Ontario

ecological
LITERACY
RESOURCE

REVISED
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ENERGY CONSERVATION LEARNING ACTIVITIES

BY GRADE (1-8)

ONTARIO ecoschools

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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.

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

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For more information about adapting this guide, go to www.ontarioecoschools.org.

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Energy Conservation Learning Activities by Grade (1-8)

Big Ecological Ideas for Energy Conservation and Waste Minimization by Grade (1-8)

This table summarizes the Big Ecological Ideas for both *Energy Conservation* and *Waste Minimization Learning Activities by Grade (1-8)* ecological literacy. These offer teachers ideas for integrating the environmental learning expectations within and across strands in the elementary curriculum. To download PDFs of these resources, visit **www.ontarioecoschools.org > curriculum resources > elementary**.

GRADE	WASTE MINIMIZATION – BIG ECOLOGICAL IDEAS	ENERGY CONSERVATION – BIG ECOLOGICAL IDEAS
1	**IDEA 1** Practicing the 3Rs keeps materials useful, reduces waste and helps the environment.	**IDEA 1** We rely on the constant flow of energy from the sun to live. **IDEA 2** Adjusting the devices we use allows us to conserve energy.
2	**IDEA 1** Clean air and clean water are very important for the health of all living things – but we can spoil the air and water through pollution.	**IDEA 1** The sun is the source of wind and water energy. **IDEA 2** People can harness water and wind power to produce electricity that is non-polluting. **IDEA 3** There are significant advantages and challenges to using renewable energy sources such as wind and water energy.
3	**IDEA 1** Waste from a community affects that community's natural environment. **IDEA 2** Early Canadian settler communities had a much smaller impact on the environment than today's consumer society. They used less energy and generated less waste. **IDEA 3** Composting is a way to recycle human food waste and garden waste so it can be used to nourish soil (and save the energy otherwise needed to transport it to landfill).	**IDEA 1** Plants are important not only as food and habitat. They also perform the important "service" of moderating outdoor temperatures. This directly affects the amount of energy we use for heating and cooling!
4	**IDEA 1** Materials used in the production and disposal of things we use have an impact on the environment.	**IDEA 1** The high consumption of energy in North America affects plant and animal habitats and communities.
5	**IDEA 1** The Earth is a closed system in terms of matter. Matter cannot be created or destroyed, it can only be changed from one form to another. Everything we think we have thrown away is still with us in some form or other – there is no "away"! **IDEA 2** Recycling and composting help redirect waste materials to appropriate new uses. **IDEA 3** Choosing household products with care can ensure that their use or disposal does not put toxic ingredients into the environment.	**IDEA 1** The extraction, transportation, and processing of natural resources uses a lot of energy. **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. **IDEA 3** Devices and systems can be designed to minimize energy use and thus reduce our impact on the environment.
6	**IDEA 1** International trade has advantages for people, but comes with harmful environmental impacts.	**IDEA 1** The use of electricity improves our lives, but has many different kinds of impacts on the environment. **IDEA 2** Conserving energy at home and in school reduces negative impacts on the environment.
7	**IDEA 1** In nature, there is no waste. Composting can help us recycle our organic waste the way nature does - and improve the health of the soil. **IDEA 2** Our production and disposal of waste materials (garbage, industrial wastes) affects the balance of local ecosystems by affecting air, water, and land. **IDEA 3** Sustainability means living our lives within the tolerances of the Earth's ecosystems, and avoiding actions that create environmental problems for future generations. **IDEA 4** Sustainable development is development "that meets the needs of the present without compromising the ability of future generations to meet their own needs."	**IDEA 1** Heat is a form of energy. This energy is becoming more costly, both economically and environmentally.
8	**IDEA 1** Informed consumers can have a positive impact on the environment by making wise purchasing choices. **IDEA 2** Our economy and society are dependent upon a healthy environment. This idea can prompt changes to how we think and what we do.	**IDEA 1** Automation has the potential to increase energy efficiency, but environmental impacts of the technology required must be considered. **IDEA 2** Ecological/environmental factors are increasingly included in manufacturer and consumer decisions.

PATHS TO DEVELOPING ECOLOGICAL LITERACY

Improve Student Achievement through Ecological Literacy

Learning In, About, For the environment

Evidence is growing which supports the connection between environment-based education and increased student achievement[1]. Improving student achievement through ecological literacy can be developed in many ways. The Ontario Ministry of Education's policy framework, *Acting today, Shaping tomorrow*, links ecological literacy to environmental education and defines it as "education about the environment, for the environment, and in the environment." Teaching and learning *in, about,* and *for* the environment are powerful means to develop ecological literacy both in and outside of the classroom. (see diagram on pg. 4 for additional strategies).

