Energy & Water Saving

Education Kit For Schools

WIRRAMINNA ENVIRONMENTAL EDUCATION CENTRE BURRUMBUTTOCK

NSW GOVERNMENT

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Further Information

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Who is this kit for?

1.1

This kit is designed for Stage 2 and 3 students to help them to understand how energy and water use can impact on climate change. There are many activities for teachers to use to support these concepts and to aid in the teaching of the new Curriculum.

The activities within this education kit have been chosen to fit into Step 1 of the Sustainability Action Process (Section 1.3, p 19). You can use these activities at the initial stage of the process to excite the kids about energy and water saving, learn the concepts and develop a general knowledge about energy and water.

Sustainability Trailer

A Sustainability Trailer is available for regional school visits with teacher support. It is currently managed by TAFE NSW Riverina Institute, National Environment Centre, Thurgoona.

The trailer has equipment for students to apply their skills and test energy of devices found in the trailer as well as make a model solar-powered or wind-powered car.

Australian Curriculum - Sustainability cross-curriculum priority

The new K-10 Board of Studies NSW syllabuses include Sustainability as a cross-curriculum priority. This approach supports students to develop the knowledge, skills, understanding, values and attitudes necessary for people to act in ways that contribute to more sustainable patterns of living as part of subject area learning. Additional outcomes can be included.

See “1.2 Curriculum Outcomes” for details.

Board of Studies NSW syllabuses – Stages 2 and 3

Energy use and efficiency investigations are appropriate contexts for achieving learning outcomes for:

- Science and Technology syllabus.bos.nsw.edu.au/science/
- Human Society & its Environment k6.boardofstudies.nsw.edu.au/wps/portal/go/hsie
- English syllabus.bos.nsw.edu.au/english/
- Mathematics syllabus.bos.nsw.edu.au/mathematics/

See “1.2 Curriculum Outcomes” for details.

Curriculum Outcomes

1.2

Australian Curriculum - Sustainability cross-curriculum priority

The Sustainability cross-curriculum priority is designed to build a deep understanding of ecological systems on Earth. It provides ways to view and engage with environmental and sustainability issues in different contexts.

Through sducation for sustainability, students develop the knowledge, skills, values and world views necessary to act in ways that contribute to more sustainable patterns of living. Sustainability education is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action.

The Organising Ideas relevant for this education kit are below.

Organising idea (and concept area)
Organising idea 3 Sustainable patterns of living rely on the interdependence of healthy social, economic and ecological systems. (Systems)
Organising idea 4 World views that recognise the dependence of living things on healthy ecosystems, and value diversity and social justice are essential for achieving sustainability. (World Views)
Organising idea 5 World views are formed by experiences at personal, local, national and global levels, and are linked to individual and community actions for sustainability. (World Views)
Organising idea 6 The sustainability of ecological, social and economic systems is achieved through informed individual and community action that values local and global equity and fairness across generations into the future. (Futures)
Organising idea 7 Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments. (Futures)
Organising idea 8 Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts. (Futures)

The Energy & Water Saving Education Kit assists students to:

- Understand the use and source/consumption of energy and water in the school.
- Understand energy production systems and sources of energy in their community.
- Investigate, plan and communicate changes to energy and water use/efficiency to improve sustainability.

The *Australian Curriculum: Geography* identifies the concept of sustainability as integral to the development of geographical understanding. The concept of sustainability can be applied across the subject to identify a question, guide an investigation, organise information, suggest an explanation or assist decision-making during student investigations.

Australian Curriculum – Science and Geography

The following tables provide links to Australian Curriculum for Science and Geography for Years 3 to 6 where the study of energy can be appropriately used as a thematic or learning context.

Year 3	
Subject	***Australian Curriculum content descriptions***
Science	Science as a Human Endeavour: Nature and development of science • Science involves making predictions and describing patterns and relationships **ACSHE050** Science as a Human Endeavour: Use and influence of science • Science knowledge helps people to understand the effect of their actions **ACSHE051** Science Inquiry Skills: Questioning and predicting • With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge **ACSIS053** Science Inquiry Skills: Planning and conducting • Suggest ways to plan and conduct investigations to find answers to questions **ACSIS054** • Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate **ACSIS055**

Year 3	
Subject	***Australian Curriculum content descriptions***
Science	Processing and analysing data and information • Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends **ACSIS057** Communicating • Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports **ACSIS060**

Year 4	
Subject	***Australian Curriculum content descriptions***
Science	Science as a Human Endeavour: Nature and development of science • Science involves making predictions and describing patterns and relationships **ACSHE061** Science as a Human Endeavour: Use and influence of science • Science knowledge helps people to understand the effect of their actions **ACSHE062** Science Inquiry Skills: Questioning and predicting • With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge **ACSIS064** Science Inquiry Skills: Planning and conducting • Suggest ways to plan and conduct investigations to find answers to questions **ACSIS065** • Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate **ACSIS066** Science Inquiry Skills: Processing and analysing data and information • Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends **ACSIS068** • Compare results with predictions, suggesting possible reasons for findings **ACSIS216** Science Inquiry Skills: Communicating • Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports **ACSIS071**

Year 4	
Subject	***Australian Curriculum content descriptions***
Geography	Geographical Knowledge and Understanding • The natural resources provided by the environment, and different views on how they could be used sustainably **ACHGK024** • The sustainable management of waste from production and consumption **ACHGK025** Geographical Inquiry and Skills: Observing, questioning and planning • Develop geographical questions to investigate **ACHGS026** Geographical Inquiry and Skills: Collecting, recording, evaluating and representing • Represent data by constructing tables and graphs **ACHGS028** • Represent the location of places and their features by constructing large-scale maps that conform to cartographic conventions including scale, legend, title and north point, and describe their location using simple grid references, compass direction and distance **ACHGS029** Geographical Inquiry and Skills: Interpreting, analysing and concluding • Interpret geographical data to identify distributions and patterns and draw conclusions **ACHGS030** Geographical Inquiry and Skills: Communicating • Present findings in a range of communication forms, for example, written, oral, digital, graphic, tabular and visual, and use geographical terminology **ACHGS031** Geographical Inquiry and Skills: Reflecting and responding • Reflect on their learning to propose individual action in response to a contemporary geographical challenge and identify the expected effects of the proposal **ACHGS032**

Year 5	
Subject	***Australian Curriculum content descriptions***
Science	Science as a Human Endeavour: Nature and development of science • Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena **ACSHE081** • Important contributions to the advancement of science have been made by people from a range of cultures **ACSHE082** Science as a Human Endeavour: Use and influence of science • Scientific understandings, discoveries and inventions are used to solve problems that directly affect peoples' lives **ACSHE083** • Scientific knowledge is used to inform personal and community decisions **ACSHE217** Science Inquiry Skills: Questioning and predicting • With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be **ACSIS231** Science Inquiry Skills: Planning and conducting • With guidance, plan appropriate investigation methods to answer questions or solve problems **ACSIS086** • Use equipment and materials safely, identifying potential risks **ACSIS088** Science Inquiry Skills: Processing and analysing data and information • Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate **ACSIS090** • Compare data with predictions and use as evidence in developing explanations **ACSIS218** Science Inquiry Skills: Evaluating • Suggest improvements to the methods used to investigate a question or solve a problem **ACSIS091** Science Inquiry Skills: Communicating • Communicate ideas, explanations and processes in a variety of ways, including multi-modal texts **ACSIS093**

Year 5	
Subject	***Australian Curriculum content descriptions***
Science	Science Understanding: Physical sciences • Electrical circuits provide a means of transferring and transforming electricity **ACSSU097** • Energy from a variety of sources can be used to generate electricity **ACSSU219** Science as a Human Endeavour: Nature and development of science • Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena **ACSHE098** Science as a Human Endeavour: Use and influence of science • Scientific understandings, discoveries and inventions are used to solve problems that directly affect peoples' lives **ACSHE100** • Scientific knowledge is used to inform personal and community decisions **ACSHE220** Science Inquiry Skills: Questioning and predicting • With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be **ACSIS232** Science Inquiry Skills: Planning and conducting • With guidance, plan appropriate investigation methods to answer questions or solve problems **ACSIS103** • Use equipment and materials safely, identifying potential risks **ACSIS105** Science Inquiry Skills: Processing and analysing data and information • Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate **ACSIS107** • Compare data with predictions and use as evidence in developing explanations **ACSIS221** Science Inquiry Skills: Evaluating • Suggest improvements to the methods used to investigate a question or solve a problem **ACSIS108** Science Inquiry Skills: Communicating • Communicate ideas, explanations and processes in a variety of ways, including multi-modal texts **ACSIS110**

Board of Studies NSW syllabuses – Stages 2 and 3

The new K-10 Board of Studies NSW syllabuses include Sustainability as a cross-curriculum priority. This approach supports students to develop the knowledge, skills, understanding, values and attitudes necessary for people to act in ways that contribute to more sustainable patterns of living as part of subject area learning. Additional outcomes can be included.

Energy & Water Saving investigations, as included in this resource, are appropriate contexts for achieving learning outcomes for:

- Science and Technology syllabus.bos.nsw.edu.au/science/
- Human Society & its Environment k6.boardofstudies.nsw.edu.au/wps/portal/go/hsie
- English syllabus.bos.nsw.edu.au/english/
- Mathematics syllabus.bos.nsw.edu.au/mathematics/

Teachers should also consider using the ***literacy continuum*** and the ***numeracy continuum*** to identify where a student's skills lie on this continuum and then use the Energy & Water Saving Education Kit to challenge them to move to the next cluster.

Stage 2	
Syllabus	***Outcomes***
Human Society and its Environment	***Relationships with place*** Describes people's interactions with environments and identifies responsible ways of interacting with environments **ENS2.6** • identifies issues about the care of places in the community or places of importance to them • examines some regulations, laws and practices associated with the management and care of natural and built features and sites • evaluates the necessity of caring for and conserving a feature, site or place • plans and implements a strategy for caring for a particular feature or site • presents alternatives to, and consequences of, using features, sites and places in particular ways • identifies the viewpoints of others regarding how sites, places and features can be cared for and demonstrates an appreciation of the rights of others to have these viewpoints • gives reasons why a specified feature, place or site should be cared for

Stage 2	
Syllabuses	***Outcomes***
Human Society and its Environment	***Resource systems*** Describes how and why people and technologies interact to meet needs and explains the effects of these interactions on people and the environment **SSS2.7** • makes statements about the responsibilities of producers and consumers within systems towards people and the environment • describes how changes in technology have affected lifestyles and the environment e.g. media technologies ***Roles, Rights and Responsibilities*** Investigates rights, responsibilities and decision-making processes in the school and community and demonstrates how participation can contribute to the quality of their school and community life **SSS2.8** • describes how decisions are made in local government and the roles and responsibilities of those involved • explains the processes involved in civic action within the community • investigates current community issues • contributes to decision-making processes in the class and school
English	***Objective A*** A student: • communicates in a range of informal and formal contexts by adopting a range of roles in group, classroom, school and community contexts **EN21A** • plans, composes and reviews a range of texts that are more demanding in terms of topic, audience and language **EN2-2A** • uses an increasing range of skills, strategies and knowledge to fluently read, view and comprehend a range of texts on increasingly challenging topics in different media and technologies **EN24A** ***Objective D*** A student identifies and considers how different viewpoints of their world, including aspects of culture, are represented in texts **EN3-8D** ***Speaking and listening 1*** Develop and apply contextual knowledge • interpret ideas and information in spoken texts and listen for key points in order to carry out tasks and use information to share and extend ideas and information **ACELY1687** • understand that social interactions influence the way people engage with ideas and respond to others for example when exploring and clarifying the ideas of others, summarising their own views and reporting them to a larger group **ACELA1488**

Stage 2	
Syllabuses	***Outcomes***
English	Respond to and compose texts • interact effectively in groups or pairs, adopting a range of roles • use interaction skills, including active listening behaviours and communicate in a clear, coherent manner using a variety of everyday and learned vocabulary and appropriate tone, pace, pitch and volume **ACELY1688**, **ACELY1792** • use information to support and elaborate on a point of view. ***Writing and representing 1*** Develop and apply contextual knowledge • identify key elements of planning, composing, reviewing and publishing in order to meet the demands of composing texts on a particular topic for a range of purposes and audiences • understand and apply knowledge of language forms and features • plan, draft and publish imaginative, informative and persuasive texts containing key information and supporting details for a widening range of audiences, demonstrating increasing control over text structures and language features **ACELY1682**, **ACELY1694** Respond to and compose texts • plan, compose and review imaginative and persuasive texts • plan and organise ideas using headings, graphic organisers, questions and mind maps • experiment with visual, multimodal and digital processes to represent ideas encountered in texts
Mathematics	***Working Mathematically*** A student: • selects and applies appropriate mental and written strategies, or technologies, to solve problems **MA22WM** ***Data 1*** A student: • selects appropriate methods to collect data, and constructs, compares, interprets and evaluates data displays, including tables, picture graphs and column graphs **MA2-18SP** • identify questions or issues for categorical variables; identify data sources and plan methods of data collection and recording **ACMSP068** • collect data, organise it into categories, and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies **ACMSP069** • interprets and compares data displays **ACMSP070**

Stage 3	
Syllabuses	***Outcomes***
Human Society and its Environment	***Patterns of place and location*** Demonstrates an understanding of the interconnectedness between Australia and global environments and how individuals and groups can act in an ecologically responsible manner **ENS3.5** • compares human use of an environmental area with use in another area of the world • explains the effects of human changes on an environment, evaluating the positive and negative aspects of these changes • participates in the maintenance or improvement of an environment, e.g. supports bush regeneration Explains how various beliefs and practices influence the ways in which people interact with, change and value their environment. **ENS3.6** • examines factors that may give rise to different views about the care of places e.g. economic circumstances, occupation, age, gender, interest in heritage • evaluates alternative views about the use of natural and built environments e.g. economic, spiritual, sentimental, historical perspectives • examines how natural, cultural, religious, historical, economic and political factors can influence people's interactions with environments • identifies their own code of behaviour as it applies to their local area • examines issues associated with differing values about natural and built environments, using a variety of sources, including the media • expresses a personal point of view on an environmental issue and provides supporting evidence
Science and Technology	***Working Scientifically*** A student: • investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanations **ST34WS** *Content* Students question and predict by: • predicting what the findings of an investigation might be **ACSIS231**, **ACSIS232** • with guidance, posing questions to clarify practical problems or inform a scientific investigation **ACSIS231**, **ACSIS232** • applying experience from similar situations in the past to predict what might happen in a new situation

Stage 3	
Syllabuses	***Outcomes***
Science and Technology	Students plan investigations: • with guidance, planning appropriate investigation methods to test predictions, answer questions or solve problems including surveys, fieldwork, research and fair tests **ACSIS086, ACSIS103, ACSHE081, ACSHE098** • collaboratively and individually selecting suitable methods for gathering data and information first-hand and from reliable secondary sources Students conduct investigations by: • working individually and collaboratively in conducting a range of appropriate investigation methods, including fair tests, to answer questions or solve problems • using suitable equipment and materials, checking observations and measurements by repeating them where appropriate • using equipment and materials safely, identifying potential risks **ACSIS088, ACSIS105** • accurately observing, measuring and recording data, using digital technologies as appropriate **ACSIS087, ACSIS104** • using formal units and abbreviations for measuring and recording data • suggesting improvements to the methods used to investigate a question or solve a problem **ACSIS091, ACSIS108** Students process and analyse data and information by: • constructing and using a range of representations, including tables, graphs (column, picture, line and divided bar graphs) and labelled diagrams • using numerical techniques to analyse data and information, including calculating the means and percentages of small sets of data • drawing conclusions and providing explanations based on data and information gathered first-hand or from secondary sources • comparing gathered data with predictions, and using as evidence in developing explanations of events and phenomena **ACSIS218, ACSIS221, ACSHE081, ACSHE098** Reflecting on their gathered evidence in relation to: • the process used to gather, process and analyse their data and information • their own prior knowledge as well as accepted scientific explanations • their own and others' conclusions

Stage 3	
Syllabuses	***Outcomes***
Science and Technology	Students communicate by: • constructing and using a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data including using digital technologies as appropriate **ACSIS090, ACSIS107** • using a variety of ways to honestly and accurately communicate ideas, explanations and processes, including multi-modal texts, labelled diagrams, as well as written and oral factual texts as appropriate **ACSIS093, ACSIS110** ***Working Technologically*** A student: • plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identified constraints **ST3-5WT** *Content* Students explore and define a task by: • exploring needs for, or opportunities to undertake, the task • identifying the users' needs and wants using techniques e.g. observations, surveys, interviews and market research • developing a design brief individually and in collaboration with others • developing design criteria that considers, where relevant, function, aesthetics, social and environmental considerations Students generate and develop ideas by: • selecting and using creative thinking techniques, including mind-mapping, brainstorming, sketching and modelling • selecting and using research techniques appropriate to the task • selecting and using techniques for documenting and communicating design ideas to others, e.g. drawings, plans, flow charts, storyboarding, modelling and presentations, using digital technologies • identifying a range of appropriate materials for the task • selecting and using techniques to investigate the suitability of materials • applying established criteria to evaluate and modify ideas

