Ontario

ecological
LITERACY
GUIDE

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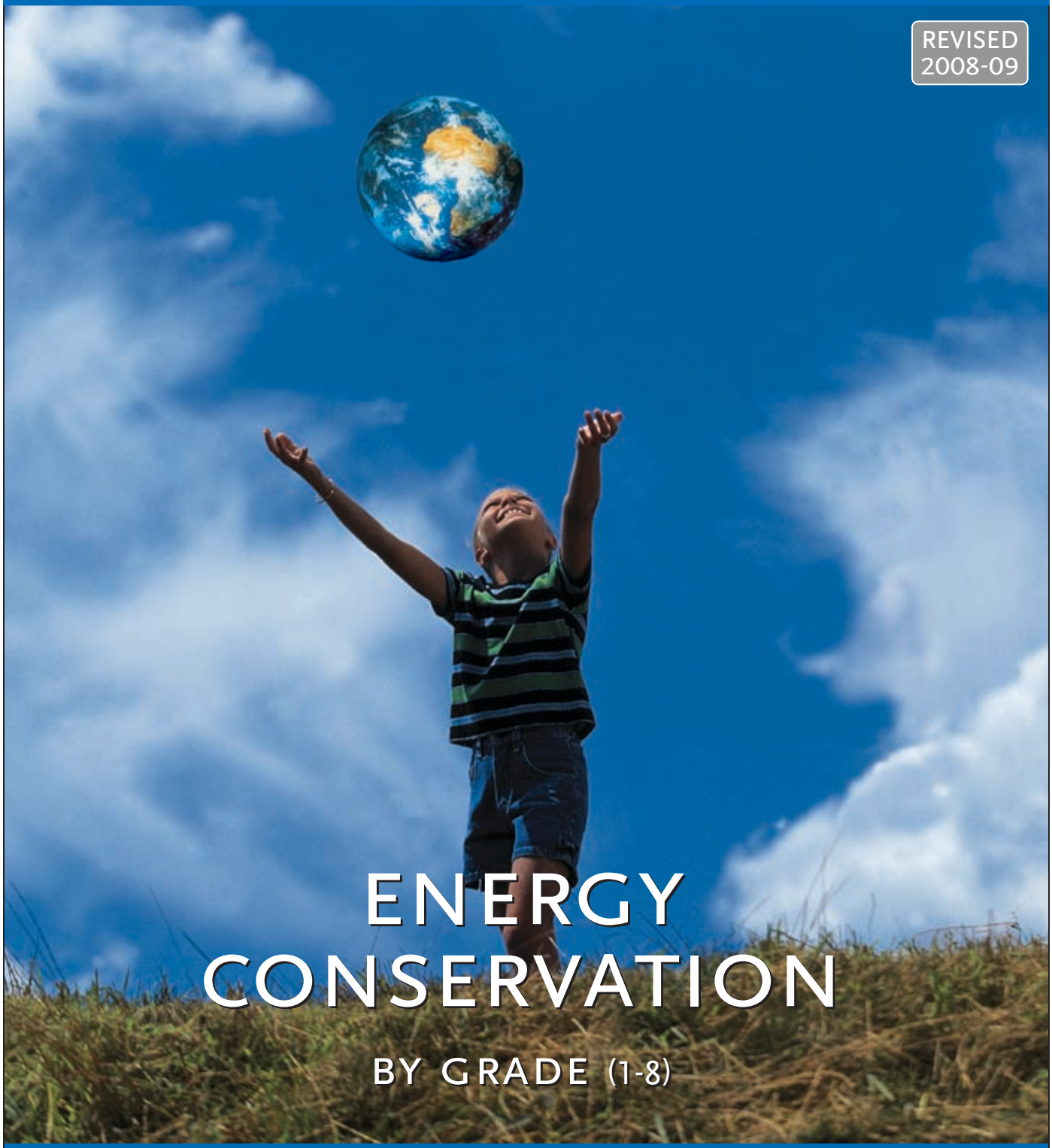

ENERGY CONSERVATION

BY GRADE (1-8)

ONTARIO
ecoschools

Acknowledgements
This guide is an adaptation of the EcoSchools *Energy Conservation by Grade (1-8)* produced by the Toronto District School Board (TDSB). The TDSB has donated this resource to the Ontario EcoSchools Program as part of its in-kind contribution to the project.

Ontario EcoSchools: Energy Conservation by Grade (1-8)

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Energy Conservation by Grade (1-8) and EcoSchools

Energy Conservation by Grade (1-8) is one in the series of Ecological Literacy guides that make up the classroom component of EcoSchools. These guides offer teachers a new lens for seeing the environmental learning possibilities in the Ontario curriculum.

This resource complements the EcoSchools *Energy Conservation Guide*. The dual focus on curriculum and school operations is central to the EcoSchools approach: what is being taught in the classroom will be modelled in the way we run our schools, and vice-versa.

With this resource, teachers are equipped to help students understand energy conservation as an environmental issue: the energy we use results in greenhouse gases that contribute to climate change.

SEPTEMBER 2008

GUIDES FOR GETTING STARTED

1 *Introduction to EcoSchools and the Five-Step Process*

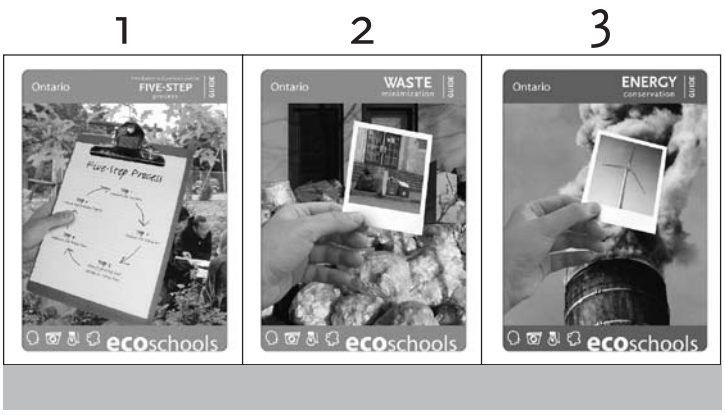
This concise guide provides an overview of the Ontario EcoSchools program and sets out a practical method for successful implementation: (1) establish an EcoTeam, (2) assess the school's needs, (3) identify priorities and develop an action plan, (4) implement the action plan, and (5) monitor and evaluate progress.

2 *Waste Minimization Guide*

This guide outlines the 10 Ontario EcoSchools waste minimization guidelines. It provides the school's EcoTeam with tips for assessing the school's current waste minimization efforts, sample reviews and action plans and a set of tools for implementing improved waste minimization practices.

3 *Energy Conservation Guide*

Similar in format to the *Waste Minimization Guide*, this resource outlines the 10 Ontario EcoSchools energy conservation guidelines. It provides the school's EcoTeam with tips for assessing the school's current energy conservation efforts, sample reviews and action plans and a set of tools for implementing improved energy conservation practices.



4 *Waste Minimization by Grade (1-8)*

This resource is organized around "big ideas" about waste and waste minimization that are based on identified clusters of learning expectations in both Science and Technology and Social Studies and Geography. Using these ideas as a focus helps the teacher incorporate ecological thinking into existing curriculum. Annotated Internet resources offer background facts and student learning activities.

5 *Energy Conservation by Grade (1-8)*

Like *Waste Minimization by Grade*, this guide is organized around "big ideas" about energy and energy conservation that are based on identified clusters of learning expectations in both Science and Technology and Social Studies and Geography. Using these ideas as a focus helps the teacher incorporate ecological thinking into existing curriculum. Annotated Internet resources offer background facts and student learning activities.

CONNECTING ECOSCHOOLS TO THE ELEMENTARY CURRICULUM

CONNECTING ECOSCHOOLS TO THE SECONDARY CURRICULUM

6 *Climate Change in Grade 9 Geography (Academic and Applied)*

This resource consists of a culminating task for summative evaluation plus a unit-by-unit breakdown of the conceptual understandings about climate change needed to ensure student success. Students select a Canadian town or small city and develop an annotated map that indicates the changes in the human and natural environments that would reduce greenhouse gases and thus slow climate change. Resource list, student worksheets and evaluation rubric are provided. See #15 for supporting multimedia presentations.