Inquiry-based learning

Part of developing ecological literacy is using inquiry-based learning to reveal 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 and complexity of life on earth deepens, we can become increasingly literate of ways to live in consideration of the well-being of all life on Earth. Ecological literacy allows us to understand this dependence and interrelatedness, as well as the urgency of developing protective, sustainable, and restorative relationships with the natural systems that are affected by our daily activities.

Systems Thinking

Systems thinking is an approach to learning that encourages students to think in terms of systems, and to recognize the world as an integrated whole with networks that define the way the parts function. One way students can use systems thinking is by *connecting the dots* in their learning, identifying interactions between the human and the natural world. Analyzing these interactions helps students understand some of the *causes and consequences* of human impact on the environment and vice versa. Through this process, students may uncover that the *whole is greater than the sum of its parts,* thereby understanding how complex human and natural system interactions are.

Tools that support systems thinking include:

- Concept mapping: visual representation of ideas where relationships are made explicit through arrows and linking words.
- Consequence mapping: a visual tool for illustrating the many kinds of future effects related to a real or imaginary event, issue problem, or trend.
- Scenario mapping: visual tool to help students show how an activity depends on resources from the Earth and sun.

[1]Glenn, 2000. National Environmental Education and Training Foundation report; Lieberman & Hoody, 1998

Ontario EcoSchools

The Ontario EcoSchools program (www.ontarioecoschools.org) offers many additional program resources that can support student achievement through ecological literacy.

STRATEGIES FOR DEVELOPING ECOLOGICAL LITERACY

	IN the environment	ABOUT the environment	FOR the environment
FOCUS	*Developing a sense of place*	*How nature works in systems. Discovering interdependence*	*Examine human impact and advocate for change*
STRATEGIES	• ORGANIZE out-of-classroom experiences • SCHEDULE routine outings (e.g.,Walking Wed., season walks) • ENGAGE in place-based learning by exploring local community features (natural, built)	• DEVELOP systems thinking (change one part and affect the whole) • ENHANCE curiosity through inquiry-based, hands-on, and critical-thinking learning strategies • EXPLORE the interconnectedness of political, economic, enviro, and social issues	• FOCUS on local issues and actions • FOSTER hope through positive actions • COLLABORATE with interdisciplinary teaching strategies • PROMOTE active citizenship skills throughout student lives

Through teaching and learning *in*, *about*, and *for* the environment and using a systems thinking, we can deepen students' ecological literacy and empower them to become active, engaged citizens of the Earth.

> *"When students are engaged in their learning and social environment, they are better able to develop the skills and knowledge and grasp the opportunities that can help them reach their full potential, pursue lifelong learning, and contribute to a prosperous, cohesive society."*
>
> Ontario Ministry of Education, *Reach Every Student: Energizing Ontario Education* (2008), p. 12

RESOURCE OVERVIEW

How to use this resource

Resource Organization

The resources for each grade have been organized into the sections listed below. Detailed descriptions of how you can use each section follow. Each grade includes:

- **Big Ecological Ideas & Learning Concepts**
- **Clustering of Expectations**
- **Learning Skills & Work Habits**
- **Learning Activities**
- **Resources**

Big Ecological Ideas

This resource offers a grade-by-grade progression of ecological concepts related to energy conservation. This resource models the Ontario Curriculum's Fundamental Concepts and Big Ideas and identifies broad, important understandings that students should retain in the long term. The Learning Concepts that follow the Big Ecological Ideas provide background information for teachers and key learnings for students in each grade. These ideas complement the revised environmental-education-enriched curriculum, helping teachers to incorporate ecological thinking into their teaching.

For example

Big Ecological Idea #2:

Adjusting the devices we use allows us to conserve energy.

LEARNING CONCEPTS

- ***Use it only when we need it:*** Being aware of the energy we use is very important because it allows us to use only what we need.
- ***Turn it off when we don't need it:*** We adjust lights and other electrical devices manually with on and off switches. 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.
- ***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 off computer monitors.
- ***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

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

Each Big Ecological 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 activities and units.

For example

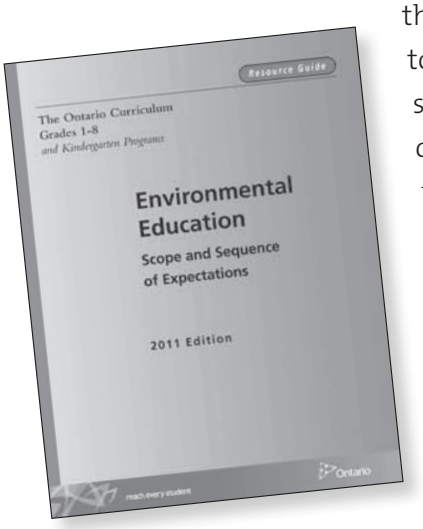
CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 1 curriculum on pages 15-20.*
SCIENCE & TECHNOLOGY: *Understanding Life Systems – Needs & Characteristics of Living Things (2007)*
2.2 investigate and compare the basic needs of humans and other living things, including the need for air, water, food, warmth, and space, using a variety of methods and resources