Stage 3	
Syllabuses	***Outcomes***
Science and Technology	Students produce solutions by: • testing the suitability of materials, considering whether the test was fair or not • developing a plan and specifications to guide production • using their plans and production sequence • for a design project, selecting and safely using a range of tools, equipment and related techniques to cut, edit, join, manipulate and shape materials and/or information Students evaluate by: • identifying the strengths and limitations of the process used • self or peer assessing the final product by using the established design criteria ***Physical world*** A student: • describes how scientific understanding about the sources, transfer and transformation of electricity is related to making decisions about its use **ST3-6PW** *Content* Electrical circuits provide a means of transferring and transforming electricity **ACSSU097** Students: • identify potential risks and demonstrate safe use when using electrical circuits and devices • demonstrate the need for a circuit to be complete to allow the transfer (flow) of electricity • construct simple circuits incorporating devices e.g. switches and light globes • observe and describe how some devices transform (change) electricity to heat energy, light, sound or movement e.g. hair dryers, light globes, bells and fans • energy from a variety of sources can be used to generate electricity and this knowledge can inform personal and community-based decisions about using these sources sustainably **ACSSU219**

Stage 3	
Syllabuses	***Outcomes***
Science and Technology	Students: • research and present ideas about the different ways electricity can be generated e.g. burning coal or natural gas; solar, hydroelectric, geothermal, wind and wave-generated electricity • describe how scientific knowledge can be used to inform personal and community decisions about the use and conservation of sustainable sources of energy **ACSHE217, ACSHE220** • planning the process considering constraints where relevant e.g. time, finance, resources and expertise Students generate and develop ideas by: • selecting and using creative thinking techniques, including mind-mapping, brainstorming, sketching and modelling • selecting and using research techniques appropriate to the task.
English	***Objective A*** A student: • communicates effectively for a variety of audiences and purposes using increasingly challenging topics, ideas, issues and language forms and features **EN31A** • uses an integrated range of skills, strategies and knowledge to read, view and comprehend a wide range of texts in different media and technologies **EN33A** ***Objective D*** A student identifies and considers how different viewpoints of their world, including aspects of culture, are represented in texts **EN3-8D** ***Speaking and listening*** • use interaction skills, varying conventions of spoken interactions such as voice volume, tone, pitch and pace, according to group size, formality of interaction and needs and expertise of the audience **ACELY1816** • participate in and contribute to discussions, clarifying and interrogating ideas, developing and supporting arguments, sharing and evaluating information, experiences and opinions **ACELY1709** • plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements for defined audiences and purposes, making appropriate choices for modality and emphasis **ACELY1700, ACELY1710**

Stage 3	
Syllabuses	***Outcomes***
English	***Writing and representing*** Engage personally with texts • experiment and use aspects of composing that enhance learning and enjoyment • understand and apply knowledge of language forms and features • plan, draft and publish imaginative, informative and persuasive texts, choosing and experimenting with text structures, language features, images and digital resources appropriate to purpose and audience **ACELY1704, ACELY1714** Reading and viewing • identify and explain how analytical images like figures, tables, diagrams, maps and graphs contribute to our understanding of verbal information in factual and persuasive texts **ACELA1524** • explain sequences of images in print texts and compare these to the ways hyperlinked digital texts are organised, explaining their effect on viewers' interpretations **ACELA1511** • use comprehension strategies to interpret and analyse information and ideas, comparing content from a variety of textual sources including media and digital texts **ACELY1703, ACELY1713** Develop and apply contextual knowledge • understand how texts vary in purpose, structure and topic as well as the degree of formality **ACELA1504** Understand and apply knowledge of language forms and features • understand that the starting point of a sentence gives prominence to the message in the text and allows for prediction of how the text will unfold **ACELA1505**
Mathematics	***Working Mathematically*** A student: • selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations **MA32WM** • gives a valid reason for supporting one possible solution over another **MA33WM** • uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables **MA318SP**

Stage 3	
Syllabuses	***Outcomes***
Mathematics	***Data 1*** Students: • pose questions and collect categorical or numerical data by observation or survey **ACMSP118** • pose and refine questions to construct a survey to obtain categorical and numerical data about a matter of interest • collect categorical and numerical data through observation or by conducting surveys. • construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies **ACMSP119** • tabulate collected data, including numerical data, with and without the use of digital technologies such as spreadsheets • construct column and line graphs of numerical data using a scale of many-to-one correspondence, with and without the use of digital technologies • choose an appropriate title to describe the data represented in a data display (Communicating) • recognise which types of data display are most appropriate to represent categorical data (Communicating) • identify and describe relationships that can be observed in data displays, (Communicating, Reasoning) • use information presented in data displays to aid decision making. (Reasoning)

Teaching for Sustainability

1.3

Learning for sustainability seeks to enable and empower students to make decisions and take actions that contribute to creating a sustainable society and ecosystem. Sustainability action is both a preferred pedagogical approach for teaching sustainability and an essential set of knowledge and skills for students to learn.

This learning is best delivered through a wide range of teaching and learning activities utilising all of the Key Learning Areas. Students will develop strong environmental knowledge, awareness and capacity for positive environmental change when sustainability is contextualised or taught using real examples, problem solving and with active student participation.

Sustainability Action Process (SAP)

This process supports students to identify, investigate and take sustainability action. When sustainability action is applied as a systematic process to issues and needs, it can be modelled, reapplied to new problems and learned by students with increasing levels of sophistication and complexity. The ultimate learning goal is for students to be able to implement sustainability action with such fluency that they can operate independently of the need for a scaffolded process. The Sustainability Action Process has five steps:

1. Making a case for change
2. Developing the scope
3. Defining the proposal
4. Implementing
5. Evaluating and reflecting

The following pages outline some of the key questions you and your students can investigate for steps 1 to 3 of the Sustainability Action Process.

For more information: www.curriculumsupport.education.nsw.gov.au/env_ed/teaching/

Sustainability Action Process

Step 1 - Making the case for change

Exploring energy

- What do I know about energy?
- How and where will I find out more about energy and my school?
- What does it mean to use energy in a sustainable way?

Assessing the current situation through a school energy audit

- How do we use energy in our school?
- How much energy is used for each purpose in our school?
- Who are the people (stakeholders) at our school who use energy and what are their opinions, needs and concerns?
- Are there issues with using too much energy and why is this important?

Investigating concepts and ideas relating to energy and its sustainable use

- What further investigations do I need to undertake to learn more about energy in my school?
- What did I find out?

Stating the case for what needs to change in the school and why

- What do we think needs to change in our school about how we use energy and why?
- Who do we need to talk to and why?
- Do we need to learn more?

Using Step 1

The activities within this education kit have been chosen to fit into Step 1 of the Sustainability Action Process. You can use these activities at the initial stage of the process to excite the students about energy and water saving, learn the concepts and develop a general knowledge about energy and water.

Step 2 - Defining the scope for action

Generating ideas and exploring options for making a change

- What have other schools done to reduce energy consumption?
- What types of action do we want to take?
- How will we know if the changes we make have been successful in using energy more sustainably?

Identifying available resources and constraints

- Who might be available to help us?
- What time is available for the project?
- What finances are available for the project?
- What might limit our actions?

Selecting ideas for action

- Considering our resources and constraints, what type of actions best meet the criteria for reducing energy consumption in our school?

Step 3 - Developing the proposal for action

Developing the statement (brief) describing an agreed direction for action

- What is the type of action we have planned?
- How will we judge the success of our improvements?
- What are the individual steps required. What budget or resources are required for each individual step or action?
- Who will be responsible for these actions?
- What could we do if things don't go to plan?

Preparing and communicating the proposal

- Which of our stakeholders do we need to share our plan with?
- How will we use feedback to improve our proposal?

Gaining agreement on the proposal

- Has our class and have others in the school agreed to our ideas?
- Has our Principal agreed?

Allegorical Apple

1.4

Activity Sheet

Use an apple to demonstrate how much of the Earth is available for us to live on. Use Appendix 1 to help show the different stages of the Allegorical Apple exercise.

The teacher will present a good-sized apple to the class and explain that in this allegorical exercise, the apple represents the Earth.

1. Cut the Earth into four pieces and discard three of the pieces to represent salt water and oceans, 75% of the Earth.
2. Slice the remaining piece of Earth in half and discard one piece to represent land, such as deserts, which is inhospitable to people.
3. Slice the remaining 1/8 of the Earth into four sections and set aside three of the sections to represent areas too rocky, too steep, or too cold to produce food.
4. Carefully peel the skin off the remaining 1/32 slice of the Earth. This represents the surface of the Earth, the Earth's crust with its topsoil which humanity depends on. The Earth's topsoil is only about one and a half metres deep and produces a relatively fixed amount of food. Over farming and erosion take away 24 billion tons of topsoil per year. Each centimetre of top soil requires 100 years to form.
5. Ensure students understand that there are 51 billion hectares of surface on Earth, of this, 12 billion (10 billion land and 2 billion water) are biologically productive and capable of supporting human demand for resources and treatment of waste.
6. Ask students how many people are on Earth - it's about 7.3 billion and growing!. "If we have 12 billion hectares of land and 7 billion people, how many hectares do we get each?" – 1.7 hectares each! Explain that if we are to share the Earth's resources equitably and have a sustainable lifestyle, our eco-footprint must be 1.7 hectares or less. Use an outdoor space to help students envision how small 1.7 hectares are. You can also tell the students that 1.7 hectares is 17,000 square metres or slightly smaller than a cricket field.
7. If someone points it out, follow their comment/question, otherwise at this stage, ask students "Now, are humans the only creatures on the Earth who need food, shelter, energy?" No, we share the Earth with 10 million other species who also need bioproductive land. So that means our eco-footprints should actually be less than 1.7 hectares if we are going to leave any land for other 10 million species besides us.

Learn more about your **eco-footprints** with the following websites:

- http://www.coolaustralia.org/activity/aussi-ecological-footprint-primary/
- http://www.wwf.org.au/our_work/people_and_the_environment/human_footprint/
- http://www.cleanup.org.au/files/my-environmental-footprint.pdf

SOURCE: Adapted from "What is Sustainability?"
http://files.earthday.net/lesson%20plans/bobbybigfoot/ES_What_is_Sustainability.pdf

Energy

2.0

2.1 Energy Sources

2.2 Solar Energy

2.3 Wind Energy

2.4 Coal Electricity Generation

Energy Sources

2.1

Teacher's Notes

Purpose

To give learners an understanding of the different types of energy sources

You will need

- Student 2.1 activity sheets
- Appendix 2 - Energy Sources Posters
- Read the Teacher's Notes on the following pages.

Activity suggestions

- Talk to learners about the different types of energy sources using the information you have read in the Teacher's Notes and using Appendix 2 – Energy Sources Posters. Alternatively, you could:
  - Invite someone from the local energy authority or an environmental scientist to talk to the class about renewable energy.
  - Have students conduct further research into the different types of energy.
- After learners have heard about renewable energy they can work through the activity. Discuss vocabulary as the need arises. There are opportunities to look at prefixes such as bio, geo etc.

Reflection

- What are the benefits of renewable energy?
- Do you think Australia could increase its use of renewable energy? How?

Other ideas

- Research and compare the environmental impact of the Snowy Mountains Scheme (NSW) vs one of the LaTrobe Valley coal power stations (Vic - Yallourn, Loy Yang or Hazelwood).
- Research the wind energy projects in Australia.
- Research plans for new technologies.
- Research why Australia doesn't use more solar energy.

Useful Links

www.cleanenergycouncil.org.au/technologies.html

Renewable and Non-renewable energy sources

Energy can be divided into two broad categories – renewable and non-renewable. Renewable energy means that the source of the energy is not depleted when it is used, such a solar energy. Non-renewable energy sources are finite. When a non-renewable energy source is completely used, it cannot be replaced, such as coal sourced from underground.

Renewable Energy

Renewable energy sources are much cleaner than non-renewable sources, produce fewer greenhouse gas emissions and have less impact on the environment. Different types of renewable energy include hydro-electricity, solar energy, wind power, biomass, geothermal energy and wave and tidal power. The Clean Energy Council provides a good overview of the different types of renewable energy technologies available.
www.cleanenergycouncil.org.au/technologies.html

Hydroelectricity

Hydroelectricity is produced from the force of running rivers, dams or waterfalls. The movement of the water spins turbines that generate electricity. Places with high rainfall and steep mountains are ideal for hydroelectricity. New Zealand, Canada, and Brazil produce most of their electricity this way. Most of Australia's hydro power is generated by Tasmania's 35 hydroelectric plants and the Snowy River Hydro Scheme in New South Wales.

Large hydroelectricity projects require large dams to store sufficient water to produce electricity. Dams can be multi-purpose; supplying water for drinking and for irrigation. There are also ecological disadvantages of hydro power. When large dams are built the flow of the dammed river is changed radically and large areas of land are flooded, impacting wildlife habitats and farming land. The Snowy Mountains Scheme had an enormous impact on the Snowy River. Smaller hydroelectric power stations (called mini or micro hydro) do not generally need dams but rely on naturally flowing water such as streams. These provide a good source of power and are often used as stand-alone systems not connected to the main electricity grid. www.cleanenergycouncil.org.au/technologies/hydroelectricity.html

Solar energy

Australia receives enough sunlight to supply the nation's total energy needs many times over. Solar energy from the sun comes in two forms - light and heat. Light energy is turned into electricity using solar photovoltaic (PV) cells. Solar PV cells are used in small electrical items, like calculators and watches, and for remote area power supplies, like telephones and space satellites. They are also used on a larger scale to supply electricity for homes, businesses and through energy authorities, such as new solar flagship programs.
www.cleanenergycouncil.org.au/technologies/solar-pv.html

Solar power is particularly useful in remote areas where regular electricity supply is not available.

Heat energy from the sun is called solar thermal energy. This energy can be used directly in our homes to heat water or it can be used to create steam to drive a small turbine which generates electricity. See “Solar Energy” fact sheet on page 31 for more details.
www.cleanenergycouncil.org.au/technologies/solar-water-heating.html
www.cleanenergycouncil.org.au/technologies/concentrated-solar-thermal.html

Wind power

Through the ages people have used windmills to capture the wind’s energy. Windmills have moving sails connected to wheels that turn to operate machinery. Windmills have traditionally been used to grind wheat and other grains into flour.

Wind power can also be harnessed to produce electricity. Wind turbines are large fan-like structures with three giant blades held on tall towers. They are placed where they can catch the wind’s energy and convert it into electrical energy. See “Wind Energy” fact sheet on page 33 for more details.
www.cleanenergycouncil.org.au/technologies/wind-energy.html

Bioenergy

Bioenergy is produced from the mass of biological matter, which is plant and animal matter, or biomass. Plant waste can be turned into liquid ethanol and used as an alternative source of fuel.

Biomass power can be generated by burning plants, including wood and crop waste. An example of this is the burning of sugar cane waste, known as bagasse, in the cane-growing areas of Queensland. Burning biomass does not significantly add to the greenhouse effect, as the carbon released from the biomass has been stored for a much shorter time than the carbon released from burning fossil fuels.

The energy given off during the natural decomposition of plants and animals is called biogas. Biogas from sewage works is being used as an alternative energy source in regions of Melbourne, Sydney, Adelaide and Brisbane. Biogas can also be collected from rubbish dumps (landfill). This gas from rotting waste would normally seep up through the ground and into the atmosphere, contributing to environmental problems like the greenhouse effect and unpleasant smells. However, biogas can be captured and processed to create electricity.
www.cleanenergycouncil.org.au/technologies/bioenergy.html

Geothermal energy

The word geothermal comes from the Greek words ***geo*** (earth) and ***therme*** (heat). So, geothermal energy is heat from within the earth. Geothermal energy uses the steam and hot water produced inside the earth to heat buildings or generate electricity. Volcanoes, bubbling mud pools, hot springs and geysers are examples of geothermal energy.

The hot water and steam created underground can be used to heat homes and buildings. The steam can be collected and used to power a generator in the same way it is used in a coal fired power station.

Another form of geothermal energy is called 'hot rock'. The granite rocks are 3-5 kilometres underground and their temperature is more than 200°C. Water is pumped below the surface to areas of hot rock. The water then turns to steam and returns to the surface under pressure to drive a turbo-generator.

Australia does not have steaming hot springs but it does have hot rock areas such as the Cooper Basin in the north of South Australia. Exploration is being carried out and there are plans to use this type of energy in the future.
www.cleanenergycouncil.org.au/technologies/geothermal.html

Wave and tidal power

Ocean waves are a more reliable source of energy than the wind or sun. Wave energy is generated by the movement of turbines and devices floating on the ocean surface.

Tidal power is effective in areas where there is a large difference between high and low tides. Tidal power is similar to a hydroelectric scheme except the dam is larger and built across an estuary. Water flows through tunnels in the dam when the tide moves in and out.

A major drawback of tidal power is that it can only generate when the tide is flowing in or out; that is, only about 10 hours each day. However, unlike wind or solar power, tides are totally predictable. Tidal power stations are extremely expensive to build but once built, tidal power is free.