7 *Climate Change in Grade 10 Civics*

This unit introduces students to the concept of citizenship through a series of well-supported activities where they analyze the accomplishments of environmental activists and organizations. A simple Public Policy Primer helps students see points at which they can influence issues. Students apply their knowledge in responding to the Government of Canada's One-Tonne Challenge for reducing climate change gases. An Environmental Citizenship Portfolio containing each student's class work and other materials sums up her/his understanding of environmental citizenship. See #15 for supporting multimedia presentations.

8 *Climate Change in Grade 10 Science (Academic and Applied)*

This resource provides two possible culminating tasks: students are introduced to an actual problem and asked to propose solutions to either The Impact of Transportation Choices or Forest Management and Climate Change. Climate change related concepts have been identified in each strand. Charts link authorized texts and the Teacher Resource for each to relevant learning expectations. A student Checklist of Preparation, annotated Internet resources and evaluation rubrics are also provided. See #15 for supporting multimedia presentations.

9 *Climate Change in Grade 11 and 12 Science*

This resource ranges over 8 different Science courses (University, University/College, College and Workplace), highlighting learning expectations that can be met using climate change issues as the examples. Focus questions help students connect the learning of facts and concepts in a meaningful way. The questions also suggest ways to adapt the existing curriculum to explore the data, evidence, interactions and technologies related to climate change issues. Lists of resources that suit the needs of the courses are included. See #15 for supporting multimedia presentations.

10 *Climate Change in Grade 11 and 12 Geography*

This resource surveys 5 Geography courses (University, University/College, and Open). Overall and specific expectations for each course are accompanied by guiding ideas linking these expectations to different parts of the climate change story. Examples are provided for developing topics, and teaching and learning strategies recommended for different student needs. Resources for planning class activities and assignments are listed. See #15 for supporting multimedia presentations.

GUIDES TO ENRICH YOUR PROGRAM

11 *Schoolground Greening: Designing for Shade and Energy Conservation*

Based on a guide developed by Evergreen and the Toronto District School Board, this resource will help schools design for increased shade to protect students and staff from ultraviolet radiation (UVR) and to shade school buildings to save energy and make them more comfortable. Tips for involving the school community in the design process, surveying user needs, completing a site analysis, creating site plans and developing a fundraising strategy are included.

12 *Celebrating EcoSchools: Festival Guide (Elementary)*

This collection of learning activities for elementary schools is designed for Earth Week or another EcoSchools celebration. While each activity can stand alone, the collection is especially designed for an entire school to engage in environmental learning adventures, focussing on the theme of human-environment connections. Based on a resource developed by the City of Toronto and the Toronto District School Board.

13 *The 20/20 Planner*

Based on a Toronto Public Health resource, *20/20 The Way to Clean Air* offers teachers a way to help students apply their learning about energy conservation at home. The planner is a "take-home" guide filled with simple tips and activity sheets that offer a range of actions that students and their families can undertake to reduce energy and vehicle use by 20%.

14 *Certification Guide*

The *Certification Guide* is based on a resource developed by the Clean Air Partnership and the Toronto District School Board. It provides sample benchmarks and a scoring system for schools wishing to assess their environmental performance in a limited number of areas. The point system establishes Bronze, Silver and Gold levels of EcoSchools.

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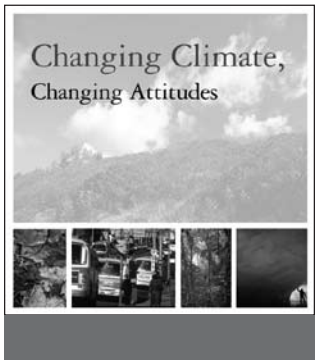
15



Free copies of all Ontario EcoSchools guides may be downloaded in PDF format. Go to www.ontarioecoschools.org

15 Multimedia presentations: *Changing Climate, Changing Attitudes; The Impacts of Climate Change; The Science of Climate Change*

Three multimedia presentations have been designed to accompany the EcoSchools curriculum resources. *Changing Climate, Changing Attitudes* provides students and teachers with a general overview of global climate change and its impacts on Ontario society. *The Impacts of Climate Change* has been developed explicitly to complement the Grade 9 Geography course but can be used with all secondary students to examine the impacts of climate change on the natural and human worlds. *The Science of Climate Change*, while developed to support the Grade 10 Science course, is suitable for all secondary science students. These presentations include potential solutions and steps that citizens can take to help slow climate change.

MULTIMEDIA PRESENTATIONS TO ANCHOR YOUR PROGRAM

ecological
LITERACY
GUIDE

Energy Conservation
by Grade (1-8)

Contents

Ecological *inquiry* reveals our dependence on the healthy functioning of the earth's living systems which give us clean air, water, soil, food, and all the other resources we depend on. As our understanding of the inter-relatedness of all life increases, we can become literate in the ways to care for the earth that consider the wellbeing of future generations. Ecological *literacy* allows us to understand the urgency of developing protective, sustainable, and restorative relationships with the natural systems that are affected by our daily activities.

Big Ecological Ideas

This resource offers a grade-by-grade progression of basic ecological concepts related to energy conservation which are referred to as the Big Ecological Ideas. The text that follows the Big Ideas provides background information for teachers and key learnings for students in each grade.

FOR EXAMPLE:

GRADE 1: SCIENCE AND TECHNOLOGY—Understanding Matter and Energy: Energy in Our Lives (2007)

Big Ecological Idea #2:

Controlling the devices we use allows us to conserve energy.

a) Controlling the energy we use is very important because it allows us to use it only when we need it.

b) We control lights and other electrical devices manually with switches to turn them on and off.

c) There are many ways to conserve energy. When it is bright outside, enough light may enter our homes or buildings so that we can turn off lights inside to conserve energy. Before leaving school we shut computer monitors off or put...

Clustering of Expectations

Expectations have been selected and clustered to uncover the potential in the curriculum for *teaching with the environment in mind*. This shift in thinking is the long-term goal of EcoSchools. The Big Ideas offer a means for classroom programs to achieve this goal.

Each Big Idea is linked to a cluster of Ontario learning expectations suited to exploring the environmental issue of energy conservation. These concepts have been organized to demonstrate how an ecological perspective can be incorporated into existing classroom curriculum units.

FOR EXAMPLE:

GRADE 1: SCIENCE AND TECHNOLOGY—Understanding Matter & Energy: Energy in our Lives (2007)

1.1 describe their own and their family's uses of energy (e.g. to operate lights, video games, cars, computers); identify ways in which these uses are efficient or wasteful, taking different points of view into consideration (e.g. the point of view of a parent, a sibling …); suggest ways to reduce personal energy consumption; and explain why it is important for people to make these choices

Note: From time to time, an additional example is supplied in the expectation to expand the potential application of the learning. These examples appear in square brakets **[ ]**.

Suggested Resource Websites

To complement each Big Ecological Idea with background facts and topic-specific classroom activities, an annotated selection of educational resources from the Internet has been provided.

FOR EXAMPLE:

HOW DEVICES USE ENERGY – "I SPY ENERGY AT WORK" (p. 24)
A Grade 1 activity with Ontario curriculum links, to help students explore the many ways devices use energy. Includes a discussion of ways to conserve energy.
http://www.schoolnet.ca/learning/down/ener-on.en.pdf

Entering the indicated URL or website address of these resources will take teachers directly to downloadable lesson plans, activity sheets, backgrounders or games from a variety of excellent sources. Each was carefully chosen to illustrate a specific ecological idea, and to make the learning associated with Energy Conservation experiential, interesting, eye-opening - and even fun.

Wherever possible, the materials from these websites has been archived on the Ontario EcoSchools website. Please see **www.ontarioecoschools.org** to download the archived Internet resources.