EE SCOPE & SEQUENCE

Environmental Education: Scope and Sequence of Expectations (2011 Edition) is referenced in each Clustering of Expectations section. It is a resource document compiled by the Ministry of Education to help teachers identify environmental education opportunities in the existing K – 8 curriculum. In the elementary curriculum, the majority of expectations connected to ecological literacy are found in the science and technology, social studies, history, and geography curriculum. In other subject areas, connections can be made to environmental topics and teachers can use the environment as the context for learning in a variety of ways. Some suggestions for using the environment as the context for learning are provided in this document.

www.edu.gov.on.ca/eng/curriculum/elementary/environ18curr.pdf



BROKEN LINK? *Google search* "Ministry of Education, Ontario" → Elementary → Other policies and documents → Environmental Education: Scope and Sequence of Expectations

LEARNING SKILLS & WORK HABITS

Throughout the guide, connections are made between Learning Activities and the Learning Skills & Work Habits of Ontario Report Cards.

OUTDOOR EXPERIENTIAL LEARNING EXTENSIONS

Wherever possible, outdoor learning opportunities are outlined for each grade (identified by the footprint graphic). Outdoor learning can help students develop a sense of place and stewardship by allowing them to explore their regional environment.

Learning Activities

To complement each Big Ecological Idea, Learning Activities have been provided. Each Learning Activity outlines, in a lesson plan format, background facts and topic-specific student engagement activities. The Learning Activities are intended to support environmental classroom learning and are connected to the Ontario curriculum.

For example

LEARNING ACTIVITIES

Source: Adapted from *Energy Output*, Mr. Collinson's Gr. 1 class website, Halton District School Board

ENERGY OUTPUT

This lesson introduces students to the concept of energy outputs and invites students to begin to explore the electrical needs of devices used at home and the sources for that electricity.

Materials

- Toaster, fan
- Copies of handouts

Learning Skills & Work Habits

- Independent work, organization, responsibility

Readiness: Prior Knowledge & Skills

- Energy comes from the sun and things need energy to function.

Teaching/Learning Strategies

1. Gather students to look at a fan and a toaster. Discuss with students what is the source of energy for each appliance. Discuss how each has a different purpose.
2. Discuss the concept of "outputs." When you put energy into something you get an output (e.g., moving air from the fan, or heat from the toaster). What are some other examples of outputs? (TV = pictures on a screen; car = transportation; lamp = light).

Resources

To help teachers find additional information or lesson plan ideas, each Big Ecological Idea lists relevant resources with website links. If a **LINK IS BROKEN**, instructions are provided for how to find the resource via a web search.

For example

Resources

FOOD CHAINS: THE SUN POWERS ALL!

Through acting and singing the students will understand the connections between the components of a food chain and realize that all energy originates with the sun. (Source: Making Connections: Elementary learning activities in, about, and for the environment)