Tidal power can damage the environment, with areas upstream and downstream suffering. For example, many birds rely on tidal movements so they can feed on mud flats.

There is no wave or tidal power in Australia yet. However, there are plans for a wave power station off the coast of Portland in Victoria. There are also a few sites being considered for tidal power stations.
www.cleanenergycouncil.org.au/technologies/marine-energy.html

Non-renewable Energy

Australia has extensive non-renewable energy resources including oil, coal, natural gas and uranium. Approximately 85% of Australia's electricity generation is derived from these non-renewable sources. These resources are non-renewable because they are finite. If they are continually used, they will run out.

It is important to note that oil, coal and gas are all carbon-based fossil fuels that produce carbon emissions when burned. Uranium is not a fossil fuel but is still a non-renewable resource that requires extraction, transport and management of toxic waste.

See "Coal Electricity Generation" fact sheet on page 34 for more details.

Energy Sources

2.1

Activity Sheet

1. There are different types of renewable energy.

   a. In the box below, match the energy with its source. The first one is done for you:

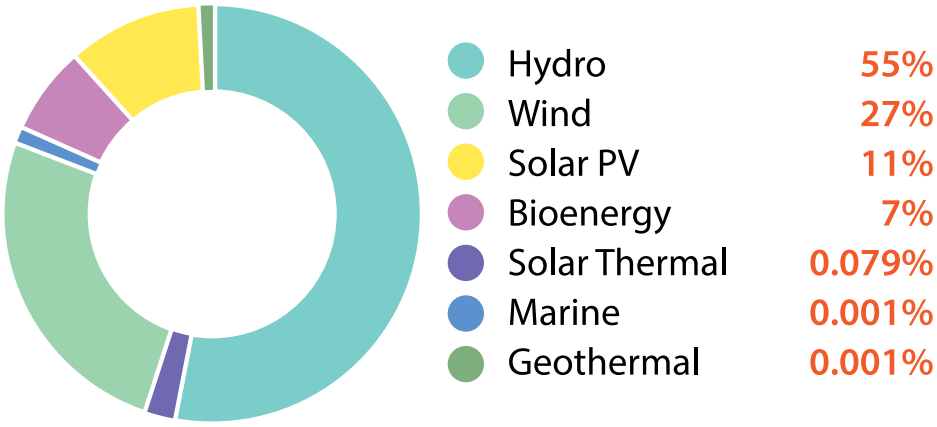
Type of energy	Source
hydro	the ocean
solar	water
wind	plants and animals
biomass	the sun
geothermal	the wind
wave	heat within the earth

   b. What are the advantages and disadvantages of using different types of energy? Write them in the table below.

Energy	Advantages	Disadvantages
hydro		
solar		
wind		
biomass		
geothermal		
wave		
coal		
natural gas		
nuclear		

2. Read the statistics below about renewable energy in Australia.

   In 2013, about 14.76% of Australia's total energy usage came from renewable energy sources. This renewable energy comes from:



Source: Clean Energy Australia Report 2013
https://www.cleanenergycouncil.org.au/policy-advocacy/reports/clean-energy-australia-report.html

3. Think about ... talk about

   - From what source does Australia generate most of its renewable energy from?
   - Does it surprise you that only 2% of Australia's renewable energy comes from the sun? Why?
   - What have you heard/read recently about energy use in Australia? Do you know what is the government's current position on using different energy sources?
   - Find out about areas in Australia that, for most of the year, have lots of strong winds, are very sunny, have large tidal movements or have strong flowing rivers. Where are these locations? Do they have existing renewable energy infrastructure set up?

Solar Energy

2.2

Background Information

Solar energy is a form of renewable energy which is based on harnessing energy from the sun. Solar energy can be used in two different ways: as a heat source (solar thermal) and as an electricity source (photovoltaic).

Solar Thermal

The sun's heat can be captured by a number of different collectors and turned into hot water. This heat can be used for applications such as hot water systems and swimming pools.

Flat plate collectors are most commonly used around the home to generate a heat source. These flat plate collectors hold the water to be heated, trapping and using the sun's heat to raise the water temperature to about 70 degrees Celsius.

Because dark colours absorb more heat than light colours, the collector surfaces are usually painted black to absorb as much heat from the sun as possible, which then heats the water circulating through the panel to high temperatures.

Photovoltaic Systems

Sunlight can be converted directly to electricity by a photovoltaic cell (PV) – or solar panel. PV cells produce Direct Current (DC), similar to a battery. This can be converted into Alternating Current (AC) by using a device known as an inverter. AC electricity is distributed around the power grid and powers appliances in homes and businesses.

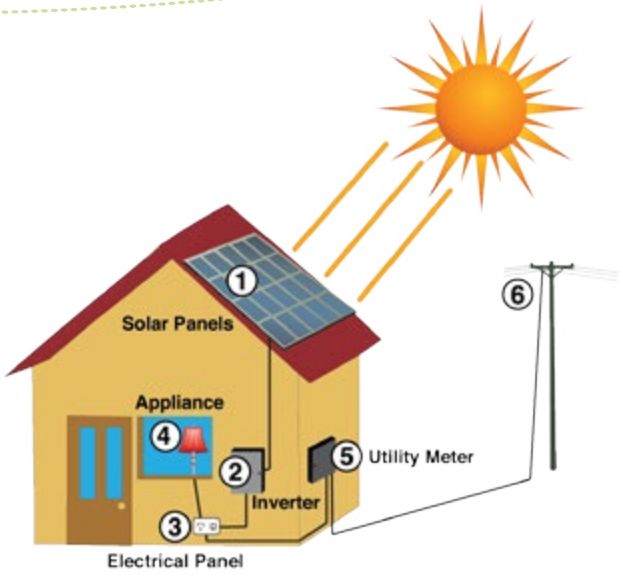
Solar panels can commonly be seen on the rooftops of houses. In the southern hemisphere, solar panels are generally placed on the northern and western side of roofs, in order to maximise the amount of sunlight the panel is exposed to. This allows the panel to absorb the maximum amount of the sun's radiation and convert it to an electrical current.

PV cells are made of semiconductors, such as crystalline silicon or various thin-film materials. A single cell can produce very tiny amounts of electricity – enough to run small electronic appliances such as watches and calculators.

A large number of single cells connected by wires forms the basis of a solar panel. You might notice small panels on the side of the road to power portable construction signs or atop houses where the electricity generated by the panel can be used to power a whole household. These solar panels can also be used for large-scale solar plants to generate electricity for the electricity grid.

Capturing Solar Energy

Most houses using solar panels in Australia remain connected to the main electricity grid that services their area. This is important, because if there are any shortfalls in solar supply, the house can draw on electricity from the grid via an electricity distribution line to sustain their energy usage needs. If the solar panel creates more electricity than the house uses then this can be fed back to the grid to be used by other households in the area.



Solar Development

Solar power in Australia provides a very small fraction of current energy production. Governments and the community are increasingly seeing the value of installing solar systems. At the end of 2014, one in five Australian houses had a rooftop solar system; equivalent to 4 gigawatts. More than 40% of homes in Queensland and South Australia have rooftop solar systems (source ABS, Renew Economy Dec 2014). Construction of several large solar farms is underway in several areas of Australia. Solar flagships are located at Broken Hill and Nyngan in NSW.

Fast Fact

Australia has the highest average solar radiation per square metre of any continent in the world.*

* www.environment.nsw.gov.au/households/renewable-energy.htm

Useful links

CSIRO
www.csiro.au/Outcomes/Energy/Renewables-and-Smart-Systems/solar-power.aspx

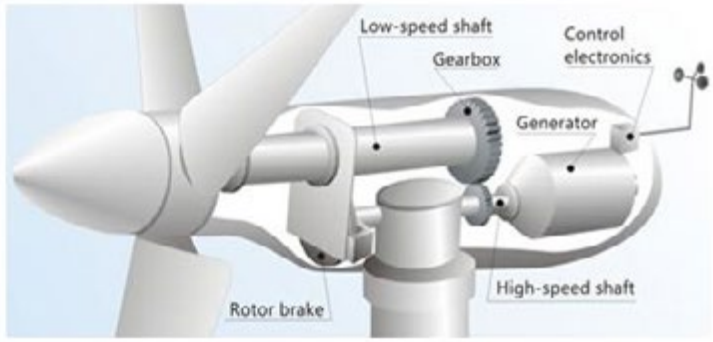
Make it solar
www.makeitsolar.com

Clean Energy Council
www.cleanenergycouncil.org.au/technologies.html

Wind Energy

2.3

Background Information



Wind energy is a clean and safe source of renewable energy. There are many wind farms operating in Australia that already generate electricity into the national power grid.

Generating electricity

The blades of the wind turbine are rotated by the wind. The blades in turn rotate the main shaft of the turbine, which is connected to an electrical generator. Through gearboxes, the generator converts kinetic energy of the spinning turbine shaft into electricity.

Cables connect the generators to the electricity grid, where households and businesses can use it.

Small turbines used to power a single home or business may have a capacity of less than 100 kilowatts. Some large commercial-sized turbines may have a capacity of 5 million watts, or 5 megawatts.

Larger turbines are often grouped together at 'wind farms' that provide power to the electrical grid. Before a wind farm is developed, the site is monitored to measure the amount of wind that occurs at that location. Turbines are generally located along ridgelines and coastal areas to maximise the wind captured.

Wind Farm Development

Wind power is a rapidly expanding form of renewable energy in Australia. In 2013, wind accounted for around 4% of Australia's electricity generation (Clean Energy Council). This is a return to traditional energy production when you consider how long windmills (wind pumps) have been used on farms to power water and agricultural machinery.

Useful links

How Stuff Works science.howstuffworks.com Kid Wind Project learn.kidwind.org
Clean Energy Council www.cleanenergycouncil.org.au/technologies.html

Coal Electricity Generation

2.4

Background Information

Coal is a fossil fuel, which is made from the remains of pre-historic plants, algae and plankton. It is non-renewable because it cannot be replenished in our (or many) lifetimes. It is one of the world's most used sources of energy. According to the International Energy Agency, in 2013, coal provided around 40% of the world's electricity needs.

How is coal converted to electricity?

Coal is burnt in power stations to generate electricity. Generally, brown coal is first ground into a powder that allows it to burn more quickly. The powdered coal is burnt at a high temperature of around 1100 degrees Celsius. The heat converts into steam.

The high-pressure steam is passed into the turbine, which is connected to a generator which is in-turn connected to the electricity grid.

When the steam is passed into the turbine it causes the turbine shaft to rotate at high speeds (the speed is usually fixed at 3000 rotations per minute). This energy is converted into electricity by the generator and passed into the electricity grid.

The electricity generated is passed through a transformer, which converts the voltages (a unit of measure for electricity) to a level appropriate for the transmission lines. The transmission line transports the power to the networks where the voltage is lowered at a zone substation to an appropriate level for industrial and commercial use.

When it nears our homes, businesses and schools, the electricity is converted to a safer level of 240 volts (at the distribution substation), which is used to power all our electrical appliances such as televisions, game consoles, fridges, toasters and washing machines.

How is coal formed?

Coal is a type of rock formed millions of years ago from plant and mineral materials in swampy areas. Over time, sediments covered these materials, forming heavy rock layers. This forced the plant material to decompose into a spongy material called peat. As the water and gasses were squeezed out by the heavy rock layers, the peat above was heated at great temperatures in the earth and coal began to form, first as brown coal (lignite) and then harder black coals. The coal formed in layers called seams.

Disadvantages of coal

Coal is relatively inexpensive to get, but it has some serious drawbacks. Coal is harmful to the environment when it is extracted (mined) and requires transport to the power station. This mining destroys habitat. Burning coal is a serious pollutant because it releases sulphur (the smell of rotten eggs), carbon dioxide (a greenhouse gas) and other dangerous pollutants.

Useful links

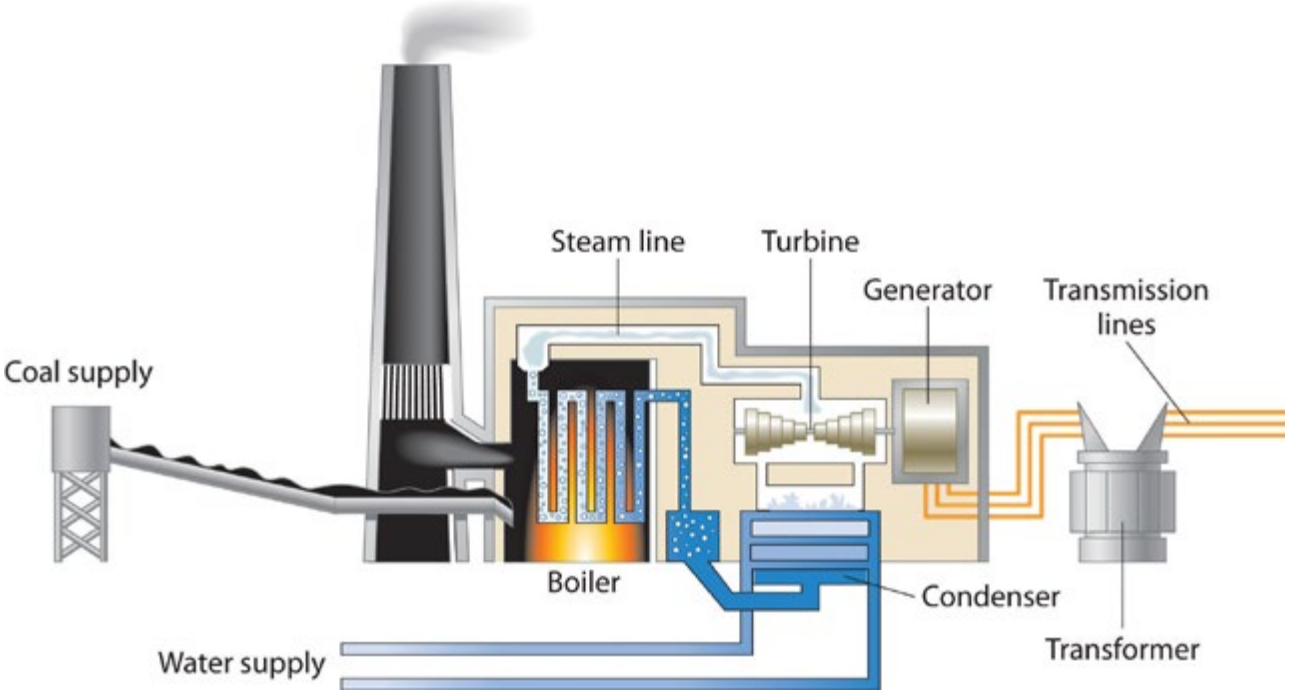
CSIRO www.csiro.au

National Geographic Education education.nationalgeographic.com.au/education/encyclopedia/non-renewable-energy/?ar_a=1

Solar Schools www.solarschool.net/resources/stuff/non_renewable_energy.aspx

Diagram: Electricity from Coal

A coal-powered electric power plant uses the combustion of coal to produce steam, which drives a turbine to produce electricity.



Electricity

3.0

3.1 Electricity Consumption

3.2 Using Electricity

3.3 Consumption Habits

3.4 Energy Efficiancy Rating

3.5 Saving Energy

Electricity Consumption

3.1

Teacher's Notes

Purpose

To give learners an understanding of how to measure electricity consumption

You will need

- Student 3.1 activity sheets
- Calculators
- Electrical appliances
- Appendix 3 - Sample electricity bill, or use a bill from home or the school

Activity suggestions

- Read about *Calculating consumption* and work through the method of calculating consumption.
- Question 2. Read about how to measure electricity consumption. Be aware that learners may not be familiar with using a formula and may need extra practice. Discuss:
  - the wattages of different appliances
  - the greater the wattage, the more greenhouse emissions (if not using green energy)
  - the cost of electricity – look at the sample electricity bill. Show where on the bill you find *electricity consumed* and the *price per kilowatt hour.*
- Help learners locate wattage on appliances.

Reflection

- Can you remember:
  - How many watts make a kilowatt?
  - How do you calculate kilowatt hours?
- Did any of the appliances you looked at use more electricity than you expected?

Other ideas

- Make up a similar activity on how to measure gas consumption.
- Look at how to read electricity meters.
- Find out about how electricity is made and how it gets to your home.

Electricity Consumption

3.1

Activity Sheet

Calculating Consumption

Watt (W) is a unit of power. The wattage, or number of watts an appliance uses, is written on its label or product plate. The higher the wattage, the more electricity the product uses. A kilowatt (kW) is equal to 1 000 watts.

Electricity is sold in units of energy called kilowatt hours (kWh). If you look at an electricity bill you will see that you are charged for every kilowatt hour of electricity you use. A kilowatt hour is the work done by 1 000 watts of electricity over a period of one hour.

1 kWh = 1 000 W of electricity used in one hour

So, if you used a 1 000 W iron for 2 hours you would have used 2 kWh of electricity.

How to calculate electricity consumption

Read the example below showing how to calculate electricity consumption.

Example

How many kilowatt hours of electricity would a 2 400 watt radiator use if left on for 3 hours?