ENERGY CONSERVATION – GRADE 1

Big Ecological Idea #1:

We rely on the constant flow of energy from the sun to live.

a) Most of the energy on the earth's surface comes from the sun. In nature, the sun's energy affects both living and non-living things.

b) The sun is crucial to our survival. It constantly warms the earth and the sea, giving us a habitable climate to live in. It makes the winds blow, and the rains fall. It also gives energy to all living things. The sun gives plants energy to grow and make food. People and animals then get their energy from eating plants and other animals. The energy from our food lets us grow, move and do work. Many people in the world use plant energy (e.g., wood) for cooking and to keep warm. When people cut down trees for wood to burn in their fireplaces, the energy stored in the wood changes form – and becomes heat!

c) It may seem surprising to realize that the electrical energy we need to run the devices we use each day – computers and lights – originated with the sun. The sun evaporates water from lakes and oceans. When it rains, some of the water is dropped on higher ground. Due to gravity, the water flows. Hydroelectric energy comes from the energy of this moving water. Our coal-produced electricity comes from fossil fuels whose concentrated energy is that of the sun stored in plants buried millions of years ago. Cars, too, run on a fossil fuel called gasoline. This is made from petroleum that, like coal, is derived from fossilized plants long buried and compressed into fuel under the ground.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Matter & Energy: Energy in our Lives (2007)

1.1 describe their own and their family's uses of energy *(e.g. to operate lights, video games, cars, computers); identify ways in which these uses are efficient or wasteful, taking different points of view into consideration (e.g. the point of view of a parent, a sibling …)*; suggest ways to reduce personal energy consumption; and explain why it is important for people to make these choices

2.2 investigate how the sun affects the air, land, and/or water, using a variety of methods *(e.g., standing outside on a sunny and a cloudy day and noting the differences; putting a dish of water in the sun and the shade and observing what happens)* and resources

2.4 investigate and compare seasonal differences in the ways we use energy and the types of energy we use *(e.g.; we keep warm in the winter by … using furnaces and woodstoves; we stay cool in summer by sitting in the shade or going to places that are air conditioned; we adjust the amount of light we need by opening or closing the curtains and turning lights on or off)*

2.5 use scientific inquiry/experimentation skills, and knowledge acquired from previous investigations, to explore the effects of light and heat from the sun *(e.g. by growing plants in the presence and absence of sunlight …)*

2.6 investigate how the sun's energy allows humans to meet their basic needs, including the need for food *(e.g., trace the flow of energy from the sun, which provides energy to plants, which make food for animals to eat, and then from plants and animals, which provide food for humans to eat)*

3.1 demonstrate an understanding that energy is what makes the things they do or see happen
3.2 demonstrate an understanding that they sun, as the earth's principal source of energy, warms the air, land, and water; is a source of light for the earth; and makes it possible to grow food
3.3 identify food as a source of energy for themselves and other living things
3.4 identify everyday uses of various sources of energy *(e.g. food to help animals, including humans, survive and move; … batteries to power toys)*
3.5 demonstrate an understanding that humans get the energy resources they need from the world around them *(e.g., the wood, oil, and gas to heat our homes and cook our food)* and that the supply of many of these resources is limited so care needs to be taken in how we use them

SCIENCE & TECHNOLOGY—Understanding Earth & Space Systems: Daily and Seasonal Changes (2007)
3.1 identify the sun as Earth's principal source of heat and light
3.2 define a cycle as a circular sequence of events

Suggested Resource Websites

ENERGY FLOWS – "THE SUN'S ENERGY IN THE FOOD CHAIN"
A participatory exercise to demonstrate to young students how the sun's energy moves through a living chain from plants, to small animals to larger predators. With a small piece of snack food as the "energy" that passes, students role-play the different creatures, and discuss how the chain works and what might make it work less well (e.g., losing species).
http://www.iit.edu/~smart/hearlyv/lesson1.htm

ENERGY FLOWS – ENERGY STORY: THE TALE OF JOHNNY ENERGY SEED
A brief, clear explanation of how the sun's energy is made available in corn (plants) as food for people, then as food for animals, as direct fuel (burning), as a source of bio-gas for cooking, and as ethanol for vehicle fuel.
http://www.eia.doe.gov/kids/cc/PrimaryActivity.pdf

Big Ecological Idea #2:

Controlling the devices we use allows us to conserve energy.

a) Controlling the energy we use is very important because it allows us to use it only when we need it.

b) We control lights and other electrical devices manually with switches to turn them on and off. If we did not use a switch to control the electrical energy it would be wasted. Just as we can stop the flow of water running through a hose by closing the nozzle, we can stop the flow of electrical energy to our lights with a switch, or to our computer monitor with the "on/off" button.

c) There are many ways to conserve energy. When it is bright outside, enough light may enter our homes or buildings so that we can turn off lights inside to conserve energy. Before leaving school we shut computer monitors off or put them to sleep.

d) When we save energy we help create a healthier environment for people, plants and animals. We also save fuel (resources) and money.

Clustering of Expectations

SCIENCE & TECHNOLOGY—Understanding Matter and Energy: Energy in our Lives (2007)

1.1 describe their own and their family's uses of energy *(e.g. to operate lights, video games, cars, computers); identify ways in which these uses are efficient or wasteful, taking different points of view into consideration (e.g. the point of view of a parent, a sibling …)*; suggest ways to reduce personal energy consumption; and explain why it is important for people to make these choices

1.2 describe how the everyday lives of different people and other living things would be affected if electrical energy were no longer available *(e.g. families, farmers, businesses and stores, a company that offers alternative energy sources such as solar-powered devices,…, the tropical animals in a Canadian zoo)*

2.3 design and construct a device that uses energy to perform a task

2.4 investigate and compare seasonal differences in the ways we use energy and the types of energy we use *(e.g.; we keep warm in the winter by … using furnaces and woodstoves; … we adjust the amount of light we need by opening or closing the curtains and turning lights on or off)*

3.5 demonstrate an understanding that humans get the energy resources they need from the world around them *(e.g., the wood, oil, and gas to heat our homes and cook our food)* and that the supply of many of these resources is limited so care needs to be taken in how we use them

Suggested Resource Websites

HOW DEVICES USE ENERGY – "I SPY ENERGY AT WORK" (p. 24)

A Grade 1 activity with Ontario curriculum links, to help students explore the many ways devices use energy. Includes a discussion of ways to conserve energy.

http://www.schoolnet.ca/learning/down/ener-on.en.pdf

MANUAL ENERGY CONTROL – CONSERVING ENERGY

An introduction to ways people can conserve energy, including turning things off (there's a good list of energy-using items at home) and planting trees. There are also games for young students.

http://www.powerhousekids.com/savingenergy/index.php

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS

A 20-chapter Energy Story, with quick-reference, easy-to-use explanations of energy sources, technologies, and alternatives. An excellent basis for class discussion for teachers Grades 1-8.

http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 2

Big Ecological Idea #1:

The sun is the source of wind and water energy.

a) The sun gives its energy to air and water. This energy can be used by humans. The sun heats the earth's surface unevenly, creating air currents that make the wind blow. The sun's heat also makes water on the earth evaporate, and lifts it up into the air.

b) Evaporated water then forms into clouds and falls as rain, some of which makes rivers flow. Energy from moving air (wind) and from flowing water can be used to generate electricity.

c) Niagara Falls is an excellent example of flowing water used to produce electricity (which we call hydroelectricity). The water moves because the force of gravity pulls it downward. The falling water is used to turn a turbine connected to a machine called a generator that produces the electricity. In some countries today (including Canada), wind is being used to turn windmills that also use generators to produce electricity.