www.ontarioecoschools.org/curriculum_resources/downloads/making_connections.html

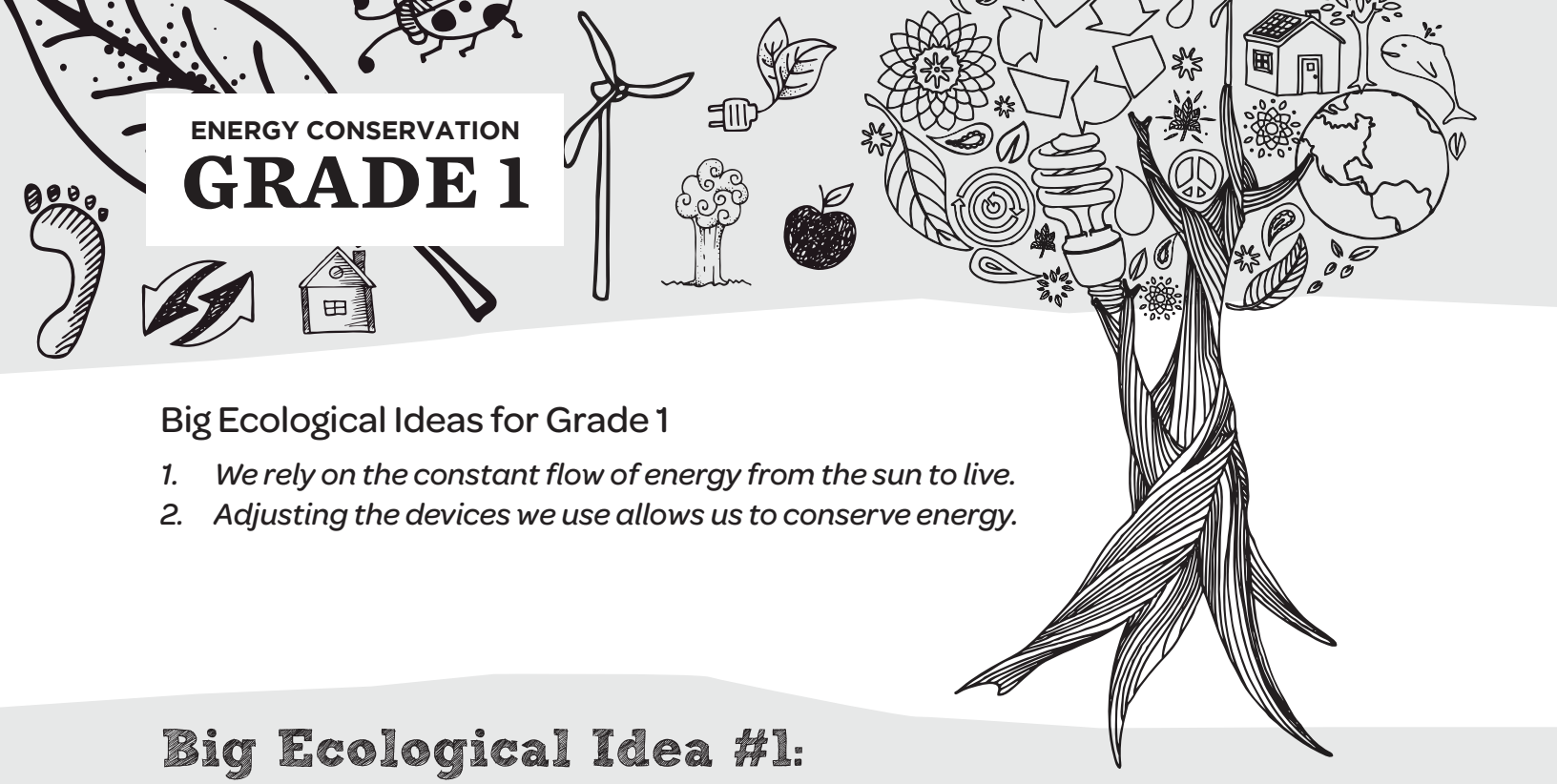
This light bulb identifies helpful resources for each Big Ecological Idea.

BROKEN LINK? *Google search* "Ontario EcoSchools" → Curriculum resources → Making Connections: Elementary learning activities in, about, and for the environment, p. 20

Learning Activities
by Grade (1-8)

ENERGY CONSERVATION

GRADE 1



Big Ecological Ideas for Grade 1

1. *We rely on the constant flow of energy from the sun to live.*
2. *Adjusting the devices we use allows us to conserve energy.*

Big Ecological Idea #1:

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

LEARNING CONCEPTS

- ***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.
- ***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 by eating plants and other animals. Many people in the world use plant energy (e.g., wood) for cooking and to keep warm.
- ***Electrical devices use the sun's energy as well:*** 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 down. 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.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 1 curriculum on pages 15-20.*

SCIENCE & TECHNOLOGY: *Understanding Life Systems – Needs & Characteristics of Living Things (2007)*

2.2 investigate and compare the basic needs of humans and other living things, including the need for air, water, food, warmth, and space, using a variety of methods and resources

SCIENCE & TECHNOLOGY: *Understanding Matter & Energy – Energy in Our Lives (2007)*

1.1 describe their own and their family's uses of energy; 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

2.2 investigate how the sun affects the air, land, and/or water, using a variety of methods and resources

2.4 investigate and compare seasonal differences in the ways we use energy and the types of energy we use

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; by feeling the temperature of dark papers that have been in the sun and in the shade; ...)

2.6 investigate how the sun's energy allows humans to meet their basic needs, including the need for food

3.1 demonstrate an understanding that energy is what makes the things they do or see happen

3.2 demonstrate an understanding that the 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

3.5 demonstrate an understanding that humans get the energy resources they need from the world around them 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 & 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

HEALTH & PHYSICAL EDUCATION: *Living Skills – Critical & Creative Thinking (2010)*

1.5 use a range of critical and creative thinking skills and processes to assist them in making connections, planning and setting goals, analysing and solving problems, making decisions, and evaluating their choices in connection with learning in health and physical education (e.g., Healthy Living: make and explain choices that protect them from the sun, such as wearing a hat and applying sunscreen)

Resources

FOOD CHAINS: THE SUN POWERS ALL!

Through acting and singing, students will understand the connections between the components of a food chain and realize that all energy originates with the sun. (Source: Making Connections: Elementary learning activities in, about, and for the environment, 2012)

www.ontarioecoschools.org/curriculum_resources/downloads/making_connections.html

BROKEN LINK? *Google search* "Ontario EcoSchools" → Curriculum resources → Making Connections: Elementary learning activities in, about, and for the environment, p. 20

Big Ecological Idea #2:

Adjusting the devices we use allows us to conserve energy.