Use this formula to calculate electricity consumption:

Electricity consumption *= wattage x hours ÷ 1 000*

= 2 400 x 3 ÷ 1 000

= 7.2

So, a 2 400 W radiator left running for 3 hours would use 7.2 kWh of electricity.

1. Look around the room. In the table below, write down 4 electrical appliances you see. If you can see the wattage of the appliance, write this down too.

Appliance	Wattage

2. From your table:

a. Which appliance has the **highest** wattage?

Appliance: _____ Wattage: _____

Calculate how many kilowatt hours of electricity the appliance uses in 2 hours. (wattage x hours ÷ 1 000)

b. Which appliance has the **lowest** wattage?

Appliance: _____ Wattage: _____

Calculate how many kilowatt hours of electricity the appliance uses in 2 hours. (wattage x hours ÷ 1 000)

3. The table below shows appliances, their wattages and the hours they are used. For each appliance, calculate the electricity consumption in kilowatt hours.

Appliance	Wattage	Hours used	Kilowatt hours
a) Iron	1 000 W	2 hours	
b) Television	100 W	5 hours	
c) Air conditioner	1 500 W	8 hours	
d) Oven	3 000 W	½ hour	

Using Electricity

3.2

Teacher's Notes

Purpose

To give learners an awareness of how much electricity is used in everyday activities.

You will need

- Student 3.2 activity sheets
- Electricity Consumption Guide
- Appendix 3 - Sample electricity bill, or use a bill from home or the school
- Calculators

Activity suggestions

- Question 1. While discussing the questions:
  - Look at the sample electricity bill and talk about the graph showing daily consumption.
  - Talk about standby power - this is when the appliance is switched off at the appliance, but left on at the wall.
  - Look around the room and see what electrical products are left on standby power even though they are not being used.
- Question 5 is about electricity consumption - revise how to calculate kilowatt hours (Activity 3.1) before completing this question.
- Question 9 is a home task. Learners are asked to do an electricity audit on 3 appliances over a week. Read the steps and model how to fill in the Electricity Audit sheet.

NOTE: The completed Electricity Audit will be needed for Activity 3.3.

Reflection

- Which appliances are heavy on electricity consumption in your household?
- Which appliances could you turn off at the wall?

Other ideas

Use the Internet to search for online energy calculators and calculate your household energy consumption and greenhouse gas emissions.

Using Electricity

3.2

Activity Sheet

1. Think about ... talk about

   a. Have you ever seen your household electricity bill? If yes, did you notice the electricity consumption graph?

   b. Think about your electricity consumption. Do you think you use an average amount, more than average or less than average?

   c. Would you like to use less electricity?

   d. Is electricity being used in your home when you are sleeping? How?

2. Look at the ***Electricity Consumption Guide*** showing appliances and their average wattages. Remember that:

   Higher wattage = more electricity = more greenhouse pollution

According to the Guide:

a. What sort of lighting uses the least amount of electricity? _____

b. What is the lowest wattage of an oil filled heater?_____

c. What sort of television uses the most electricity? _____

d. What is the average wattage of a plasma television? _____

e. Does a front loading or a top loading washing machine use more electricity?

_____

f. What is the wattage of a 7.5 kg front loading washing machine? _____

- How many watts of electricity would this washing machine use in half an hour?

  _____

- How long would it take for this washing machine to use a kilowatt hour of electricity?

  _____

Remember: A kilowatt hour is equivalent to 1000 watts used over one hour.

3. Think about ... talk about

   Is there anything that surprises you when you look at the Electricity Consumption Guide (pages 45-46)?

   Why is the electricity consumption of refrigerators given as annual usage rather than giving the wattage?

4. According to the electricity consumption of refrigerators:

   a. How many kilowatt hours of electricity does a 440 litre refrigerator with a top mount freezer use in a year? _____

   b. Which uses more electricity – a chest freezer or a vertical freezer? _____

5. A family uses a 2 000 watt fan heater for 4 hours a day during the winter.

   a. How many kilowatt hours of electricity does the heater use each day?

      Use the formula: wattage x hours ÷ 1 000

   b. How many kilowatt hours of electricity does the heater use in a week?
      Multiply the amount above by 7

   c. Using the sample electricity bill, or one from home, find out how much your family is being charged per kilowatt hour for electricity. Use this charge/rate to work out how much it costs to use their heater for a week.

      Multiply the above amount by that number in dollars. For example, the sample bill has a rate of 31.11c/kWh so you use $0.3111 in your calculation.

DID YOU KNOW?

Opening the fridge door increases electricity consumption

6. An electricity bill shows that the electricity provider is charging $0.3111 cents per kilowatt hour.
   a. Round this amount to the nearest cent _____
   b. Use the Electricity consumption of refrigerators and calculate the yearly cost of running these refrigerators:

      - Bar fridge _____
      - 589 L fridge with a bottom mount freezer _____
      - Pigeon pair _____

7. It is estimated that standby power accounts for around 10% of the total electricity bill. If a household's electricity bills are $1 000 for a year, how much money has standby power cost them?

8. Look at the Electricity consumption guide again. Tick the electrical appliances your household uses. Make a list of any other appliances your household uses.

9. At home, follow the steps below to do an Electricity Audit on three of your own appliances.

   You are going to check how much electricity you use each week in:

   - lighting your living room
   - having the television turned on
   - using your washing machine

An energy audit will analyse your electricity use.

a. Write down the wattage of each appliance on the Electricity Audit worksheet. If you can't find the wattage on the appliance you could contact the manufacturer or use the Electricity consumption guide.

b. Each day, as you use your lights, television and washing machine, record the number of hours and minutes on the Electricity Audit sheet.

c. At the end of the week, add up the total number of hours and minutes you use each appliance and complete the last column on the Electricity Audit.

Note: You will need your Electricity Audit to complete Activity 3.3.

Electricity Consumption Guide

3.2

Source: Integral Energy

The tables below are a general guide to the amount of electricity some appliances use.

Hot water		Average wattage
Hot water systems	Instantaneous	13 000
	Quick recovery	2 400, 3 600, 4 800
	Off-peak	3 600, 4 800
	Twin element	4 800
Storage heaters	Heat banks and hard wired	3 600, 4 800, 6 000

Lighting		Average wattage
Lighting *Figures based on the same lumen output as a 60W incandescent globe*	Incandescent	60
	Halogen	42
	Compact Fluorescent Lamps (CFL)	15
	Light Emitting Diode (LED)	6
	Fluorescent tube	18

Heating and Cooling		Average wattage
Air Conditioning	Ducted - 5 hp	3 750
	- 7.5 hp	5 600
	- 8.5 hp	6 300
	Split, Wall, Window - 1 hp	750
	- 2 hp	1 500
	- 3 hp	2 250
Heater	Oil filled, column, radiator, fan	1 000 to 2 400
	3-in-1 bathroom heater	1 100
Fan	Ceiling	100
	Pedestal	80

Laundry		Average wattage
Clothes dryer		2 100
Iron		1 000
Washing machine	Front loading 7.5 kg (cold wash)	1 000
	Top loading 7.5 kg (cold wash)	1 900

Television		Average wattage
Television *Figures based on 83-106cm (33-42") screens*	LED	90
	CRT	146
	LCD	193
	Plasma	328
	Rear projection	208

Cooking		Average wattage
Hotplates	Ceramic halogen (small)	1 200
	Ceramic halogen (large)	1 800
	Induction (small)	1 500
	Induction (large)	2 700
Oven	Conventional (separate grill)	2 200
	Fan forced (separate grill)	2 200
	Multi function (single)	3 000
	Multi function (double)	5 300
Microwave	Microwave oven	1 100

Refrigerator	Litres	Approximate kWh per year
Bar fridge	140	300
Top mount freezer	234	409
	440	486
	520	508
Bottom mount freezer	305	485
	589	660
Pigeon pair	670	899
Side by side dispenser	567	738
Chest freezer	215	341
Vertical freezer	213	498

Note: The information provided by the manufacturers of refrigerators and freezers is shown as annual usage.

Electricity Audit

Activity Sheet

3.2

Appliance	Wattage	Hours and minutes of use							Total hours and minutes
		Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
Living room light									
Television									
Washing machine									

Consumption Habits

3.3

Teacher's Notes

Purpose

To help students realise how electricity use 'adds up' and how much of this is wasted.

You will need

- Calculators
- Student 3.3 activity sheets

Note: Learners will need to have completed the *Electricity Audit* (from Activity 3.2).

Activity suggestions

- Question 1. Discuss the experience of doing the Electricity audit at home using Think about … talk about questions.
- Question 2. Demonstrate how to fill in the table – read the steps and model how to collate and transfer information from the Electricity audit. Talk to learners about:
  - How to write hours in decimal form e.g. 30 minutes = ½ hour = 0.5 hour, 15 minutes = ¼ hour = 0.25 hour. If an appliance was used for 3 hours and 30 minutes, this would be written as 3.5 hours
  - Depending on the level of learners it may be best to round time to the nearest whole hour, 1/2 hour (0.5) or 1/4 hour (0.25).
- Question 3. Discuss the title before reading the article titled "Bad habits and wasteful appliances costing the earth."
- Question 4. Compare Question 3 with a case study about being more energy efficient.
- Question 5. Look at the sample energy rating labels and check them out in more detail on the website provided in the activity. This could be a class competition. Stickers could be mass produced and shared using the computer and sticky labels.

Reflection

- How does your household save energy?
- How could your household be more efficient?
- What change will you make and measure?

Other ideas

Learners could compare results from their Electricity Audits and make class graphs.

Consumption Habits

3.3

Activity Sheet

1. Think about ... talk about

   At home you did an Electricity Audit on 3 appliances. Discuss these questions about your experience.

   a. Did anything surprise you about the amount of time these appliances were used?

   b. Did you find ways that you could use less electricity? Was someone watching television the whole time it was switched on? Did the light get switched off when there was no-one in the living room? Did you always have a full load of washing?

   c. What did you learn from doing the audit?

2. Work out your household's electricity consumption

   a. Fill in the middle two columns of the table below using the information from your Electricity audit.

   b. Fill in the last column. Calculate the kilowatt hours of electricity consumption using the formula: wattage x hours ÷ 1 000

Electrical appliance	Wattage	Weekly hours of use	Kilowatt hours used in a week (wattage x hours ÷ 1 000)
Living room light			
Television			
Washing machine			

   c. Do you think this was a typical week for using these three appliances? _____

   Why? _____

   d. How many kilowatt hours of electricity did your household's television use during the week?

   _____

3. A newspaper article titled “Bad habits and wasteful appliances costing the Earth” appeared in The Sun-Herald on June 8, 2008.

   From the title, what do you think the article may be about?

   Now read the article and answer the questions that follow.

Bad habits and wasteful appliances costing the earth

By Rachael Browne

NSW householders are wasting up to $300 million each year through inefficient use of home appliances, a study of 500 people in Sydney, the Central Coast and Hunter has found.

Bad habits such as leaving the fridge door open and neglecting to switch off lights are adding hundreds of dollars to energy bills and pushing greenhouse gas emissions up by 2.5 million tonnes each year.

Energy efficiency expert, Paul Myors, said most people wanted to do the right thing but had simply developed bad domestic routines. “Our bad habits in the home are literally costing the earth,” he said.

The survey showed that most NSW householders are committing at least one of the seven domestic sins each day.

Many householders also use refrigeration inefficiently with 22 per cent of people surveyed saying they leave the door open while unloading shopping and 29 per cent own a second fridge that is rarely used.

Young people waste more energy than older people, with people under 30 more likely to leave the fridge door open while making a meal (28 per cent) compared with people over 60 (7 per cent).

People under 30 are also more likely to use a clothes dryer, with 29 per cent saying they mostly use the dryer compared with only 9 per cent of people aged over 60.

St Ives recruitment officer Toranz Wildie admits she commits some of the seven domestic sins but large energy bills have convinced her to use her household appliances more efficiently.

Mrs Wildie had a smart meter installed to monitor her electricity usage and now uses many of her appliances at night, taking advantage of off-peak electricity rates. She has also installed energy-efficient light bulbs.

a. From the article:
   - This is a report about a survey. How many people were surveyed? _____
   - Where did the people who were surveyed come from? _____

   _____

b. Find these percentages from the information given:
   - Percentage of people under 30 who mostly use a clothes dryer_____
   - Percentage of people over 60 who mostly use a clothes dryer _____

c. How many tonnes of greenhouse gases are emitted each year because of our bad habits? _____

d. What are two steps Mrs Wilde has made to reduce her energy consumption?

_____

_____

e. An instrument which monitors electricity usage is called a: _____

f. Which appliance pictured uses the most electricity? _____

g. According to the Seven Domestic Sins table:

- Not installing a low-flow shower head will cost you $_____ a year on energy and water and emit _____ tonnes of carbon dioxide.
- Running a second fridge will cost you $_____ a year and emit _____ tonnes of carbon dioxide.

h. Research and find out what the current cost and tonnes of carbon dioxide would be.

4. Read the following case study about saving energy and answer the questions that follow.

Egyptian family saves $900 on power bill

Yasmin Mohamed is a passionate member of the Ethnic Communities Sustainable Living Project (ECSLP) team. Originally a vet in Sudan, Yasmin now supports Arabic speakers across Sydney to learn more about sustainability in the Australian context. Workshop participants discuss sustainable practices in their first language and share new ideas.

Randwick participant, Mrs Samira Mittas, has changed to energy efficient lighting and started switching off appliances at the power point.

Before the workshop Mrs Mittas would set the air conditioning to very warm in winter and really cool in summer. 'I now keep a thermometer nearby to remind me to adjust the airconditioning to the right temperature,' she said.

Hot water accounted for nearly half of Mrs Mittas' power bill. She started using cold water for the washing machine and reduced her shower times. 'I learnt that it is not hot water that cleans the clothes, it's the quality of the detergent.'

Since making the changes, Mrs Mittas has seen a 63 percent reduction in her power bill. 'My bill has dropped from $1500 to $560 and I am so happy.'

a. Did you notice any differences in the writing styles between this article and the previous one on 'bad habits'. Please describe.

_____

_____

_____

_____

b. According to the article Mrs Mittas saved 63 percent on her quarterly power bill.

List three power saving actions she took to make these cost savings.	List three actions that your family does at home to save power.

c. Mrs Mittas spent half of her power bill on heating water.

- How much was she spending on hot water before she made changes around the home? _____
- What is the difference between how much she was spending on hot water and her current total power bill? _____

d. The 'Bad Habits' article talked about energy inefficient appliances. Ss a class, or in pairs, discuss optiions to help Mrs Mittas continue to be energy efficient and how can she tell what appliances are energy efficient.

5. There are two key features of the Energy Rating Label:

- Rates the energy efficiency of the appliance on a scale of 1 to 10 stars, increasing in half-star increments up to 6 stars and full stars thereafter.
- The more stars, the more energy efficient an appliance is. Efficient products use less electricity to achieve the same level of performance of similar models with the same size and capacity.

Appliances that are labelled up to 6 stars are considered 'efficient' while those above 6 are defined as 'super efficient.' This tells you how much energy the appliance uses in kilowatt-hours when tested to the relevant Australian Standard.

Check out the Energy Rating website for current examples:
www.energyrating.gov.au/about/energy-rating-labels/sample-labels/

Design a sticker that could go on an electrical appliance in your home to remind your household to conserve energy. Things you could include on your sticker are: a rating system, is it an energy saver or energy waster and "turn off" reminders.

Energy Efficiency Rating

3.4

Teacher's Notes

Purpose

To show how to read Energy Rating labels

You will need

- Student 3.4 activity sheets

Activity suggestions

- Discuss what it means for an appliance to be energy efficient.
- Start by asking learners if they have seen or used Energy Rating labels and where else you see 'rating labels'?
- Read about Energy efficiency ratings and answer the questions that follow.
- Spend time exploring the website shown on the Energy Rating label (www.energyrating.gov.au).

Reflection

Ask questions which enable learners to examine their own attitudes as consumers. For example:

- How does knowing the energy efficiency of an appliance help you?
- Would the Energy Rating label be likely to influence you when you buy a new appliance?
- What other factors are important to you when choosing appliances?
- Do you think that Energy Rating labels are likely to make a difference to the overall amount of energy we use in Australia?

Other ideas

- Use the Energy Rating website and compare the energy efficiency of appliances. Make a table, graph, comparison chart or report on the results.
- Calculate energy savings using energy efficient products.
- Ask learners 'Is the electrical product with the lowest price the best buy?' Go to an appliance store - look at the price, the star ratings and energy consumption of different appliances. Record these, do some calculations and come to a decision.
- Do your own energy ratings. Ask learners to choose an appliance and use the Smarter Choice calculator to make an assessment. Visit www.smarterchoicecalculator.com.au

Energy Efficiency Rating

3.4

Activity Sheet

Throughout Australia, large appliances must carry an Energy Rating label.

The greater the number of stars, the more energy efficient the appliance is. Choosing the right sized appliances with more stars means you use less energy, which will help the environment and save you money on your energy bill.

The star rating labels also show energy consumption.

Energy rating on electrical appliances

You will find electrical energy rating labels on:

- fridges or freezers
- dishwashers
- air conditioners
- washing machines
- clothes dryers

Here is an example of an Energy Rating label on an electrical appliance.