Clustering of Expectations

SCIENCE & TECHNOLOGY—Understanding Earth & Space Systems: Air & Water in the Environment (2007)

2.2 investigate, through experimentation, the characteristics of air and its uses *(e.g., living things breathe air to stay alive; air makes certain activities possible:* [*turn wind turbines to produce electricity*]*)*

2.3 investigate, through experimentation, the characteristics of water uses *(e.g. …water makes things move* [*turns a turbine to produce electricity*] *…)*

2.4 investigate the stages of the water cycle, including condensation, precipitation and collection

3.3 describe ways in which living things, including humans, depend on air and water *(e.g. …wind generates energy… water is used for …transportation, energy generation)*

Suggested Resource Websites

ALL ABOUT THE SUN: EFFECTS OF THE SUN ON OUR PLANET

A teacher overview and Science Explorations to discover the many "jobs" of the sun's energy: • Sunlight and Plant Life • Life in a Greenhouse • Evaporation: How fast? • Now We're Cookin'! (Stanford University Solar Centre)

http://solar-center.stanford.edu/webcast/wcpdf/sunonearth2-4.pdf

CATCH AND FEEL THE WIND'S ENERGY: FEEL THE WIND, FLY A KITE

The sun's energy makes the wind blow. This web page contains complete time tested instructions to get 20 kids making their own kites and flying them in 20 minutes. Kites allow children (and adults!) to feel the energy of the wind and capture it with a device.

http://www.aloha.net/~bigwind/20kidskites.html

Big Ecological Idea #2:

People can use water and wind power to produce electricity that is non-polluting.

a) The power of the wind and the water (which comes from the sun's energy) can be captured to make things turn. A wheel with turning blades can be attached to machines used to do work or produce electricity.

b) In Ontario in 2002, 32% of our electricity came from the power of water (hydro-electricity). (Source: Ontario Power Generation, http://www.e7.org/Pages/M-OPG/html)

c) Canada is also beginning to use wind power to produce electricity – the Pickering wind turbine near Toronto is one of North America's largest wind turbines. Denmark uses windmills to make over 15% of its electricity in a non-polluting way. (source: http://www.awea.org/ news/news020319glo.html)

Clustering of Expectations

SCIENCE & TECHNOLOGY—Understanding Earth & Space Systems: Air & Water in the Environment (2007)

2.2 investigate, through experimentation, the characteristics of air and its uses *(e.g., living things breathe air to stay alive; air makes certain activities possible:* [*turn wind turbines to produce electricity*]*)*

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2.4 investigate the stages of the water cycle, including condensation, precipitation and collection

3.3 describe ways in which living things, including humans, depend on air and water *(e.g. …wind generates energy… water is used for …transportation, energy generation)*

Suggested Resource Websites

WATCH THE POWER OF GRAVITY - HYDRO POWER: THE ENERGY OF WATER AND GRAVITY!

This simple experiment with a milk carton demonstrates to students the power of water pressure. It shows the power of water under pressure (of gravity and the water's weight) and relates this observation to how electricity can be generated by big hydroelectric dams.

http://www.energyquest.ca.gov/projects/hydro-power.html

ELECTRICITY FROM WATER

A simple experiment and discussion of how the power of water can be used to make electricity. Illustrated, with clearly written concept development. (The Comprehensive Water Education Book, International Office for Water Education, Utah State University).

http://www.uen.org/stream/html/2lesson2.html

THE PICKERING WIND TURBINE BACKGROUNDER

If you'd like to tell students the story of exciting new wind power activity, here is the official fact sheet on North America's largest wind turbine – the Pickering wind turbine.

http://www.opg.com/envComm/windturb.pdf

WHO HAS SEEN THE WIND?
Students will gain an understanding of how energy, in the form of wind, can act on other objects to cause motion. Students will learn that they can use this energy to move their own objects and that wind energy is harvested in large quantities to produce electricity for manufacturers and communities. (Teacher's Corner Lesson Plans, Evergreen)
http://www.evergreen.ca/en/lg/lessons/wind-waterloo.pdf

EXPLORING WAYS TO CONSERVE ENERGY – ENERGY'S MANY TYPES AND HOW TO CONSERVE IT
This environmental education unit is appropriate for Grades 2 or 3. It invites students to explore the many devices they use in their lives which consume energy, and discuss why the energy which powers them should be conserved whenever possible. (University of Tennessee)
http://www.utm.edu/departments/ed/cece/second/2I3.shtml

Big Ecological Idea #3:

There are significant advantages and challenges to using renewable energy sources such as wind and water energy.

a) One advantage to using renewable resources (which also includes bio-diesel fuel from grains, water energy from waves, heat energy from the earth [geothermal]) is that they are healthier for people and the earth than nonrenewable resources such as fossil fuels (e.g., coal, oil, gasoline) because they do not make as much pollution.

b) Another advantage is that renewable resources are continuously replaced by the earth's processes (e.g., trees are used for wood, grains are used for fuels [ethanol], the sun drives the cycles that make the wind blow and the water evaporate and fall again).

c) Non-renewable resources were formed in the earth over a million of years ago. When we use them up we cannot replace them. In Canada we use fossil fuels because they give us a lot of the sun's stored energy easily (for running factories, heating homes and making cars, planes, trains and ships go). But they also pollute the air and release gases into the atmosphere which make the earth become warmer (greenhouse gases causing climate change).

d) A disadvantage to using some of the renewable forms of energy (e.g., wind, solar) is that they are less concentrated than fossil fuels. They require many devices (e.g., windmills, solar panels) to capture their energy, and are only available when it is windy or sunny. These renewable forms of energy also need to be transformed into some other forms for storage (e.g., batteries). So although they are non-polluting, they are less efficient to use than fossil fuels. Research and development efforts, however, are working to increase their efficiency and lower their costs.

Clustering of Expectations

SCIENCE & TECHNOLOGY—Understanding Earth & Space Systems: Air & Water in the Environment (2007)

2.2 investigate, through experimentation, the characteristics of air and its uses *(e.g., living things breathe air to stay alive; air makes certain activities possible:* [*turn wind turbines to produce electricity*]*)*

2.3 investigate, through experimentation, the characteristics of water uses *(e.g. …water makes things move* [*turns a turbine to produce electricity*] *…)*

2.4 investigate the stages of the water cycle, including condensation, precipitation and collection

3.3 describe ways in which living things, including humans, depend on air and water *(e.g. …wind generates energy… water is used for …transportation, energy generation)*

Suggested Resource Websites

RENEWABLE AND NON-RENEWABLE FORMS OF ENERGY

A good list of energy definitions for primary students. Eight Energy and Control activities for Grade 2 to demonstrate ways in which different forms of energy can be applied, at

http://www.schoolnet.ca/learning/teacher/classroom/thematic/energy/chart.htm.

(Learning for a Sustainable Future)

http://www.schoolnet.ca/learning/teacher/classroom/thematic/energy/guide/forms/content.htm

ENERGY EXISTS IN MANY TYPES AND MUST BE CONSERVED

A Grade 2 exercise in exploring devices which use energy, the meaning of energy conservation, some reasons why – and how we might do things differently. (University of Tennessee)

http://www.utm.edu/departments/ed/cece/second/2I3.shtml

CONTROLLING NATURE'S FORCES – HOW THE FORCE OF WATER PRODUCES HYDRO-POWER

Ontario gets much of its electricity from the immense power of falling water. This activity guides students in building two simple models of devices which allow water to do work: a turbine (used to run a generator which makes electricity) and an overshot waterwheel, used in the past to grind grain and run machines.

http://www.energyquest.ca.gov/projects/waterenergy.html

CAPTURING NATURE'S FORCES – MEASURING THE FORCE OF WIND – BUILDING AN ANEMOMETER

Scientists and pilots measure the speed of the wind with an instrument called an anemometer. With simple materials, your class can construct an instrument to help observe the speed of the wind at different times. Observations can lead to a discussion of uses of the wind to produce energy for people's use.

http://www.energyquest.ca.gov/projects/anemometer.html

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS

A 20-chapter Energy Story, with quick-reference, easy-to-use explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.

http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 3

Big Ecological Idea #1:

Plants are important not only as food and as habitat: they perform the important (but often overlooked) "service" of moderating outdoor temperatures. This directly affects the amount of energy we use!

a) Plants are important to other plants and animals as habitat - places where they can find food and shelter.

b) By providing shade and moisture, plants, and particularly trees, also play an important role in moderating temperatures during warm seasons. A cooler, shaded building can reduce its need for air-conditioning - a significant energy savings.

c) In winter, trees act as windbreaks, sheltering both animals and human habitations. By reducing wind speed they can help to reduce heat loss and the heating energy needed.

d) Trees in urban areas play a significant role in regulating the outdoor temperature in the summer: cities with little vegetation often experience a "heat island effect" where temperatures are uncomfortably higher than in the surrounding areas. The trees lower temperatures by transpiring moisture into the air, making the area feel cooler.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Life Systems: Growth and Changes in Plants (2007)

1.1 assess ways in which plants are important to humans and other living things, taking different points of view into consideration *(e.g., the points of views of home builders …)*, and suggest ways in which humans can protect plants *Sample Prompts:* …Trees reduce humans' energy use in summer by providing cooling shade…

1.2 assess the impact of different human activities on plants, and list personal actions they can engage in to minimize harmful effects and enhance good effects *Sample Prompts:* … When humans plant trees, they benefit the environment in many different ways.