LEARNING CONCEPTS

- ***Use it only when we need it:*** Being aware of the energy we use is very important because it allows us to use only what we need.
- ***Turn it off when we don't need it:*** We adjust lights and other electrical devices manually with on and off switches. Just as we can stop the flow of water running by closing the nozzle, we can stop the flow of electrical energy with a switch, or with the on/off button.
- ***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 off computer monitors.
- ***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

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 1 curriculum on pages 15 – 20.*

SCIENCE & TECHNOLOGY: *Understanding Matter & Energy – Energy in Our Lives (2007)*

1.1 describe their own and their family's uses of energy; 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

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

3.5 demonstrate an understanding that humans get the energy resources they need from the world around them and that the supply of many of these resources is limited so care needs to be taken in how we use them

LEARNING ACTIVITIES

Source: Adapted from *Energy Output*, Mr. Collinson's Gr. 1 class website, Halton District School Board

ENERGY OUTPUT

This lesson introduces students to the concept of energy outputs and invites students to begin to explore the electrical needs of devices used at home and the sources for that electricity.

Materials

- Toaster, fan
- Copies of handouts

Learning Skills & Work Habits

- Independent work, organization, responsibility

Readiness: Prior Knowledge & Skills

- Energy comes from the sun and things need energy to function.

Teaching/Learning Strategies

1. Gather students to look at a fan and a toaster. Discuss with students what is the source of energy for each appliance. Discuss how each has a different purpose.
2. Discuss the concept of "outputs." When you put energy into something you get an output (e.g., moving air from the fan, or heat from the toaster). What are some other examples of outputs? (TV = pictures on a screen; car = transportation; lamp = light).
4. Hand out and complete the "Output Worksheet" (p. 14) and discuss the answers.
5. Hand out the "Energy at Home" pamphlet (p. 15-16). Show students how to fold the piece of paper so it will form the pamphlet. Discuss with students the information that is needed to complete the booklet and that they will be collecting the information at home over the next week. Remind students of the importance of having an adult helper when doing this work.

EXTENSIONS

Have students share their findings from their "Energy at Home" pamphlet. Brainstorm a list of ways to conserve energy at home and in the classroom.

Outdoor experiential learning extension

Have students go outside and find energy inputs and energy outputs. Have students share their findings and discuss how plants and animals capture energy to survive.

Energy Inputs and Outputs

1. Draw lines to connect the energy inputs to where the energy is used.
2. Draw lines to connect where the energy is used to the energy outputs.

Energy Inputs

Energy Outputs

LIGHT

HEAT

MOVEMENT

SOUND

MOVEMENT

Saving Energy

After looking at all of the things that use energy in your home, the next step is to try to save energy. Saving energy helps our environment, so let's see what you can do!

What type of energy do you think your family can save?

_____

_____

How will you try to save energy at home?

_____

_____

Draw a picture of how you can save energy at home.

Energy at Home

Name: _____

Some words you may find helpful:

electricity	*sun*	*furnace*
solar	*light switch*	*faucet*
wind	*wires*	*water tank*
water	*outlet*	*lights*

Energy Sources

Ask an adult if they can show you where the following things are in your home. Then fill in the information.

My furnace is located _____

My hot water tank is located _____

Electricity comes into my home from _____

Gas comes into my home from _____

Draw a picture of one of the things mentioned above.

Energy at Home

Some words you may find helpful:
Electricity, solar, wind, water, sun, wires, furnace, water tank, light switch, outlet, faucet, lights

Using Energy
For each of the things listed below, count how many you have in your home. Ask an adult if you need help.

☐ Lights	☐ Appliances	☐ Faucets
☐ TVs	☐ Cars	☐ Windows
☐ Computers	☐ Furnace vents	

How many things in your home use gas? ☐

How many things in your home use electricity? ☐
(you will probably have to guess)

How many things in your home use sun energy? ☐
(hint: all energy comes from the sun)

Do you have a fireplace? If so, what does it use? ☐

Draw a picture of something in your home that uses energy.

ENERGY CONSERVATION

GRADE 2

Big Ecological Ideas for Grade 2

1. *The sun is the source of wind and water energy.*
2. *People can harness water and wind power to produce electricity that is non-polluting.*
3. *There are significant advantages and challenges to using renewable energy sources such as wind and water energy.*

Big Ecological Idea #1:

The sun is the source of wind and water energy.

