 1 *Natural systems*

The interdependence of elements of the natural system and the dependence and impact of people on Natural systems, influences the nature of communities.

Level Assessment Guidelines

NSS 1

The student understands that the natural and social world contains elements that, in various ways, satisfy needs and wants.

Typically, students have an egocentric perspective of the world. They have an understanding of the elements of systems that are familiar to or of interest to themselves. However, they perceive them in isolation and not as part of a system. They have yet to develop an understanding of processes, as this involves perceiving the interrelationship between elements.

Natural systems

Students can identify that there are elements in their world that affect them: for example, they explore the natural world and understand that trees, rocks, soil, water and weather are natural things they can identify. They can identify that weather conditions do change, although they have yet to link them to the seasons.

NSS 2

The student understands that the natural and social world contains elements that interact in communities to satisfy needs and wants.

Students become aware of some connections between elements. However, their perspective shows a literal understanding that is still largely fragmented and personal.

Natural systems

Typically students' understanding is demonstrated when they make simple one-way links between elements in Natural systems: for example, they use a tree because it provides shade; they observe rainwater entering a drain or seeping into the ground. The students can make these connections but do not recognise them as parts of a natural cycle.

They are aware that these links can be broken or that changes happen; for instance, if there is no rain the environment becomes very dry and living things may suffer.

NSS 3

The student understands that, in natural and social systems, relationships occur to provide order to the interactions found within them.

They make explanations about how relationships between elements attempt to provide order and sequence within natural and social systems. These relationships are usually in the form of cycles in natural systems, reciprocal rights and responsibilities in political and legal systems and production and distribution flows in economic systems. Students can provide some reasons for changes in these systems.

Typically students' awareness is demonstrated when they can explain how simple relationships between elements act to establish equilibrium in natural systems: for instance, they can describe the relationships in the water cycle and the flow of energy in a constructed electrical supply system. In exploring specific contexts, students are aware that these flows and cycles are dynamic: for instance they can make generalisations about natural and social interrelationships, such as weather and energy use and the cost of water and energy supply.

Learning Area: Society and Environment

Outcome: Active Citizenship

Students demonstrate active citizenship through their behaviours and practices in the school environment, in accordance with the principles and values associated with the democratic process, social justice and ecological sustainability.

Focal Areas

From Aspect 1: Democratic Process

The student values and participates in community life:

- contributes to community life in a way that is consistent with good citizenship
- accepts social responsibility

From Aspect 3: Ecological Sustainability

The student values and appreciates the need to conserve resources and preserve environments/habitats:

- upholds the values of ecological sustainability and uses resources in a sustainable way
- appreciates the need to conserve resources
- works to preserve natural habitats/species

The following is excerpted from the Curriculum Council's guidelines on this outcome as provided by the Western Australian Department of Education and Training:

The Monitoring Framework

This monitoring framework for the Active Citizenship outcome attempts to capture the phases through which students typically pass as they develop and mature as active citizens. It is a diagnostic tool, designed to assist teachers to monitor students' progress on the outcome by observing the extent to which their behaviours, practices and actions are in accordance with the underlying principles and values associated with democratic process, social justice and ecological sustainability. As a result of this monitoring process, teachers will be able to design appropriate strategies that should enable students to develop further as active citizens.

Phases of development

The ways that students typically develop and mature as active citizens are described in terms of phases of development: *Emerging, Developing or Well-developed*. The target age range of this package means that most students are only likely to be assessed according to the *Emerging* phase, but in some cases may display behaviours from the *Developing* phase. Details of these are provided overleaf.

Active Citizenship

Emerging phase

Students are relatively self-centred. Typically, they demonstrate their behaviours and actions within settings, which are familiar to them, such as in the classroom, school grounds, or within their friendship group; and their behaviours and actions are often guided by their teachers.

In this case, this will typically be evident when a student:

- shows an interest in and respect for the use of energy or water in their immediate area (classroom, home, school)
- with direction participates in environmentally-friendly routines
- helps to manage the use of energy and/or water in the classroom, school and home
- with direction, takes action to conserve and protect the water system and to use water and energy in a careful way
- takes action, with guidance, to minimise water pollution in the immediate environment

Developing phase

Students are looking beyond themselves and their immediate surroundings. Typically, they demonstrate their behaviours and actions in an increasing range of contexts (including less-familiar settings and an increasing variety of groups) and an increasingly independent manner, although they sometimes seek the guidance of teachers in more complex situations.

In this case, this will typically be evident when a student:

- shows concern for the environment beyond the classroom, school and home
- initiates action (with some guidance) to reduce water and energy use in the wider community
- articulates respect and concern for the water and energy supply systems
- initiates action/devises strategies to reduce the school's use of water and energy
- with guidance, helps to reduce water and energy use in the wider community
- articulates values pertaining to ecological sustainability
- takes some independent action to minimise negative environmental disturbance
- articulates concern
- takes steps to rehabilitate/regenerate degraded areas (especially water system infrastructure or natural water features) in the school and wider community