3.6 describe ways in which plants and animals depend on each other

3.8 identify examples of environmental conditions that may threaten plant and animal survival

Suggested Resource Websites

WHAT PLANTS DO FOR US – A BACKGROUNDER

This brief and clearly written page is an excellent introduction for teachers to the concept of "ecosystem services" – the essential work that plants and ecosystems perform for the well-being of humans, and which may be taken for granted until human activity interrupts them. This is a "Big Idea" way of looking at the importance of plants! (Ecological Society of America)

http://www.esa.org/ecoservices/comm/body.comm.fact.ecos.html

BIODIVERSITY PERFORMS!
An animated on-line look at some of nature's "secret services" – to help students begin to understand the wonderful work that nature does to keep its systems working. (World Wildlife Fund)
http://www.worldwildlife.org/windows/performs/flash/4answer.html

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS
A 20-part Energy Story, with quick-reference, easy-to-use illustrated explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.
http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 4

Big Ecological Idea #1:

The high consumption of energy in North America has an effect on plant and animal habitats and communities.

a) Plants and animals depend on their habitats and communities for food and shelter.

b) Humans use different forms of energy in their lives, for transportation, for manufacturing, and for comfort and convenience in their homes, schools and offices.

c) Our production and use of energy affects natural communities of plants and animals by disturbing their habitat in mining for minerals, building pipelines, dams (flooding large areas), roads, hydro corridors, and power plants.

d) We can care for communities of animals and plants by reducing our energy use, which in turn reduces some of the effects of energy production.

e) Exploring the ways in which energy production affects habitats can help remind us of the importance of making wise energy choices.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Life Systems: Habitats and Communities (2007)

1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities, taking different perspectives into account and evaluate ways of minimizing the negative impacts

1.2 identify reasons for the depletion or extinction of a plant or animal species *(e.g., …, changes in or destruction of its habitat)*, evaluate the impacts on the rest of the natural community, and propose possible actions for preventing such depletions or extinctions from happening

2.3 use scientific inquiry/research skills to investigate ways in which plants and animals in a community depend on features of their habitat to meet important needs

2.4 use scientific inquiry/research skills to create a living habitat containing a community, and describe and record changes in the community over time

3.1 demonstrate an understanding of habitats as areas that provide plants and animals with the necessities of life
3.2 demonstrate an understanding of food chains as systems in which energy from the sun is transferred to producers (plants) and then to consumers (animals)
3.3 identify factors that affect the ability of plants and animals to survive in a specific habitat
3.4 demonstrate an understanding of a community as a group of interacting species sharing a common habitat
3.9 demonstrate an understanding of why all habitats have limits to the number of plants and animals they can support
3.10 describe ways in which humans are dependent on natural habitats and communities

SCIENCE AND TECHNOLOGY—Understanding Earth and Space Systems: Rocks and Minerals (2007)

1.1 assess the social and environmental costs and benefits of using objects in the built environment that are made from rocks and minerals *Sample issues:* (a) Quarried stone, sand, and gravel are used to make concrete. We need the strength and long life that concrete gives to roads and buildings, but making concrete uses a lot of natural resources and energy. (b) Aluminum is used to make soft drink containers and trash cans. It can be recycled many times, and recycling uses much less energy than making aluminum from ore.
1.2 analyse the impact on society and the environment of extracting and refining rocks and minerals for human use, taking different perspectives into account *(e.g., …, residents who live in communities located near refineries and manufacturing facilities and who are concerned about the environment) Sample issues:* (a) Surface mining is used to extract rocks and minerals for eventual human use. It is less hazardous for humans than underground mining, but it has a greater impact on the surface landscape, including the removal of significant amounts of rich topsoil. Efforts are being made by mining companies to reclaim land where mines and quarries have been closed. Mined-out quarries can be filled with water and used for recreational purposes. When a mine is closed, the topsoil that had been removed can be replaced and native species replanted. …

Suggested Resource Websites

LIVING ENERGY IN COMMUNITIES OF LIFE – KIDS DO ECOLOGY

Taking a look at the science of Ecology is a good way to see how energy works in ecosystems as well as in our human-built energy systems. In living systems, food is the fuel that passes energy from one living thing to another. This website offers an introduction to Ecology for students beginning to learn about communities of living things and the important connections among their parts. (University of California, Santa Barbara)

http://www.nceas.ucsb.edu/nceas-web/kids/main_pages/faq.htm

ENERGY AND HABITAT-ONTARIO POWER GENERATION'S BIODIVERSITY STRATEGY

A very interesting brief backgrounder on the relationships between generating electricity with fossil fuels and protecting habitats and wildlife. This web page will offer teachers reasons for thinking about how we make and use energy in our lives. (Ontario Power Generation)

http://biodiversityeconomics.org/business/handbook/hand-01-24.htm

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS

A 20-part Energy Story, with quick-reference, easy-to-use illustrated explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.

http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 5

Big Ecological Idea #1:

The extraction, transportation and processing of natural resources use a lot of energy.

a) A great deal of energy is used to extract, transport and process natural resources. Since one third of Ontario's energy comes from greenhouse gas and pollution-emitting fossil fuels, the more natural resources we use, the greater our impact on the environment.

b) When we know that all of our "stuff" comes from natural resources (which requires a lot of energy to extract, transport and process), we can make more informed choices about what we buy and how much we buy.

c) The amount of energy we use can be reduced further by minimizing the amount of materials needed to make the things we want to buy (e.g., a laptop computer uses fewer materials in its manufacture than a desktop computer).

d) Recycling of materials (aluminum, steel, glass) saves both natural resources and energy, and reduces pollution.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Earth and Space Systems: Conservation of Energy and Resources (2007)

1.1 analyse the long-term impacts on society and the environment of human uses of energy and natural resources, and suggest ways to reduce these impacts *(e.g., … reusing or recycling products, or using fewer products, conserves natural resources and energy) Sample issue:* Natural gas is a clean, reliable, and safe fuel for heating our homes, but it is non-renewable and its use contributes to climate change (although not as much as other fossil fuels). Alternative forms of energy such as solar energy or wind energy do not deplete natural resources or contribute to climate change, but they may have other drawbacks (such as being more expensive and less reliable).