LEARNING CONCEPTS

- ***The sun gives its energy to air and water:*** Energy from wind and air can be used to generate electricity, which is used by humans.
- ***Wind:*** The sun heats the earth's surface unevenly, creating air currents that make the wind blow.
- ***Water:*** The sun's heat makes water on the earth evaporate into the air. Evaporated water forms into clouds and falls as rain, some of which makes rivers flow.
- ***Niagara Falls is an excellent example of hydroelectric power*** (flowing water used to produce electricity). 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

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 2 curriculum on pages 21 - 27.*

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

2.2 investigate, through experimentation, the characteristics of air and its uses

2.3 investigate, through experimentation, the characteristics of water uses

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

2.5 investigate water in the natural environment (e.g., observe and measure precipitation; observe and record cloud formations; observe water flow and describe where it goes; observe a puddle over time and record observations)

3.3 describe ways in which living things, including humans, depend on air and water

3.5 identify the three states of water in the environment, give examples of each and show how they fit into the water cycle when the temperature of the surrounding environment changes

DRAMA: *Creating and Presenting (2009)*

B1.2 demonstrate an understanding of the element of role by communicating thoughts, feelings, and perspectives appropriate to the role being played. Teacher prompts: "How would you change your gestures and movement if you were portraying wind or water as a character from the story?"

Resources

EVAPORATION: HOW FAST?

In this science experiment, students explore the effect of the sun's energy on water through guided inquiry. (Source: Stanford Solar Center)

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

BROKEN LINK? *Google search* "Stanford Solar Center" → For Educators → 2. Effects of the Sun on our Planet → Plant Growth and Evaporation

LET'S GO FLY A KITE

This resource shares instructions and info for an excellent day of kite construction and flying. The sun's energy makes the wind blow. This web page contains complete time tested instructions to get kids making their own kites. Kites allow children (and adults!) to feel the energy of the wind and capture it with a device.

www.aka.kite.org/docs/Handbooks/kitc.pdf

BROKEN LINK? *Google search* "American Kite Association" → Resources → Educational Resources → Lesson Plans → Kites in the Classroom (PDF)

Big Ecological Idea #2:

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

LEARNING CONCEPTS

- ***Capturing energy in wheels:*** The power of wind and 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 to produce electricity.
- ***Ontario's power:*** In Ontario in 2011, almost one-third of our electricity came from the power of water (hydroelectricity) (Source: Ontario Power Generation).
- ***Wind power:*** Canada is also beginning to use wind power for electricity – in Ontario, wind turbines generate almost 600 MW (megawatts) of power, or enough energy to meet the needs of the city of Brampton (Independent Electricity System Operator, 2011).

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 2 curriculum on pages 21 - 27.*

SCIENCE & TECHNOLOGY: *Understanding Earth & Space Systems: Air & Water in the Environment*

2.2 investigate, through experimentation, the characteristics of air and its uses

2.3 investigate, through experimentation, the characteristics of water uses

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

SCIENCE & TECHNOLOGY: *Understanding Structures & Mechanisms: Movement (2007)*

1.0 assess the impact on society and the environment of simple machines and mechanisms

1.1 assess the impact on society and the environment of simple machines that allow movement

LEARNING ACTIVITIES

Source: Adapted from *Who Has Seen the Wind?*, Teacher's Corner Lesson Plans, Evergreen (www.evergreen.ca)

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 (Source: Teacher's Corner Lesson Plans, Evergreen).

Time Allotment

Preparation time: 30 minutes

Length of lesson: 45 minutes

Materials

- construction paper
- crayons
- markers
- paint
- pin

Learning Skills & Work Habits

- Initiative

Teaching/Learning Strategies

Activity: Making the Pinwheel

1. To make pinwheels, precut the construction paper into 5-inch (13-centimetre) squares.
2. Hand the paper squares out to the students and have them colour and decorate them as they like.
3. Using a ruler, draw lines connecting opposite corners of the square to create an 'x' on the square.
4. Trace a nickel or a button to create a small circle in the centre of the square.
5. Carefully cut to, but not through, the centre circle.
6. Curl the corners into the center; do not crease the triangular sections.
7. Secure the pinwheel corners to the eraser of an unsharpened pencil by pushing a pin or thumbtack through the four folded corners, through the centre circle of the pinwheel, and into the pencil eraser.

Activity: Outdoor Pinwheel Experiment

1. On a windy day, take the students outside and experiment with various objects (leaves, stones) to see if they can be blown about by the wind.
2. Discuss why the wind moves some things and not others (shape, weight, material).
3. Observe the weight of the objects and the strength of the wind.
4. Let the students compare pairs of objects, such as a leaf and a tree, petals and flowers, sand and mud, low and high grasses, and water and ice.
5. Have the students hold their pinwheels and observe how they are moved by the wind.
6. Move to a sheltered area and observe the differences in the pinwheels' movements.
7. Have the students mark one of the four parts of the pinwheel and record how many times it rotates in a designated amount of time. Do this for both the windy and the sheltered areas and observe any differences.

Discussion and Questions

- Discuss with the students how wind energy can be harvested by bigger windmills and how this can be used to produce electrical energy.