Source: www.energyrating.gov.au

There are 1 to 6 stars. The higher the star rating, the more efficient the appliance. It is important to select the right size appliance for your needs.

This figure shows:

An estimate of how many kilowatt hours (kWh) the appliance uses in a year. The lower the kWh, the less energy you use.

or

For air conditioners, the energy it uses in kW or kWh/hour (kilowatt hours per hour)

Take photos of Energy Rating Labels you can find in school or at home. Using your photo, or the sample on the previous page, answer the following questions:

1. What is the star rating?_____

2. What is the annual energy consumption? _____

3. What does kWh stand for? _____

4. What appliance could have this label? _____

5. What website can you go to if you want to compare appliances?

_____

6. Log on to the website. Click on 'Search and compare appliances' and look for two door refrigerators/freezers with a capacity of 500 to 600 litres. Choose 3 refrigerators/freezers with an energy rating of 4 stars or more. Fill in the table below.

Refrigerator/Freezer Brand	Star rating	Energy consumption (kWh per year)

7. If you were going to buy a new refrigerator/freezer, which one would you choose?

_____

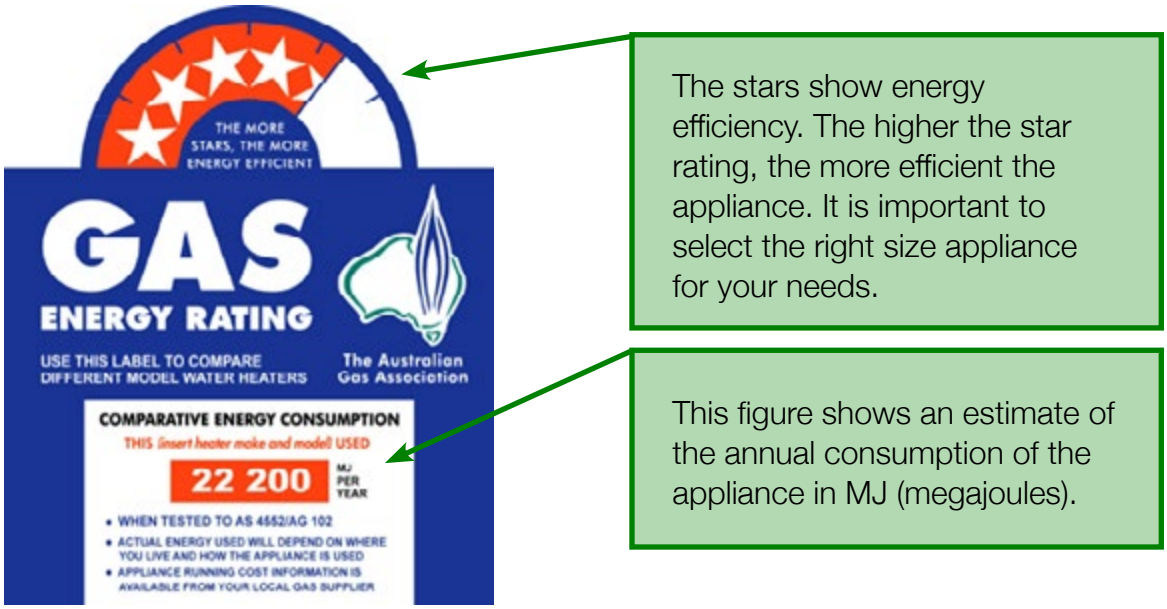
8. Why?_____

Energy rating on gas appliances

You will find gas energy rating labels on:

- Space (room) heaters
- Ducted heaters (central heating)
- Water heaters

Here is an example of an Energy Rating label on a gas appliance.



Source: www.energyrating.gov.au

Look at the Energy Rating label for the gas appliance and find:

9. What is the star rating?_____

10. What is the annual energy consumption? _____

11. What does MJ stand for?_____

12. What appliance has this label? _____

13. Where can you get information about the cost to run the appliance? _____

_____

Saving Energy

3.5

Teacher's Notes

Purpose

To identify ways to use less household energy

You will need

- Calculators
- Student 3.5 activity sheets
- Electricity Consumption Guide (Activity 3.1)

Activity suggestions

- Start by asking learners if they have ever consciously tried to reduce the amount of electricity they use. When? How? Why? Were they successful?
- Work through Parts A and B giving opportunities to discuss vocabulary as the need arises.

Reflection

Ask questions which will encourage the reduction of electricity consumption. For example:

- If the cost was not a problem, what sort of hot water system would you have?
- If cost was not a problem what could you do to make your home as energy efficient as it could be in heating and cooling?

Other ideas

- Use the website www.environment.nsw.gov.au/households/hot-water-systems.htm to find the most suitable type of hot water service. Take into account the number of people in the household, whether there is a gas connection and the location.
- Use the Internet to find out about rebates for installing solar hot water or heat pumps.
- After working through these activities, learners can similarly research an appliance of their choice.
- Make up small signs to remind people to do things that will reduce electricity use. For example, turn off the heater when leaving the room.

Saving Energy

Activity Sheet

3.5

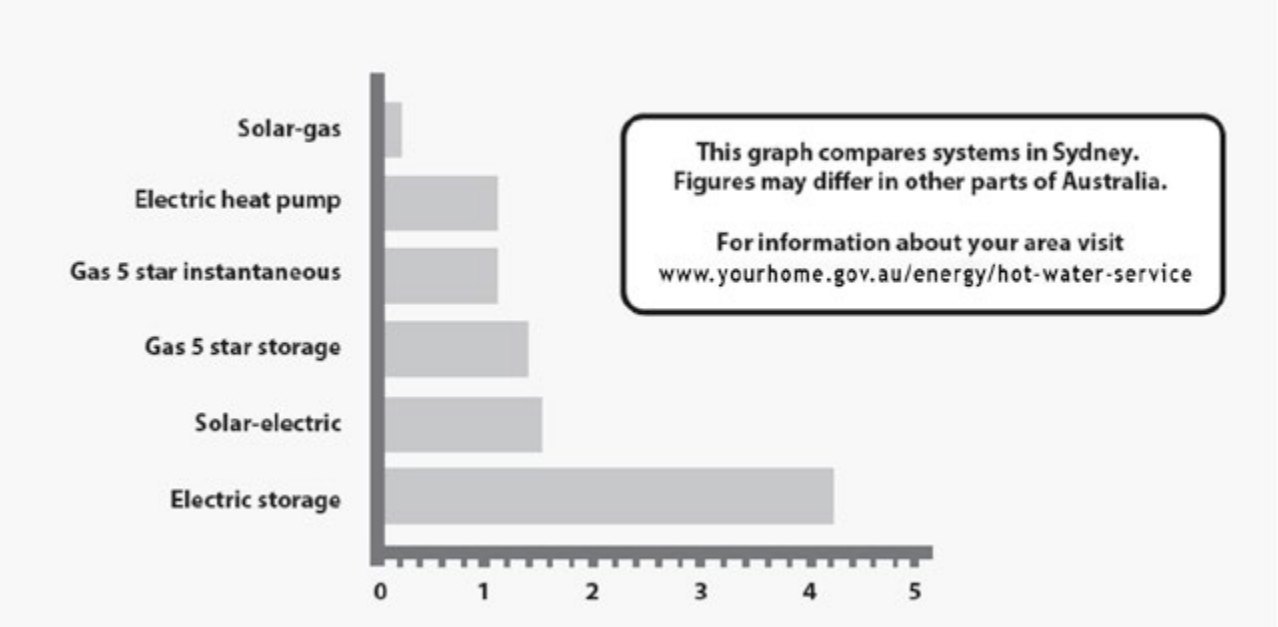
Australia emits the highest amount of greenhouse gases per person in the world. Saving energy will help reduce greenhouse gases and help us to save money too. Every kilowatt hour of energy you save will save the planet over a kilogram of greenhouse gases.

Part A - Water heating

1. Types of hot water systems

There are many different types of hot water systems to choose from. The graph below shows the average greenhouse gas emissions of different types of hot water systems for a medium-sized Sydney household.

Tonnes of greenhouse gas emissions



Source: Dept of the Environment, Water, Heritage and the Arts

DID YOU KNOW?

Water heating is responsible for about 21% of energy use and generates about 23% of household greenhouse gas emissions.

Source: www.yourhome.gov.au

According to the graph:

a. Which type of hot water system emits the largest amount of greenhouse gases each year?

_____

b. How many tonnes does it emit? _____

c. Which type of hot water system emits the smallest amount of greenhouse gases each year? _____

d. How many tonnes does it emit? _____

e. Circle the type of storage heater that produces the smallest amount of greenhouse gases. Gas Electric

f. Circle the type of solar heater that produces the smallest amount of greenhouse gases. Gas Electric

g. Which website would you go to for information about hot water services in your area?

_____

2. Think about … talk about

a. How can the information from the graph in Question 1 help you if you need to buy a new hot water system?

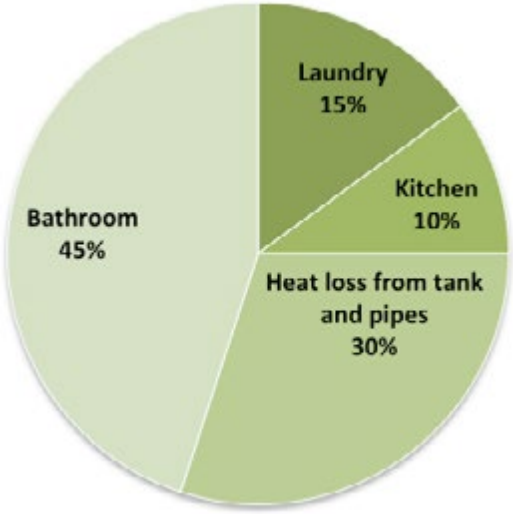
b. What do you think we should be considering when choosing a new hot water system?

DID YOU KNOW?

A heat-pump hot water system extracts heat from the atmosphere and transfers it to water. It works like a fridge but in reverse.

3. Look at the pie chart then answer the questions below:

Greenhouse gas emissions from an electric Hot Water Service
(based on 140 litres usage per day)



a. What does the graph show?

_____

_____

b. From the chart you can see that about half the hot water is used in the bathroom. Do you think you use around half your hot water in the bathroom?

_____

c. Estimate what fraction of the pie graph is 'Heat loss from tank and pipes'.

_____

d. What do you think the term 'heat loss' means in the chart?

_____

e. Where in your school or home would you find this 'heat loss'? What can you do to prevent it?

_____

_____

4. Showering produces around half a kilogram of greenhouse gases each minute. If you choose to spend 1 minute less in the shower each day, how many kilograms of greenhouse gas could you save in a year?

_____

5. Read the Tips to save hot water energy below.
   a. Put a tick against the energy saving tips you do now.
   b. Put a circle around the tips that may help you save energy.
   c. Add any other tips you have to the list.

Tips to save hot water energy

- ☐ If possible, use the sun's energy to heat water. Solar hot water can reduce household hot water energy consumption by around 70%.
- ☐ Choose the right size system for your needs. Don't heat more water than you need.
- ☐ Avoid gas water heaters with continuous pilot lights.
- ☐ Install water efficient showerheads and taps. Save energy and water!
- ☐ Take shorter showers.
- ☐ Turn the thermostat down on your hot water service.
- ☐ Insulate hot water pipes.
- ☐ Fix dripping hot water taps.
- ☐ Avoid using small amounts of hot water. About one litre of water is wasted before hot water comes out of the tap. Check how much you lose at home by using a bucket/ measuring jug.
- ☐ Position hot water service so that pipes to outlets are as short as possible.
- ☐ Wash your clothes in cold water.
- ☐ Turn off your hot water if you are going away for more than a few days.

Part B - Heating and cooling

1. Think about ... talk about

   a. What methods of heating and cooling do you use in your household?

   b. Have you ever had to choose a new heater, cooler, fan or air conditioner? What did you think about when making your choice?

2. Think about your heating needs during the winter. Choose a heater from the Electricity Consumption Guide (Activity 1.1) and answer these questions:

   a. What sort of heater did you choose? _____

   b. What is the wattage? _____

   c. Estimate the number of hours a day you use the heater in winter. _____

   d. Calculate the number of hours a week you use the heater in winter.
   Hint: Multiply the amount above by 7

   _____

   e. How many kilowatt hours of electricity would the heater use in a week?
   Use the formula: wattage X hours ÷ 1 000

   _____

   f. How many weeks would you use the heater? _____

   g. How many kilowatt hours of electricity would you use in winter?
   Kilowatt hours used in a week X the number of weeks

   _____

   h. Do you think this would be a good choice of heater?_____

   Why?_____

3. Read the Tips to save heating and cooling energy below.
   a. Put a tick against the energy saving tips you do now.
   b. Put a circle around the tips that you may help you save energy.
   c. Add any other tips you have to the list.

Tips to save heating and cooling energy

- ☐ Insulate your house. Good insulation can save up to 30% energy and make your home up to 7°C warmer in winter and 10°C cooler in summer.
- ☐ Provide shade and window covering for your windows.
- ☐ Seal drafts around doors and windows. Use door snakes or rolled towels.
- ☐ Only heat or cool the area you are using.
- ☐ The temperature of a heated room should be 18-21°C in winter and a cooled room should be 23-26°C in summer.
- ☐ Turn the thermostat of air conditioners up 1°C in summer and down 1°C in winter. This will reduce greenhouse gas emissions from heating by 10%.
- ☐ Gas heaters and reverse cycle air conditioners produce only one third of the greenhouse gas emissions of standard electric heaters.
- ☐ Look for star ratings on gas heaters. Each additional star means the heater is 10% more efficient.

DID YOU KNOW?

Heating and cooling is responsible for over one third of household energy bills and greenhouse gas emissions.

Water

4.0

4.1 Water Facts and Figures

4.2 Measuring Water

4.3 Using Water

4.4 Saving Water

Water Facts and Figures

4.1

Teacher's Notes

Purpose

To activate learner's interest in water usage

You will need

- Appendix 4 Posters - (1) Map of the world, (2) Australian rainfall map, (3) Collecting water in Africa, (4) Tap water, (5) Leaking tap and toilet cistern and (6) Shower head.
- Student 4.1 activity sheets. Note: The article Water Facts and Figures could be recorded and used as a listening activity.

Activity suggestions

- Brainstorm/mind map the uses of water.
- Read or listen to a recording of ***Water Facts and Figures*** then do the quiz, matching questions to answers.
- Discuss answers using Appendix 4. For example,
  - Question 1. Look at the world map (Appendix 4 - poster 1) and talk about the fact that over 70% of the world is water yet less than 1% can be used as drinking water
  - Question 2. Look at the Australian rainfall map (Appendix 4 - poster 2). Show desert areas and talk about where the areas of greatest population are. Why do most people live near the coast?

Reflection

- Do any of these facts and figures surprise you? Why?
- Why does the average person in Australia use so much water compared with the average person in rural Africa?

Other ideas

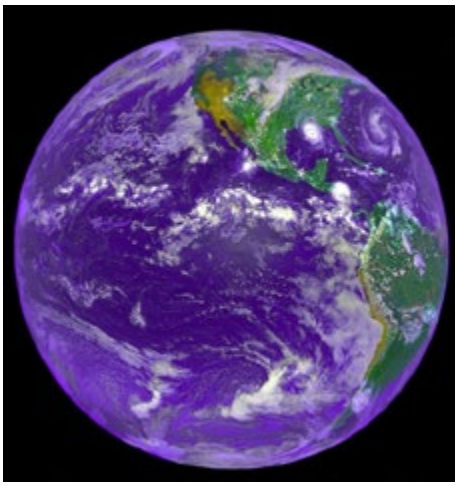
- Do the quiz (guessing answers) before listening to the reading of ***Water Facts and Figures***. Check answers while listening to the information.
- Use ***Water Facts and Figures*** as a reading article. Scan article, highlight statistical information and discuss vocabulary.

Water Facts and Figures

4.1

Activity Sheet

Water facts and figures



We all need water to survive, yet it is often taken for granted. Little attention is paid to where it comes from, how much we use and what happens to it after we have finished with it.

If you look at a map of the world you will see that our Earth has huge masses of water. In fact, over 70% of the world is covered in water. There is the same amount of water on the Earth now as when it was formed. Most of our water is salty and only 3% is fresh. Of this fresh water, humans can only use less than 1% for all their needs. The rest of the world's fresh water is frozen in glaciers or ice caps, or is deep within the earth, out of our reach.

Australia is the driest populated continent on Earth. Around 70% of our country is desert or semi-desert. These areas are extremely dry and not many people live there. Australia has a lot less rainfall than most countries, but we are one of the greatest consumers of water per person. The average Australian uses around 300 litres each day. This includes water from taps or tanks, around the house or garden, at work or in the community. Just in turning on the shower we use a bucket of water each minute.

How different life is for a person living in rural Africa where many people may only be able to use 6 litres of water a day. Over 1 billion people in the world do not have any water within a 15 minute walk from their homes. One third of the world's population is facing problems because they don't have enough water or the quality of the drinking water is not good.