2.2 use scientific inquiry/research skills (see page 15) to investigate issues related to energy and resource conservation *(e.g., interview an Aboriginal person about his or her traditional teachings on conservation)*

Suggested Resource Websites

LIFE AFTER FOSSIL FUELS? - USING ENERGY WISELY

In this illustrated resource, Tiki the Penguin explains both the problems and some possible solutions available to societies wishing to move beyond fossil fuel and nuclear energy sources to more benign and renewable methods of energy production. (United Kingdom)

http://www.oneworld.net/penguin/energy/energy.html

Big Ecological Idea #2:

Different energy sources have different impacts on the environment. Learning to assess the different environmental impacts will help our society make wise energy choices for a healthy, sustainable future.

a) Energy can be used most sustainably by using the least polluting form of energy production available and by using the least amount of energy required to perform a task efficiently. In 1992, the U.S. Environmental Protection Agency (EPA) introduced Energy Star as a voluntary labeling program that was designed to identify and promote energy efficient products to help reduce greenhouse gas emissions. The EPA has expanded this program's scope to include new homes and commercial and industrial buildings (including schools). This program has made it easier for consumers to identify more sustainable choices when purchasing products.

b) Burning non-renewable fossil fuels – coal, oil and natural gas – gives us enormous amounts of the sun's energy previously stored underground. However, burning these fossil fuels also contributes to climate change by increasing the total amount of carbon dioxide in the atmosphere.

c) Renewable energy sources vary in the amount of power they can produce and in their environmental impacts. Solar panels require energy and resources to produce but do not cause pollution when they are used. The same is true of wind turbines – they also require energy to produce but do not emit greenhouse gases when operating. Even the burning of wood and bio-mass (plant fuel) releases carbon dioxide into the air. Hydroelectric power is non-polluting, but dam-building to produce it can flood vast areas of habitat, displacing both natural and human communities. Nuclear power raises concerns about the long-term storage of radioactive waste.

d) Renewable resources can be defined as those that are consumed at or below the rate at which they are created.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Earth and Space Systems: Conservation of Energy and Resources (2007)

1.1 analyse the long-term impacts on society and the environment of human uses of energy and natural resources, and suggest ways to reduce these impacts *(e.g., …) Sample issue*: Natural gas is a clean, reliable, and safe fuel for heating our homes, but it is non-renewable and its use contributes to climate change (although not as much as other fossil fuels). Alternative forms of energy such as solar energy or wind energy do not deplete natural resources or contribute to climate change, but they may have other drawbacks (such as being more expensive and less reliable).

3.1 identify a variety of forms of energy *(e.g., electrical, chemical, mechanical, heat, light, kinetic)* and give examples from everyday life of how that energy is used

3.2 identify renewable and non-renewable sources of energy *(e.g., renewable: sun, wind, ocean waves and tides, wood; non-renewable: fossil fuels such as coal and natural gas)*

3.3 describe how energy is stored and transformed in a given device or system

Suggested Resource Websites

THE FORMATION OF FOSSIL FUELS

If we go back in geological history, we find that it took millions of years for our fossil fuels to form. Because of the time needed to form these fuels, and because the conditions for formation must be just right, most geologists feel that little or no new fossil fuel is being produced. For this reason, we call fossil fuels "nonrenewable." This activity explores fossil fuels and compares them to renewable energy sources. (Alliance to Save Energy)

http://www.ase.org/educators/lessons/fossil.pdf

RENEWABLE ENERGY IN CANADA – SUCCESS STORIES – CANADIAN RENEWABLE ENERGY

Renewable energy success stories for class discussion. (Natural Resources Canada)

http://www.canren.gc.ca/default_en.asp

A WEBQUEST ON RENEWABLE ENERGY

This site offers a complete lesson plan for Grades 4-6, with prior knowledge requirements and an evaluation rubric, on sources and uses of renewable energy. Students have an opportunity to evaluate strengths and weaknesses of the energy sources presented, and write a persuasive essay defending their choice of recommended resource for "Electric City."

http://coe.west.asu.edu/students/scondojani/webquest.htm

USING RENEWABLE ENERGY – EXPLORE RENEWABLE ENERGY

This site offers a range of educational activities to explore ways to use renewable energy. (Texas State Energy Conservation Office)

http://www.infinitepower.org/lessonplans.htm#Middle%20School%20Lesson%20Plans

POWERING FUTURE CARS: AFTER THE GASOLINE ENGINE…
WHAT? – HOW DO FUEL CELLS WORK?

A potentially effective substitute for fossil-fuel-using internal combustion engines, fuel cells can generate electricity using hydrogen, with only water as a by-product (and no moving parts!). This clearly illustrated fact sheet explains how fuels cells are designed and work. (Rocky Mountain Institute)

http://www.rmi.org/sitepages/pid537.php

RENEWABLE ENERGY IN CANADA – WHAT IS IT?

This site outlines the features and uses of the main types of renewable energy (solar, wind, hydro, bio-mass, wood waste). Links to other useful energy sites for students. (Natural Resources Canada)

http://www.nrcan.gc.ca/es/etb/cetc/kids/htmldocs/kids_homework_e.html

DR. E'S ENERGY LAB

Lots of facts, links and ideas about the sustainable use of energy, for students. (U.S. Department of Energy)

http://www.eren.doe.gov/kids/

CONSERVING ENERGY – UNDERSTANDING ENERGY

An "Eco-Link" to help students understand important energy issues: renewable energy, climate change, and fossil fuels. (Earth Day Canada)

http://ecokids.earthday.ca/pub/eco_info/books_n_links/eco_links/e_links.cfm

Big Ecological Idea #3:

Devices and systems can be designed to minimize energy use and thus reduce our impact on the environment.

a) Efficiency – using devices and practices which require the smallest amount of energy to produce the most work and make the smallest amounts of polluting wastes – is one of the best forms of conservation.

b) Devices – Design ideas to achieve greater energy efficiency might include prevention of heat loss (insulation, double windows, weather-stripping), de-materialization (using less material), fluorescent bulbs to replace heat-wasting incandescent ones, and co-generation to produce electricity from the waste heat of an industrial process or a heating system.

c) Systems – Designing communities to make maximum use of public transportation systems is energy-efficient because it moves a lot of people using fewer resources. (Efficiencies may be realized even in suburban/lower density communities if developments are planned along existing public transport routes, e.g., GO trains/ buses. Then, as communities grow, there is an existing transport system to build on.)

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Earth and Space Systems: Conservation of Energy and Resources (2007)

1.2 evaluate the effects of various technologies on energy consumption *(e.g., improving our home's insulation allows us to conserve heat and reduce energy consumption; aerodynamic design can improve the energy efficiency of cars and buses; household appliances designed to make our lives easier use large amounts of energy; some cars and recreational vehicles use energy less efficiently than others)*, and propose ways in which individuals can improve energy conservation *Sample problem:* Conduct an energy audit of your home (e.g., look for places where there are drafts; check the wattage of light bulbs; with the help of an adult, estimate the standard of insulation; check the energy efficiency ratings of heating and cooling equipment and large appliances), and create a plan for how your family could improve their energy conservation efforts.

2.3 use technological problem-solving skills to design, build, and test a device that transforms one form of energy into another and examine ways in which energy is being "lost" in the device *Sample guiding questions:* Describe the energy transformations that are taking place in your device. What challenges did you encounter in making these transformations take place? As one form of energy is being transformed into another, where is energy being lost in your device? How might you minimize that loss?

3.4 recognize that energy cannot be created or destroyed but can only be changed from one form to another

3.5 explain that energy that is apparently "lost" from a system has been transformed into other energy forms (usually heat or sound) that are not useful to the system)

Suggested Resource Websites

A HOME ENERGY AUDIT

Most of us don't pay much attention to how the systems around us work – including our energy systems. What is it that makes a building comfortable? And what is it that determines how much money we spend on energy? This home energy audit, a good topic for discussion in class, will help uncover some of these unnoticed aspects of how energy works in our everyday lives – and how we might conserve it. Audit objectives: recognizing energy conservation design features in buildings, using energy conservation vocabulary, making and recording observations.
http://www.ase.org/educators/lessons/audit.pdf

DESIGNING A CAR-FREE CITY

Cars, while certainly convenient, cause both health and environmental problems. At the present time in North America, car-free cities are difficult to imagine. But there are parts of many cities in the world which are designed to work well without cars. This site could provide some inspiration for students to design a car-free city, explore the health, social and environmental advantages of human-scale environments, and determine what it would take to make such a city work.
http://www.carfree.com/

TORONTO HEALTHY HOUSE

See the Toronto Healthy House website for an example of the design elements in a house in Toronto that's completely self-sufficient using only solar power and rain water for its needs.
http://www.cmhc-schl.gc.ca/popup/hhtoronto/works.htm

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS

A 20-part Energy Story, with quick-reference, easy-to-use explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.
http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 6

Big Ecological Idea #1:

The use of electricity improves our lives, but has many different kinds of impacts on the environment.

a) In Ontario nearly all of our electricity is generated from three principal sources: water (hydroelectricity), fossil fuels (coal, oil and natural gas), and nuclear fuel (uranium). All of these have environmental impacts.