Credits

Thanks to the Waterloo Region District School Board Outdoor Education Staff.

EXTENSIONS

FOR ADDITIONAL CLASSROOM PROJECTS/ACTIVITIES

Discuss the impact of wind upon the trees in the school ground. How can we tell which direction the prevailing winds are from?

Resources

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

This simple experiment uses a milk carton to demonstrate 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. (Source: Energy Quest)

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

BROKEN LINK? *Google search* "Energy Quest Projects" → Science Projects → Hydro Power/ Water Energy Projects → Hydro Power

Big Ecological Idea #3:

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

LEARNING CONCEPTS

- ***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 non-renewable resources such as fossil fuels (e.g., coal, oil, gasoline). This is because they do not create as much pollution.
- ***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).
- ***We cannot replace non-renewable resources:*** 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 moving cars, planes, trains, and ships). But they also pollute the air and release gases into the atmosphere that cause the Earth to become warmer (greenhouse gases causing climate change).
- ***It is difficult to capture renewable energy:*** A disadvantage to using some of the renewable forms of energy (e.g., wind, solar) is that they are less concentrated than fossil fuels. Many devices (e.g., windmills, solar panels) are required to capture their energy, and they are only available when it is windy or sunny. These renewable forms of energy also need to be transformed into other forms for storage (e.g., batteries). So although they are non-polluting, they are less efficient to use than fossil fuels. Ongoing research and development is increasing the efficiency and affordability of renewable forms of energy.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 2 curriculum on pages 21 - 27.*

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

2.2 investigate, through experimentation, the characteristics of air and its uses

2.3 investigate, through experimentation, the characteristics of water uses

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

Resources

ENERGY QUEST. 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 that allow water to do work: a turbine (used to run a generator that makes electricity) and an overshot waterwheel (used in the past to grind grain and run machines). (Source: Energy Quest)
www.energyquest.ca.gov/projects/waterenergy.html

BROKEN LINK? *Google search* "Energy Quest Projects" → Science Projects → Hydro Power/Water Energy Projects: Using Water to Produce Energy

20/20 PLANNER TO CLEAN AIR.

Lesson 6: Here today, gone tomorrow - renewable and non-renewable energy, p. 27.
www.ontarioecoschools.org/curriculum_resources/downloads/20_20_In_Class_Lessons_2009.pdf

BROKEN LINK? *Google search* "Ontario EcoSchools" → Curriculum resources → 20/20 Planner to Clean Air, p. 27

MEASURING THE FORCE OF WIND BY 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 how the wind can produce energy for people's use. (Source: Energy Quest)
www.energyquest.ca.gov/projects/anemometer.html

BROKEN LINK? *Google search* "Energy Quest Projects" → Science Projects → Wind Energy Project: Making an Anemometer

ENERGY CONSERVATION

GRADE 3

Big Ecological Idea #1:

Plants are important not only as food and habitat. They also perform the important "service" of moderating outdoor temperatures. This directly affects the amount of energy we use for heating and cooling!

LEARNING CONCEPTS

- ***Plants as habitat:*** Plants are important to other plants and animals as habitat - places where they can find food and shelter.
- By providing shade and moisture, plants, particularly trees, play an important role in ***moderating temperatures during warm seasons***. A cooler, shaded building reduces the need for air conditioning - a significant energy savings.
- ***In winter, trees act as windbreaks***, sheltering both animals and human habitations. By reducing wind speed, they can help reduce heat loss and the heating energy needed.
- 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 higher than in the surrounding areas. Trees lower temperatures by transpiring moisture into the air, making the area feel cooler.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 3 curriculum on pages 28 - 34.*

SCIENCE & TECHNOLOGY: *Understanding Life Systems - Growth & 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, 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.

2 investigate similarities and differences in the characteristics of various plants, and ways in which the characteristics of plants relate to the environment in which they grow

2.4 investigate ways in which a variety of plants adapt and/or react to their environment, including changes in their environment, using a variety of methods

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

SCIENCE & TECHNOLOGY: *Understanding Matter and Energy – Forces Causing Movement (2007)*

1.1 assess the effects of the action of forces in nature (natural phenomena) on the natural and built environment, and identify ways in which human activities can reduce or enhance this impact

LEARNING ACTIVITIES

Source: Adapted from Plants Help Keep a House Cool, GECDSB. For additional EcoSchools-related curriculum ideas, visit www.gecdsb.on.ca/staff/teachers/ecoSchools/Curriculum/index.asp.

PLANTS HELP KEEP A HOUSE COOL

This experiment is best completed by a large group and done in three steps. First you will discover if shading your "house" will keep it cooler. Second, you will discover if painting the outside of your "house" different colours affects the temperature inside. Third, you can decide whether or not to shade the coloured houses.