There are so many ways water can be wasted. A massive 16 000 litres of water can be washed away in a year from a slowly leaking toilet cistern. So, don't take water for granted. It is a scarce and precious resource and we need to ensure there is enough clean water for everyone.

Water Facts and Figures Quiz

Questions: Water Facts and Figures

1. What percentage of the world's water can be used as drinking water?	2. What percentage of Australia is desert or semi-desert?	3. How much water does the average person in rural Africa use in a day?
4. Approximately how much water does the average Australian use in a day?	5. How much water can be wasted in 1 year from a leaking toilet cistern?	6. If you spend 1 minute less in the shower, how much water could you save?

Answers: Water Facts and Figures

1. 16 000 L	2. 10 L	3. 300 L
4. Less than 1 %	5. 6 L	6. 70%

Measuring Water

4.2

Teacher's Notes

Purpose

To understand the units used in measuring capacity

You will need

- Measuring equipment, e.g. eye dropper, medicine cup, 1 litre jug, 250 mL glass, 10 L bucket
- Student 4.2 activity sheets

Activity suggestions

- Visually demonstrate water quantities focussing on the units used to measure capacity – millilitres, litres, kilolitres
- Talk about strategies to remember facts:
  1 000 mL = 1 L and 1 000 L = 1 kL
- What other goods do we measure using these units of capacity?

Reflection

Encourage the remembering of facts. For example,

- What units are used to measure water?
- How many millilitres make a litre? How many litres make a kilolitre?
- Can I mentally picture 250 mL, 1 litre, 10 litres etc.?

Other ideas

- Measuring volume activities

Measuring Water

4.2

Activity Sheet

1. In everyday life we usually measure small quantities of water in _____

   and larger quantities in _____.

2. 1 _____ = 1 000 _____ and 1 000 _____ = 1 _____

3. What is the capacity of the following?

250 mL glass of water

_____

1 litre jug of water

_____

10 L bucket of water

_____

4. Water authorities, for example Local Councils, use kilolitres (kL) to measure the amount of water households and businesses use.

   How many litres are there in a kilolitre. _____ litres = 1 kilolitre (kL)

5. A tank that is 1 metre wide, 1 metre long and 1 metre high, holds 1 kL of water. Calculate the dimensions of a cube that will hold:

   10,000 litres Answer = _____

   1 litre Answer = _____

6. Other huge water units you may hear about are megalitres and gigalitres.

   1 megalitre (ML) = 1 000 000 L

   1 megalitre (ML) = 1 000 kL

   1 gigalitre (GL) = 1 000 000 000 L

   1 gigalitre (GL) = 1 000 ML

   Lake Mulwala has a capacity of 117,500 ML or _____ GL
   Hint: Divide by 1 000

   The Hume Dam has a capacity of 3 036 GL or _____ ML
   Hint: Multiply by 1 000

Using Water

4.3

Teacher's Notes

Purpose

To give learners an awareness of how much water is used in everyday activities

You will need

- Calculators
- Student 4.3 activity sheets

Activity suggestions

- Question 1. Discuss how much water is used in everyday activities.
- Question 2. Talk about how to estimate water quantities used in everyday activities.
- Question 5. Ask learners to keep records of how they use water. Discuss possible methods. For example,
  - have tally sheets for toilet flushes, glasses of water, washing up etc.
  - keep a pen and paper in the bathroom for a day and ask each person to write down the time they spend in the shower, brushing teeth, washing hands

Note: Learners will need their records of household water use for Activity 4.4.

Reflection

Ask questions which highlight the large quantities of water we use in everyday activities. For example,

- What surprised you when you looked at the *Water Usage Guide*?
- What activities use lots of water in your household?

Other ideas

- Check your current water restriction status with your local water authority. Make a poster showing the current restrictions for using water.
- Research the amounts of water used in agriculture and manufacturing. For example, it takes 246 litres of water to produce a glass of milk (because cows drink water and it is used to grow cattle feed), 567 litres of water to make for a loaf of bread and 4100 litres of water for a cotton T-shirt.

Examples adapted from information in: ***Every Last Drop***, Craig Madden and Amy Carmichael, 2007

Using Water

4.3

Activity Sheet

1. Think about … talk about
   a. Do you know how much water you use every day?
   b. Consider one activity – showering. How long do you or members of your household spend in the shower?
   c. How could you find out how much water your shower uses?

2. Estimate how much water is used in the following activities:
   a. A full load of washing in a top loading washing machine
   b. A 10 minute shower
   c. Hosing the garden for ½ hour

4. Look at the ***Water Usage Guide*** in this Activity. How much water is used in:
   a. A full load of washing in a top loading washing machine
   b. A 10 minute shower using an ordinary shower head
   c. A 10 minute shower using a water efficient shower head
   d. Hosing the garden for ½ hour
   e. Flushing the toilet 10 times using a full flush
   f. Brushing teeth twice a day with the tap running

5. Look at the ***Water Usage Guide*** again. Tick the water usage activities for your household.

5. For 1 day, estimate, calculate and write down (a) how many or how often you do each of these things, (b) how much you use each time and (c) your total water use in these activities:

	How many or how often (total number of…)	How much you use (litres)	Total
Glass of water			
Shower			
Bath			
Toilet - full flush			
Toilet - half flush			
Wash hands			
Brush teeth with tap running			
Brush teeth without tap running			
Wash dishes			
Wash vegetables			
TOTAL			

How much water would you use for 1 week? _____

How much water will you use in 1 year? _____

If my water costs me $0.29 per kilolitre, how much will my water bill be? _____

Water usage guide

Here are approximate quantities of water used in everyday activities:

Water use	Amount used
Glass of water	250 mL, 4 glasses = 1 L
Shower - ordinary shower head	20 L / minute
Shower – water efficient shower head	10 L / minute
Bath – full bath	120 L
Toilet – full flush	10 L
Toilet - half flush	5 L
Wash hands	5 L
Brush teeth with tap running	15 L
Brush teeth without tap running	1 L
Wash dishes	20 L
Dishwasher	25 L
Wash vegetables	10 L / minute
Wash clothes – top loading machine (full load)	120 L
Wash clothes – front loading machine (full load)	60 L
Use hose - wash car, water garden	20 L / minute

Saving Water

4.4

Teacher's Notes

Purpose

To give learners an awareness of how much water is saved in everyday activities

You will need

- Calculators
- Student 4.4 activity sheets

Activity suggestions

- Question 1. Discuss how much water is used in everyday activities and how water can be saved.
- Question 2.
  - Identify ways that water can be saved in the identified activities listed.
  - Use the results from Activity 4.3 and identify how many litres of water can be saved in each activity. Calculate the total savings and how this could translate to dollar savings on an average water bill.

Note: Learners will need their records of household water use from Activity 4.3.

Reflection

Ask questions which highlight the large quantities of water savings we can make in everyday activities. For example,

- What surprised you when you looked at the water use figures from Activity 4.3?
- What household activities can you save the most water in?
- Is there anything you can do, with your parents, to try and save even more water?

Other ideas

- Check your current water restriction status with your local water authority. Make a poster showing the current restrictions for using water.
- Conduct the same activity with water use and water saving at your school. Create an awareness campaign in your school to help everyone save water, for example posters in toilets or wet areas reminding people to turn taps off, use the half flush on toilets etc.

Saving Water

4.4

Activity Sheet

1. Think about … talk about
   a. Do you need to use as much water as you use every day?
   b. Discuss one thing that you can do each day to save water?

2. For each of the activities below, identify at least one thing you can do to reduce your water use.

Activity	
10 minute shower twice a day	
Bath each day	
Toilet - full flush (old cistern)	
Toilet - half flush	
Wash a load of clothes each day	
Brush teeth with tap running	
Wash car on driveway	
Wash dishes in dishwasher	

3. Using the answers you have from the "4.3 Using Water" exercise, calculate the amount of water you could save in the following activities:

	Total water used *Use answers from "Using Water" exercise*	**How many litres of water could you save?**	**Total Saving**
Glass of water			
Shower			
Bath			
Toilet - full flush			
Toilet - half flush			
Wash hands			
Brush teeth with tap running			
Brush teeth without tap running			
Wash dishes			
Wash vegetables			
TOTAL			

4. How much water could you save in 1 week? _____

5. How much water could you save in 1 year? _____

6. How much money will I save by using less water if my cost of water is $0.29 per kilolitre?

   _____

7. Water for domestic use is pumped at least seven times (estimate) from the time it leaves the water supply (river or dam), is filtered and treated with chemical, delivered to our home, we use it and send it to a treatment/sewerage works for more treatment and chemical application before it is returned to the environment.

   Calculate the total volume of water in litres that does not have to be pumped because of the savings you have made in one year?

   _____

References

Useful Websites

Allegorical Apple
files.earthday.net/lesson plans/bobbybigfoot/ES_What_is_Sustainability.pdf

Ausgrid Electricity Learning Resources
learnelectricity.ausgrid.com.au

Clean Energy Council
www.cleanenergycouncil.org.au/technologies.html

CSIRO
www.csiro.au

Energy and Earth Resources
www.energyandresources.vic.gov.au/energy/education-and-training/kids-corner

Energy and water saving at home
www.environment.nsw.gov.au/households

Energy Awareness Quiz
cleanet.org/clean/literacy/energyquiz.html

Energy Rating
www.energyrating.gov.au

How Stuff Works
science.howstuffworks.com

Kid Wind Project
learn.kidwind.org

Make it solar
www.makeitsolar.com

National Geographic Education
education.nationalgeographic.com.au/education/encyclopedia/non-renewable-energy/?ar_a=1

Renewable Energy
www.environment.nsw.gov.au/households/renewable-energy.htm

School A to Z - Electricity
www.schoolatoz.nsw.edu.au/homework-and-study/other-subjects-and-projects/science/electricity-project

Smarter Choice Energy Efficient Appliances
smarterchoicecalculator.com.au

Solar Schools
www.solarschool.net/resources/stuff/non_renewable_energy.aspx

Image Credits

1.1 Who is this kit for?

Photo Sustainability Trailer, Owen Dunlop

Appendix 1: 1.3 Allegorical Apple Posters

Ocean
Port Jackson Shark, Klaus Stiefel, Kurnell, Sydney 2013
Killer Whales, Holly, British Columbia Canada 2011
Green Sea Turtle, Kydd Pollock, Palmyra Atoll 2009
Red-tailed Tropicbird, Byron Chin, Hawaii 2014
Lined Surgeon Fish, Mrs eNil, Maldives 2009

Desert
Fat-tailed Dunnart, David Watson, Sturt National Park NSW, 2008
Ancient Desert, Maggie Watson, Israel 2014
Cactus, Jack Canary Special Collection, San Diego Air and Space Museum, 2013
Lone Mulga, Douglas Watson, Sturt National Park NSW, 2014

Rocks and Ice
Vermillion Cliffs, Alan English, Utah, 2009
Gibber Plain, edenink, South Australia, 2011
Tongariro Crossing Emerald Lakes, Mark Houchin, New Zealand, 2008
Patagonian Glacier, Nestor Galina, Argentina, 2013

Top Soil
Rice Terraces, Brian Sterling, Ping'an China, 2010
Ploughing Fields, Ray Witlin, India, 2008
Combine Harvester, Paul Glendell, Wiltshire England, 2001

Human Population Pilgrims throng the Kaaba after Hajj, Omar Chatriwala, Saudi Arabia, 2009 [Data from United Nations Department of Economic and Social Affairs, 2013]

Appendix 2: 2.1 Energy Sources Posters

Coal Coal Loader, eyeweed, Kooragang Island NSW, 2011

Solar Solar Panels, James Moran, Spain, 2014

Wind Wind Energy, Gurit, unknown, 2008

Hydro Snowy Hydro Scheme, Michael Mazengarb, NSW, 2010

Other
Turn of the Tide, Daniel Taylor, South Australia, 2013
Geothermal Power Station, Zonifer Lloyd, Strzelecki Desert SA, 2009

2.2 Solar Energy

Diagram: How is solar energy captured? PeeKdesigns, 2014

2.3 Wind Energy

Diagram: Wind turbine, "Wind Turbine Generator Technologies", Wenping Cao, Ying Xie and Zheng Tan; from Wavege, 2012 http://www.wavege.com/wind-turbine-diagram.html

2.4 Coal Electricity Generation

Diagram: Electricity from Coal, "General Chemistry: Principles, Patterns, and Applications, v. 1.0 (2 Volume Set)", Bruce Averill and Patricia Eldredge, http://catalog.flatworldknowledge.com/bookhub/4309?e=averill_1.0-ch05_s05