b) Some principal causes and effects of environmental impacts related to our electricity production include mining for coal and uranium (causing pollution, land stripping, habitat destruction), oil and natural gas drilling (causing habitat destruction and oil spills), logging (causing

habitat destruction), pipeline building, road building, shipping, clearing land for hydro corridors, oil refining, coal, oil and gas-burning power plants, and dam-building (possibly causing displacement of human and/or natural communities).

c) In recent years, more attention is being paid to generating electricity in more environmentally-friendly ways. Ontario has just begun to invest in power generation from wind. Some new development is happening in small de-centralized hydro projects. A small amount of power is generated from solar panels.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Structures and Mechanisms: Electricity and Electrical Devices (2007)

1.1 assess the short- and long-term environmental effects of the different ways in which electricity is generated in Canada *(e.g., hydro, thermal, nuclear, wind, solar),* including the effect of each method on natural resources and living things in the environment *Sample problems:* (a) Electricity in Ontario is generated by nuclear plants, hydroelectric plants, coal-fired plants, and natural gas plants, and a small percentage is obtained through alternative energy sources. Choose an electricity-generating plant that supplies electricity in your community, and compare the environmental effects of the generating method it uses with a method used in another part of the province. (b) The James Bay Hydroelectric Project was one of the biggest hydroelectric developments of the past century, but it has also had a serious impact on the environment and the James Bay Cree people. Investigate both sides of this issue, and suggest how things might be approached differently today.

2.4 design, build, and test a device that produces electricity *(e.g., a battery built from a lemon or potato; a wind turbine) Sample guiding questions:* … Is this a good method of producing electricity? Why? Why not?

Suggested Resource Websites

HOW IS POWER GENERATED? WHAT ARE THE ADVANTAGES AND DISADVANTAGES?

Energy Resources

A good succinct source of information on all kinds of power generation, and some points of view on their positive and negative attributes. Excellent information for a class discussion on energy in our lives and its effects on the environment. (Energy Quest, Saskatoon East School Division, No. 41)

http://sesd.sk.ca/teacherresource/energyquest/webquest/Resources/resources.htm

Big Ecological Idea #2:

Conserving energy at home and in school reduces negative impacts on the environment.

a) The ease with which we have access to the electrical energy we need can make us forget that its production has effects on the environment (and our budgets).

b) We can conserve energy in school by working to have everyone i) do a "lights off" test to see if it is bright enough to turn off all or some of the lights; ii) turn off or "sleep" all computer monitors when they are not actually in use; iii) turn off all machines promptly when their use is no longer needed; iv) turn off all lights when leaving rooms; v) make signs to remind all members of the school community (or our families) of the importance of saving energy – and to turn things off! (See the Ontario EcoSchools *Energy Conservation Guide*.)

c) Energy-saving appliances and devices also help reduce energy use: motion-control lights outside buildings, compact fluorescent bulbs in lamps, kettles and irons with "automatic off" buttons. We can conserve heat energy by turning down the heat and closing all windows at night, closing curtains or drapes when it is dark outside to keep in the heat and by making sure doors are snugly closed. Using a computer controlled thermostat at home or school can save a great deal of heat energy.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Structures and Mechanisms: Electricity and Electrical Devices (2007)

1.2 assess opportunities for reducing electricity consumption at home or at school that could affect the use of non-renewable resources in a positive way or reduce the impact of electricity generation on the environment
Sample issue: Peak demand times for electricity are morning and early evening. Because electricity cannot be stored in a cost-effective way, it must be supplied as it is being used. This means that almost all of a utility's available power plants must run to meet the demand and prevent system outages. Some utility companies are considering a plan to pay consumers to reduce their electricity consumption, especially during peak hours. This plan would not only reduce demand but would also reduce the cost of electricity for all customers and the impact of electricity production on the environment.

Suggested Resource Websites

REDUCING THE IMPACTS OF OUR ENERGY USE - IDEAS FOR SAVING ENERGY

Once we've understood something of the impacts of energy on our lives and our environment, there are many things we can do to conserve energy. The Environmental Action Ideas Exchange offers over 100 environmental action ideas to do in schools. Whether it's reducing drafts, saving paper, turning off lights, or discussing the environmental impacts of soft-drink containers in class, nearly all of these suggested actions can help you to save energy in your school. (SEEDS Foundation)

http://www.greenschools.ca/Ideas/ideasenergy.html

ENERGY EFFICIENCY EDUCATION - ARE YOU AN ENERGY SAVER STAR?

This activity sheet offers useful activities for students to involve them in investigating how energy is used – and wasted – at home. It also outlines ideas for how they can work with their families to become more aware of and more careful with energy use – be Energy Stars! (Oregon Energy Efficiency Education)

http://www.bpa.gov/Corporate/KR/ed/eelesson/homepage.htm#activity7

ENERGY TRANSFORMATIONS – CONVERTING FUELS TO OBTAIN ENERGY

This activity sheet allows students to explore in detail some of the forms of energy, sources of energy, and types of energy transformations. It also provides some interesting comparisons of the efficiencies of different types of power generation. (Alliance to Save Energy)

http://www.ase.org/educators/lessons/convert.pdf

ENERGY TRANSFORMATIONS – HOW DOES ENERGY WORK?

Measuring energy and understanding the ways in which energy can change form (to do useful work) are explained. (Energy Quest)

http://www.energyquest.ca.gov/story/chapter01.html

EFFICIENT SYSTEMS – DEVICES AND SYSTEMS CONVERT ENERGY WITH VARYING EFFICIENCIES
This unit on electrical principles and technologies helps students learn how different kinds of systems compare in energy-efficiency ratings.
http://www.edquest.ca/Notes/94-2sia.html

ENERGY PRINCIPLES AND TERMS – LESSON SEQUENCE FOR ENERGY, MACHINES AND MOTION
A helpful one-page schematic fact sheet on energy, batteries, transformations, friction, force, mechanical advantage, machines, motion and work. (U.S. National Academy of Sciences)
http://www.carolina.com/stcms/acrobat/EMM_lesson_sequence.pdf

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS
A 20-part Energy Story, with quick-reference, easy-to-use illustrated explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.
http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 7

Big Ecological Idea #1:

Heat is a form of energy. This energy is becoming more costly both economically and environmentally. To save energy in buildings one needs to check the heating system for inefficiencies and the building for "heat leaks" – and fix them.

a) Efficiency is one of the best forms of energy conservation.

b) In cold northern countries such as Canada, conserving our heat energy is important.

c) There are three ways in which heat can escape from a building: conduction (through walls or windows – which can be reduced by insulation or double-glazing); infiltration of cold air through cracks and holes in the building (cold air leaks in, letting warm air out – this can be reduced by caulking and weather-stripping); and radiation (which can be reduced by the use of an infra-red reflective surface inside the walls and through the installation of windows with an infra-red reflective coating).

d) Understanding the thermal properties of heat and the ways in which systems can be designed for maximum energy savings are important in promoting energy conservation.

(See the Ontario EcoSchools *20/20 Planner*, a program to help students and their families to reduce energy use.)

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Earth and Space Systems: Heat in the Environment (2007)

1.1 assess the social and environmental benefits of technologies that reduce heat loss or transfer *(e.g., … building insulation, green roofs, energy-efficient buildings) Sample guiding questions:* … (b) A well-insulated home is more comfortable and costs less to heat. Reducing heat loss saves energy, and saving energy reduces the environmental impact of energy production. What are some areas of your home where heat might be lost? How can this heat loss be counteracted? What are the benefits of doing so? (c) Green roofs save on heating and cooling costs and reduce the amount of insulation that is needed. But they have not gained wide acceptance in Ontario. What might be some deterrents to having a green roof? How might these deterrents be overcome? (d) Energy-efficient buildings are extremely airtight compared to conventionally constructed buildings. This minimizes the amount of warm (or cool) air that can pass through the structure. What are some of the disadvantages to having airtight buildings (e.g., lack of fresh air, moisture buildup)? How can these problems be solved (e.g., through mechanical ventilation systems with heat recovery and humidity control), and how effective are the solutions?