Appendix 4: 4.1 Water Facts and Figures

World Map Winkel triple projection SW, Strebe (via Wikipedia), 2011

Rainfall Map Bureau of Meteorology, 2014

Africa Boy drinks water from a pond, International Business Times, REUTERS, 2009

Ugandan women carrying water, WaterScan Perspective, 2011

Water distribution in Horn of Africa, Oxfam (via Wikipedia), 2011

Australia Tap water into a glass, stock photo

Leaks Dripping tap, stock photo

Leaking Toilet, http://tanktruss.blogspot.com.au, 2013

Shower Showerhead, stock photo

Appendices

Appendix 1

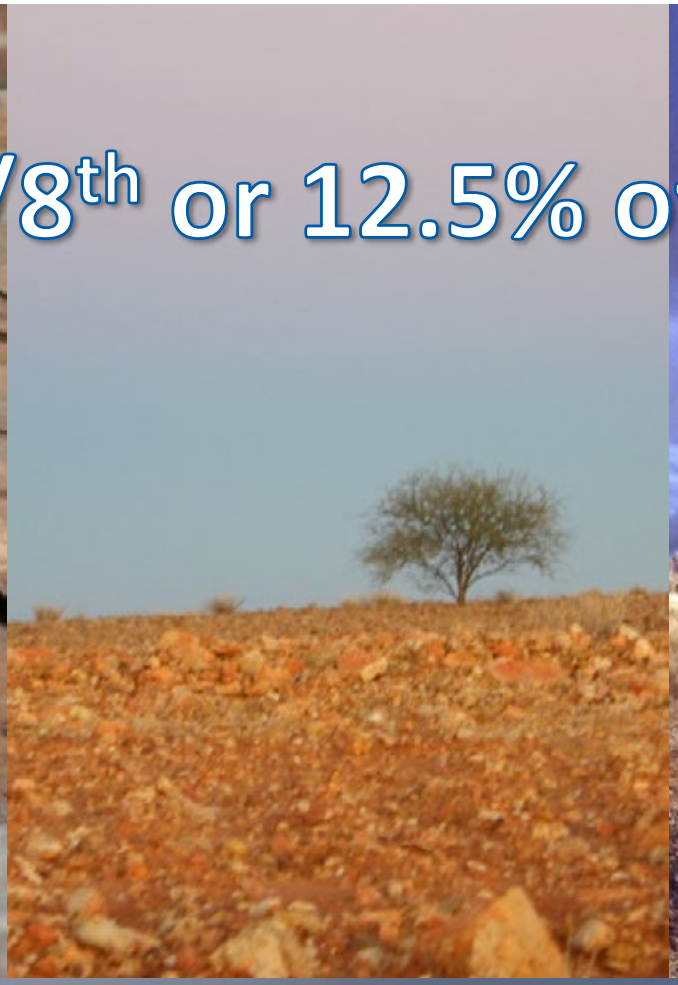
Appendix 2

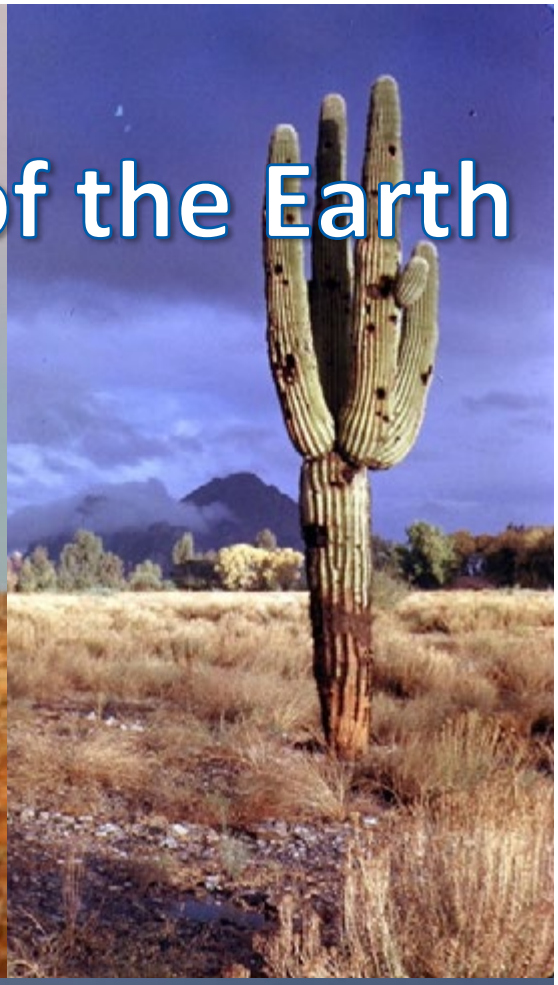
Appendix 3

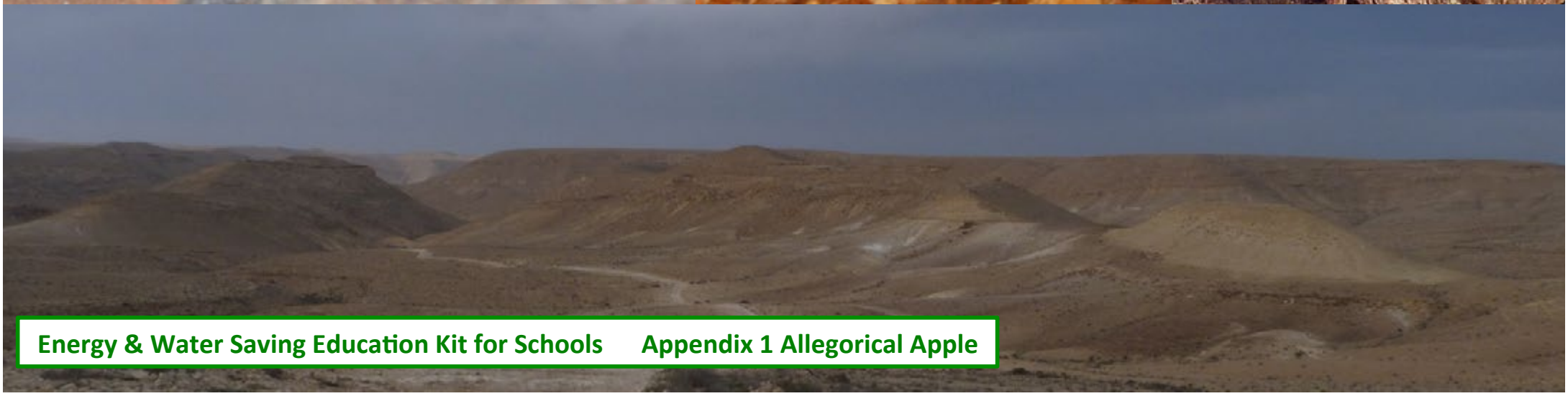
Appendix 4


Oceans make up 75% of the Earth

Deserts make up 1/8th or 12.5% of the Earth

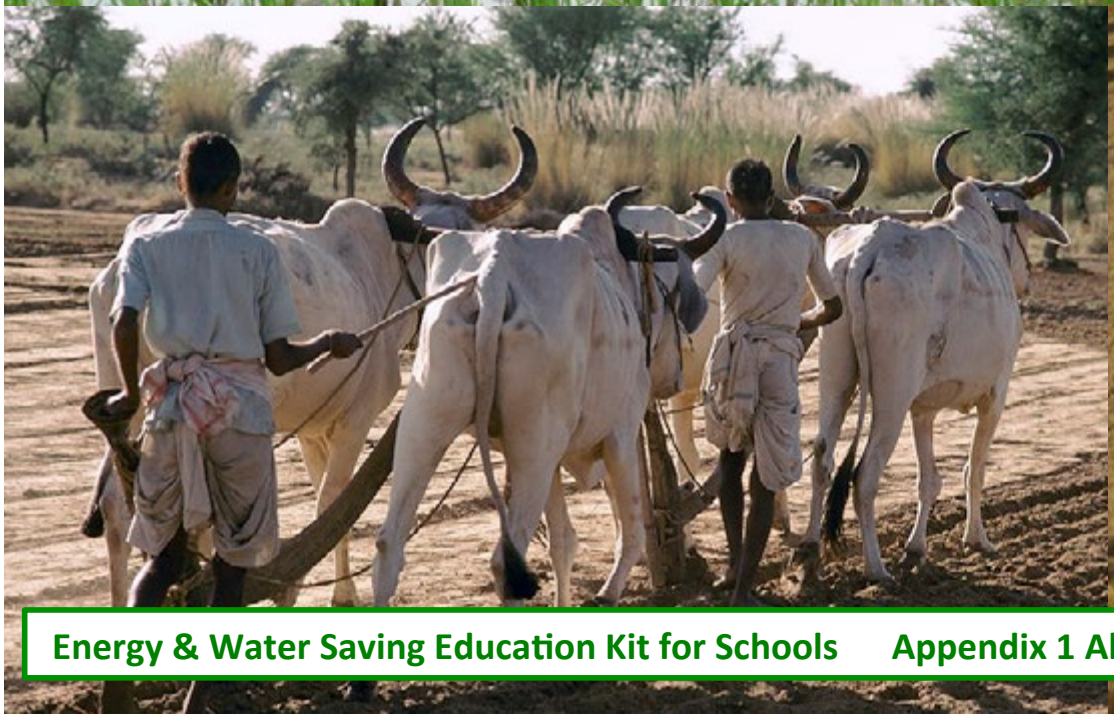


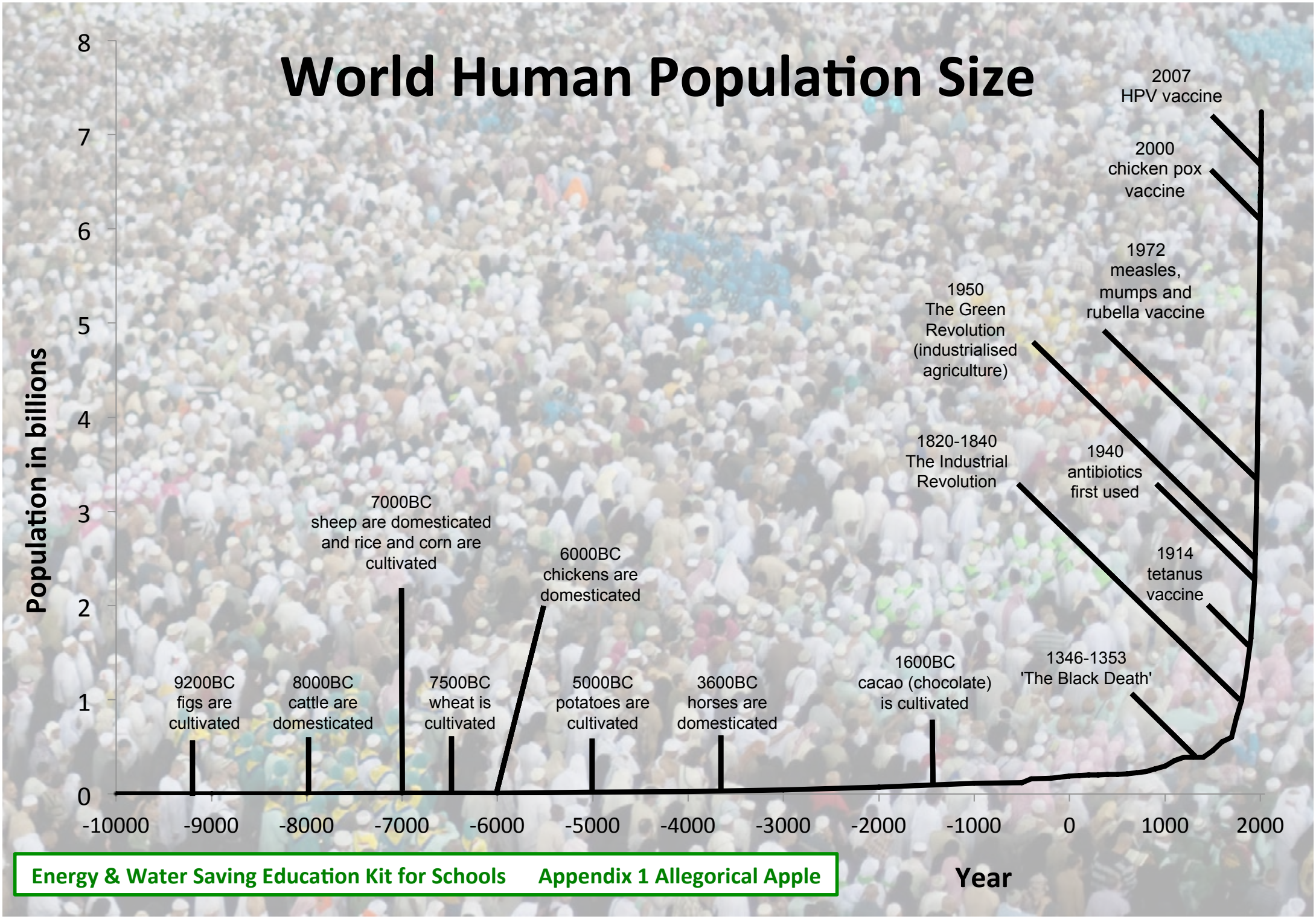





Mountains, cliffs, rocks and ice make up
3/32nd or 9.4% of the Earth

Topsoil makes up the remaining 1/32nd or 3.1% of the Earth




World Human Population Size
Population in billions
0
1
2
3
4
5
6
7
8
-10000
-9000
-8000
-7000
-6000
-5000
-4000
-3000
-2000
-1000
0
1000
2000
Year
9200BC figs are cultivated
8000BC cattle are domesticated
7000BC sheep are domesticated and rice and corn are cultivated
7500BC wheat is cultivated
6000BC chickens are domesticated
5000BC potatoes are cultivated
3600BC horses are domesticated
1600BC cacao (chocolate) is cultivated
1346-1353 'The Black Death'
1820-1840 The Industrial Revolution
1914 tetanus vaccine
1940 antibiotics first used
1950 The Green Revolution (industrialised agriculture)
1972 measles, mumps and rubella vaccine
2000 chicken pox vaccine
2007 HPV vaccine

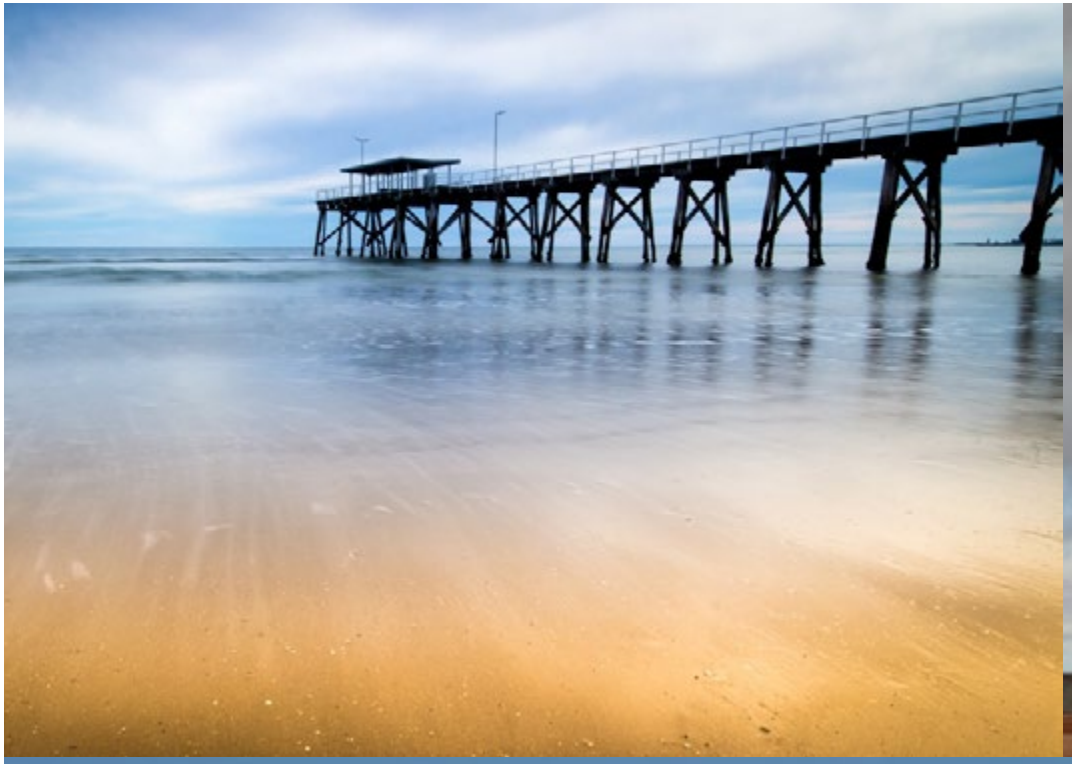
85% of Australia's energy comes from coal, gas and oil

2% of Australia's energy comes from solar power

4% of Australia's energy comes from wind

8% of Australia's energy comes from hydro

1% of Australia's energy comes from waves, geothermal and biomass



Energy & Water Saving Education Kit for Schools Appendix 3 Sample Energy Bill

Green Electricity

Tax Invoice: Issued: **18 Sep 14**

Enquiries & moving address (8AM - 6PM Local Time Mon - Fri) **13 24 61**

Faults or emergencies, call Essential Energy (24hrs) **13 20 80**

How to pay your account — see reverse for payment options

Account No:

Total Amount Due: **$666.15**

Debited On: **09 Oct 14**

Preferred Payment Method: Direct Debit.

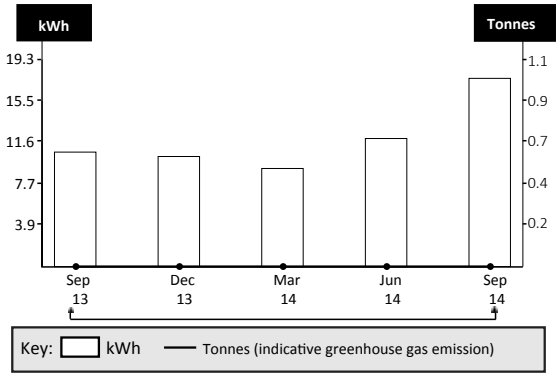
Service Address:

Meter Read: Actual
National Meter Identifier (NMI):

Account Summary: 19 Jun 14 to 17 Sep 14

Opening Balance	$568.32
Payments Received - Thank You	$568.32 CR
Balance Carried Forward	$0.00
New Charges	
Total Electricity Charges incl. Discounts (see over for details)	$687.93
Total Solar Contribution	$21.78 CR
Total Amount Due - incl. Overdue Amount	**$666.15**
New Charges incl. GST Charges of	$62.54

Your Average Daily Usage & Indicative Greenhouse Gas Emissions



Average Cost Per Day:	**$7.32**
Average Daily Usage:	**17.59 kWh**
Same Time Last Year:	**10.70 kWh**

Indicative Greenhouse Gas Emissions (Tonnes)

Generated This Account:	**0.0T**
Same Time Last Year:	**0.0T**
Saved With a Green Product:	**1.6T**

Payments Received - Thank You

09 Jul 14	Direct Debit - Bank Account	$568.32 CR
Total Payments Received		**$568.32 CR**

Electricity Usage and Service Calculation

Next Scheduled Read: 17 Dec 14 (+- 2 business days) **Last Meter Read:** 27 Jun 14

Description: General Domestic

Billing Period: 19 Jun 14 to 17 Sep 14 (91 Days) (A = Actual, E=Estimated)

Usage:

Meter No.	Current Reading	Previous Reading	Usage kWh	Total kWh	Bill Days
64974	23888(A)	23706(A)	182	182	8
28106	7083(A)	7083(A)	0	0	8
63026989	251(A)	0(A)	251		83
	234(A)	0(A)	234		83
	934(A)	0(A)	934	1419	83

Charges:	Usage kWh	Charge/Rate c/kWh	Amount $
19 Jun 14 to 30 Jun 14 (12 Days)			
Peak Usage			
Energy Use	250	31.11	77.78
Supply Charge			14.97
Supply Charge Off-Peak 1			1.16
01 Jul 14 to 14 Sep 14 (76 Days)			
Peak Usage			
Energy Use	1298	29.95	388.75
Supply Charge			93.42
Supply Charge Off-Peak 1			8.49
15 Sep 14 to 17 Sep 14 (3 Days)			
Peak Usage			
Energy Use	53	27.47	14.56
Supply Charge			3.69
Supply Charge Off-Peak 1			0.34
Sub-Total			603.16
Plus Green Product Charges			
100% GreenPower $/Week			58.92
Sub-Total			58.92
Less Discounts & Rebates			
Carbon Repeal Adjustment			31.87 CR
Direct Debit Usage Discount (1%)			0.78 CR
Direct Debit Usage Discount (1%)			3.89 CR
Direct Debit Usage Discount (1%)			0.15 CR
Sub-Total			36.69 CR
Sub Total Electricity Charges			**$625.39**
GST			**$62.54**
Total Electricity Charges			**$687.93**

Solar Contribution **Billing Period: 19 Jun 14 to 17 Sep 14** (91 Days) (A = Actual, E=Estimated)

Usage:

Meter No.	Current Reading	Previous Reading	Generation kWh	Bill Days
63026989	363(A)	0(A)	363	83

Charges:	Generation kWh	Rate c/kWh	Amount $
Solar Feed-in (incl. any GST)	363	6.00 CR	21.78 CR
Sub Total			**21.78 CR**
Total Solar Contribution			**$21.78 CR**

How you Compare

The table to the right allows you to compare your average daily electricity usage with other households in your region.

Household size	1 Person	2 People	3 People	4 People
Summer	11.2kWh	14.4kWh	17.7kWh	20.9kWh
Winter	13.6kWh	17.1kWh	20.5kWh	23.9kWh

Adjusted prices following the carbon repeal will be on your first bill with a billing period that ends after 14 September 2014. Any credit owed to backdate the change to 1 July 2014 will be on the same bill (except for hot water or unmetered supply).

Moving Address?

For a quick and simple way to disconnect and connect electricity and/or gas at your new property (allow 3 business days notice):

Contacting us

For any questions or complaints relating to your account:

Solar, Home Products & Solar Billing

Solar Power, Hot Water, Heating and Cooling Products. Sales, installation and solar billing enquiries call

Energy and Life Support rebates

You may be entitled to the NSW Government Energy or Life Support rebate/s. For details or to apply, please contact us on

Energy Accounts Payment Assistance

Applications for payment assistance may be made to authorised welfare groups. For details contact us on

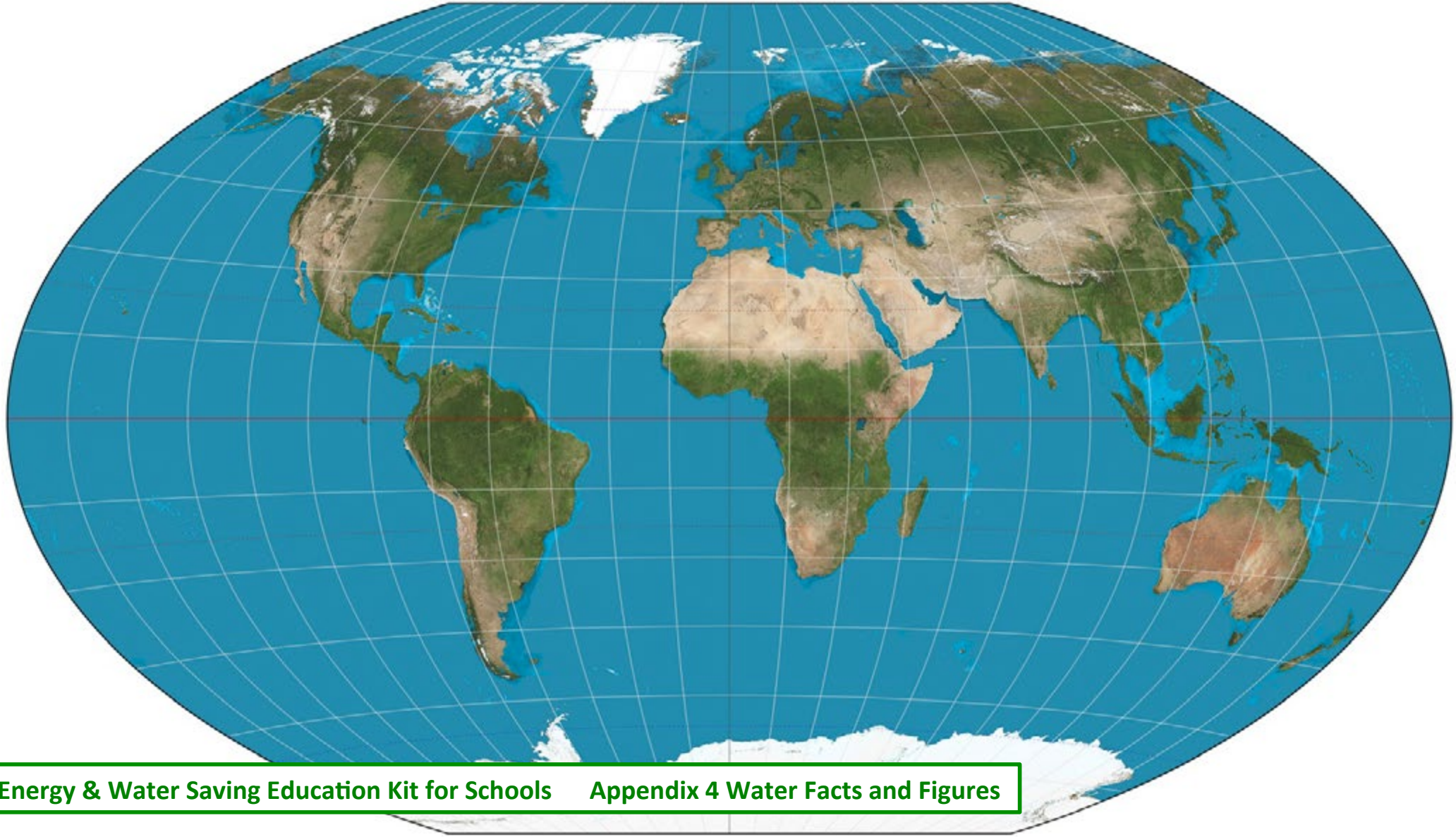
Payment assistance

To arrange a payment extension, special payment or instalment plan or to obtain information, call us on .

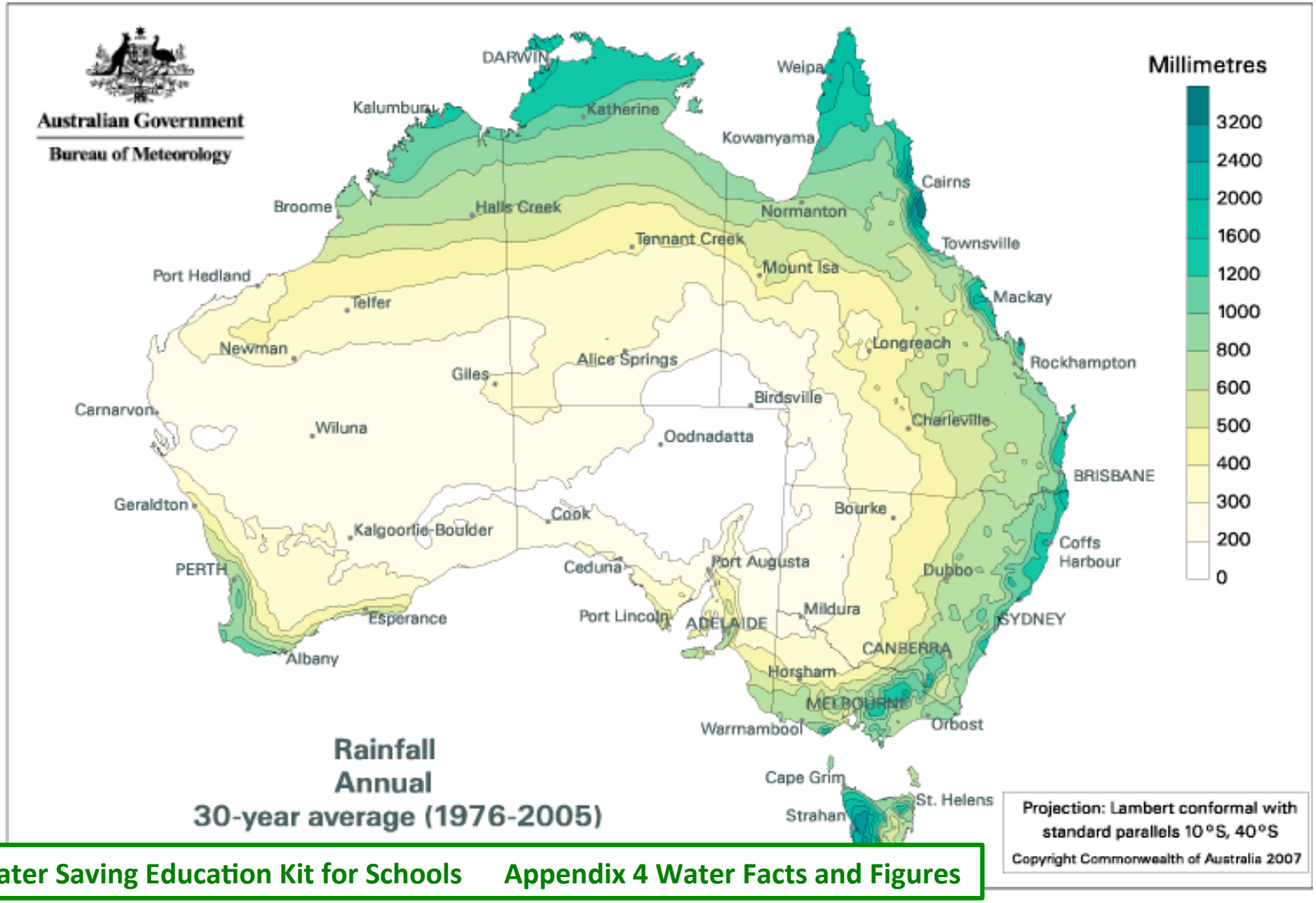
Interpreter Service

خدمة الترجمة الهاتفية للغات غير الإنكليزية.
Servicio Telefónico de Intérpretes para otros idiomas.
Per lingue oltre all'inglese contattate il Servizio d'Interpretariato Telefonico
Dịch vụ thông dịch qua điện thoại cho những ngôn ngữ khác không phải tiếng Anh.
Τηλεφωνική Υπηρεσία Διερμηνέων για άλλες γλώσσες εκτός της αγγλικής.
非英語語言電話傳譯服務。

Over 70% of the Earth is water
Of this, less than 1% can be used for drinking



Rainfall in Australia 1976-2005
70% of Australia is desert or semi-desert

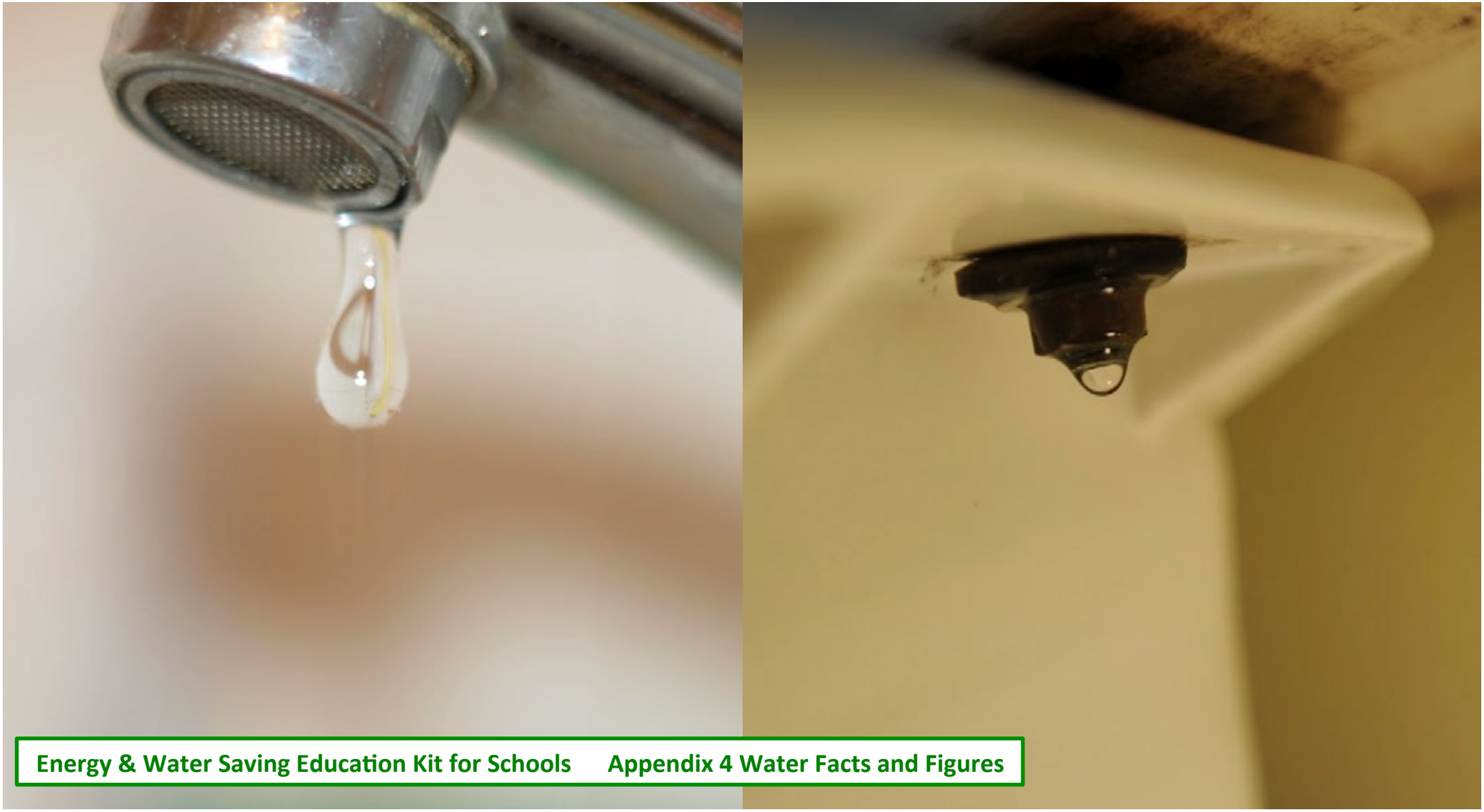


Collecting water in parts of Africa

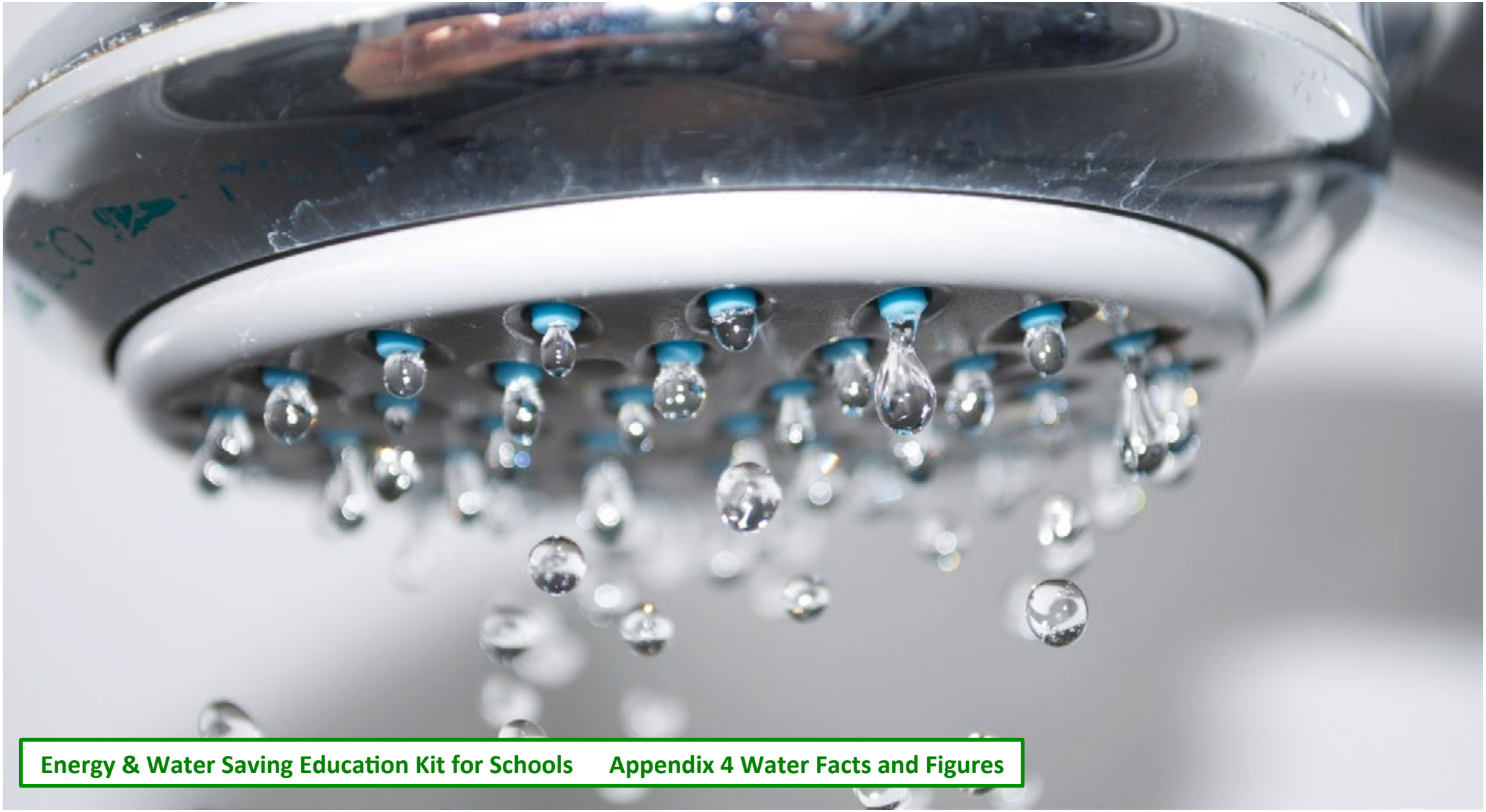
People in rural Africa use about 6 L of water a day

The average Australian uses around 300 L of water a day

Stop the leaks
A leaking toilet can lose 16,000 L a year



Bring on the 3 minute showers
1 minute less can save 10 L per shower



The Energy & Water Saving Education Kit for Schools has been developed by Wirraminna Environmental Education Centre with support from the NSW Government.

For more details about this education kit, the Sustainability Trailer and other classroom toolkits, please contact:

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