2.3 use technological problem-solving skills to identify ways to minimize heat loss *Sample problem:* Use the materials provided to create a product that will minimize heat loss

2.4 use scientific inquiry/experimentation skills to investigate heat transfer through conduction, convection, and radiation

Suggested Resource Websites

HEAT AND TEMPERATURE

A comprehensive Grade 7 unit on the importance of the transfer and transformation of heat energy in meeting human needs. A thorough examination of sources and uses of heat energy – and the impact of their use on our long-term ability to meet energy needs. Includes a comparison of heat sources, environmental impacts, positive and negative consequences of energy use, materials and designs that maximize or minimize heat transfers, and ways to use and control thermal energy. Web links are provided on all the principal points covered for a more thorough investigation of individual sub-topics. (Edquest)

http://www.edquest.ca/Notes/7unitc.html

INSULATION - KEEPING IN THE HEAT

How can precious heat be kept in heated areas? Insulation is one very important way to promote energy conservation. This experiment will help students observe the capabilities of insulating materials to conserve heat energy.

http://www.ase.org/educators/lessons/insulate.pdf

COMPARING INSULATION MATERIALS – WHAT MAKES THE BEST INSULATION?

Comparisons are a good way to observe what works best. In this activity students test a variety of materials to compare their insulating properties.

http://www.energyquest.ca.gov/projects/insulation.html

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS

A 20-part Energy Story, with quick-reference, easy-to-use illustrated explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.

http://www.energyquest.ca.gov/story/

ENERGY CONSERVATION – GRADE 8

Big Ecological Idea #1:

Automation has the potential to increase energy efficiency, but environmental impacts must be considered.

a) Factors that contribute to energy efficiency are things such as reducing friction between moving components, reducing the weights of parts by using alternative materials, and using components in devices with lower power demands (e.g., solid state LEDS rather than incandescent bulbs).

b) Some mechanisms and structures have been designed to be more energy efficient (e.g., well-insulated buildings don't lose and waste heat energy; compact fluorescent bulbs as opposed to incandescent bulbs don't give off waste energy as heat; motion-detection light sensors and automatic shut-off devices and timers prevent unnecessary use of energy; co-generation can use heat waste to generate electricity; the Energy Star rating identifies appliances and devices which are energy efficient; good maintenance keeps things running more efficiently).

c) A consistent effort to buy efficient electrical appliances, use appliances only when needed and insulate our homes can save a lot of energy.

d) Saving energy reduces the need to build coal, gas, nuclear and hydroelectric power stations. This in turn reduces the impact of energy consumption on the environment.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Structures and Mechanisms: Systems in action (2007)

1.1 assess the social, economic, and environmental impacts of automating systems *Sample issues:* … (c) The effects of automation can be environmentally disastrous. Serious pollution coincided with the development of factories and the widespread use of coal to run their machinery. Although factories and automation continue to exist, we are more aware of what these systems can do to the environment.

1.2 assess the impact on individuals, society, and the environment of alternative ways of meeting needs that are currently met by existing systems, taking different points of view into consideration *Sample issues:* (a) A large city decides that it will put in more bicycle lanes and bikeways instead of expanding its existing public transit system.

3.1 identify various types of systems

3.2 identify the purpose, inputs, and outputs of various systems

3.3 identify the various processes and components of a system that allow it to perform its function efficiently and safely

3.7 explain ways in which mechanical systems produce heat, and describe ways to make these systems more efficient (e.g., friction produces heat, which can be reduced by lubrication)

3.9 identify social factors that influence the evolution of a system *(e.g., growing concern over the amount of waste creates a need for recycling centres, and the recycling centres must grow as population and waste increase…)*

Suggested Resource Websites

ASSESSING EFFICIENCY FACTORS - MEASURING LIGHT EFFICIENCY

Taking a look at the efficiency of the lights we use at school and at home every day is an interesting way to discover more energy-saving ways to light up our lives. This activity sheet gives students an opportunity to assess the light power and efficiency of different types of light bulbs and compare recorded data. (National Teacher Enhancement Project)
http://www-ed.fnal.gov/ntep/f98/projects/nrel_energy_2/lightinglab.html

DECIDING OUR ENERGY FUTURE - USE ENERGY WISELY: ACTIONS YOU CAN TAKE

Whether we're using energy from fossil fuels or from non-polluting renewable sources, it's important to use it as efficiently as possible for our comfort, convenience and wise use of financial and natural resources. This set of tips from one of the United State's most advanced research organizations for future energy use provides a good basis for discussion by students on ways to save energy. (Rocky Mountain Institute)
http://www.rmi.org/sitepages/pid480.php

THE COSTS OF ENERGY – HOW PRACTICAL IS RENEWABLE ENERGY?

An exercise to help students explore the practical and economic factors involved in the use of different renewable energy sources. Includes the idea of energy efficiency as a renewable resource. Adaptable to inquiry about Ontario energy futures. (BC Hydro)
http://eww.bchydro.bc.ca/education/8-12/8-12_2811.html

Big Ecological Idea #2:

Ecological/environmental factors are increasingly included in manufacturer and consumer decisions.

a) Questions to ask about environmental factors that affect the manufacturing of a product include: What are the government's environmental regulations? What is the cost of complying with them? What is the likelihood of future liability for cleaning up environmental pollution (e.g., toxic chemicals) and compensating individuals whose health may be affected by industrial processes? What is the consumer demand for "green" product features including energy efficiency? Are products made from recycled materials competitive?

b) An increasing number of manufacturers committed to sustainability are attempting to minimize the impact of their businesses on the environment. This "cradle to grave" perspective takes into account the entire life cycle of their products which includes asking how their products will be disposed of. Some of the ways this issue has been addressed have involved modularizing components so that they are reusable and using methods of joining that allow products to be taken apart easily for recycling.

Clustering of Expectations

SCIENCE AND TECHNOLOGY—Understanding Structures and Mechanisms: Systems in action (2007)

1.1 assess the social, economic, and environmental impacts of automating systems *Sample issues:* … (c) The effects of automation can be environmentally disastrous. Serious pollution coincided with the development of factories and the widespread use of coal to run their machinery. Although factories and automation continue to exist, we are more aware of what these systems can do to the environment.

1.2 assess the impact on individuals, society, and the environment of alternative ways of meeting needs that are currently met by existing systems, taking different points of view into consideration *Sample issues:* (a) A large city decides that it will put in more bicycle lanes and bikeways instead of expanding its existing public transit system.

3.1 identify various types of systems

3.2 identify the purpose, inputs, and outputs of various systems

3.9 identify social factors that influence the evolution of a system *(e.g., growing concern over the amount of waste creates a need for recycling centres, and the recycling centres must grow as population and waste increase…)*

Suggested Resource Websites

CONSUMERS: THE BEST FORCE FOR CHANGE

An increasingly important question that affects the manufacturing of a product is "how environmentally sustainable is it"? This site provides a succinct backgrounder for a discussion on ways to become a "green consumer." Based on the premise that "buying choices become the driving force in determining how green markets will be," this sheet provides a good set of points for discussion with Grade 8 students on how their shopping dollars can influence manufacturers in taking more environmentally-friendly directions in their production decisions. See also http://www.thegreenguide.org/goods/shopping.php for a Green Shopping Guide. (Minnesota Twin Cities)

http://www.thegreenguide.org/goods/environmental.php

ENERGY BACKGROUND FOR TEACHERS

From the U.S. Office of Energy Efficiency and Renewable Energy, a quick reference sheet on energy facts, use, conservation, glossary and additional web resources.

http://www.eren.doe.gov/erec/factsheets/savenrgy.html

A QUICK REFERENCE ENERGY RESOURCE FOR TEACHERS

A 20-part Energy Story, with quick-reference, easy-to-use illustrated explanations of energy sources, technologies, alternatives. An excellent basis for class discussion for teachers Grades 1-8.

http://www.energyquest.ca.gov/story/

This guide is an adaptation of the EcoSchools *Energy by Grade Guide (1-8)* produced by the Toronto District School Board (TDSB). The TDSB has donated this resource to the Ontario EcoSchools Program as part of its in-kind contribution to the project.

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