Readiness: Prior Knowledge & Skills

This learning event is best suited to occur after some prior learning about plants has occurred. Students should be able to identify the major parts of plants and understand some of the most basic ways in which humans use plants for food, shelter, and clothing. This learning event may be used as an effective culminating activity at the end of a unit on Growth and Changes in Plants.

Time Allotment

The activity is best completed as three separate learning events. You may choose to complete one activity each day over three days.

Materials

- Two shoeboxes or small cardboard boxes
- A reflector lamp with a 100 watt incandescent light bulb (you can also use a reading lamp or another light source; using sunlight will also work)
- Various types of potted plants (a small bonsai tree would work well)
- Two good thermometers to measure air temperature. Optional: A digital thermometer that measures inside temperature, with an external sensor to measure outside temperature, would work well.
- Stopwatch (a watch with a second hand will also work well)
- Black or dark-coloured liquid tempera paint (or black construction paper)
- White liquid tempera paint (or white construction paper)

Teaching/Learning Strategies

DAY ONE

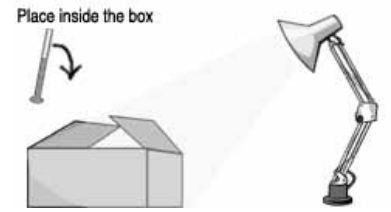
1. Have students review procedure and record predictions in chart provided.
   - Investigation: *Which box (house) will have the lower temperature inside – the house with plants outside or the house without plants? Why?*

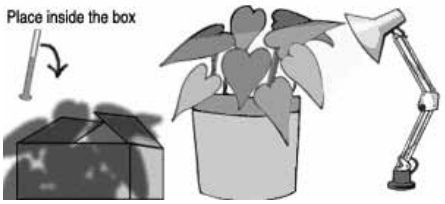
THE PROCEDURE

Hypothesis (my guess): Have students write down their hypothesis for the first experiment.

Procedure (what we did):

1. Take two boxes and place them an equal distance from the lamp so that the same amount of light hits both of them.
2. Put the thermometers inside the boxes.
3. Place plants between the lamp and one of the boxes so that the shadows cast by the plants cover most of the box (house).
4. Turn on the lamp.
5. Measure the air temperature in each box at 1 minute, 3 minutes, and 5 minutes. Record your findings in a chart.





DAY ONE: HYPOTHESIS (MY GUESS):			
HOUSE IN LIGHT AND HOUSE SHADED BY PLANT			OBSERVATIONS (WHAT WE SAW)
Time	Temperature in plain house	Temperature in shaded house	
1 minute			
3 minutes			
5 minutes			
DAY TWO: HYPOTHESIS (MY GUESS):			
HOUSE PAINTED BLACK AND HOUSE PAINTED WHITE			OBSERVATIONS (WHAT WE SAW)
Time	Temperature in black house	Temperature in white house	
1 minute			
3 minutes			
5 minutes			
DAY THREE: HYPOTHESIS (MY GUESS):			
BLACK HOUSE SHADED AND WHITE HOUSE SHADED			OBSERVATIONS (WHAT WE SAW)
Time	Temperature in shaded black house	Temperature in shaded white house	
1 minute			
3 minutes			
5 minutes			

2. Discuss your findings. Students can record their conclusions.

DAY TWO

1. Repeat the experiment. Have students hypothesize what will happen and write down their predictions in the chart provided. Use the procedure from day one and have students record their observations.
   - *Which box (house) will have a lower temperature inside – the black house or the white house? Why?*
2. Follow the procedure from day one and make this change: paint one of the boxes white and the other black. You may also cover the boxes with the appropriate colour of construction paper. Remove the plant so that both boxes are in full light.
3. Discuss your findings. Students can record their conclusions.

DAY THREE

1. Repeat the experiment. Have students hypothesize what will happen. Using the procedure from day one, have students review the procedure, and record observations in their chart.
   - *Which box will have a lower temperature inside – the dark house with plants outside or the white house with plants outside? Why?*
2. Follow the procedure from day one, but place a plant in front of the black house. Repeat the experiment using the white house.

Outdoor experiential learning extension

Conduct a similar experiment outside on a bright sunny day. Have students experiment comparing environments: shade or sun, cement or grass, dark area or light. Discuss their findings and identify commonalities.

Resources

USING PLANTS TO SAVE ENERGY

This lesson gives students the chance to explore the concept of how green space helps control temperatures. In winter, green materials help naturally warm areas and therefore less energy is needed. In the summer, green material helps shade and cool areas, also helping to conserve energy. Energy conservation leads to less use of fossil fuels. This is one of the environmental benefits of green space and landscaping. (Source: Discovery Education)
http://turfmutt.discoveryeducation.com/misc/downloads/lesson-two.pdf

BROKEN LINK? *Google search* "TurfMutt Discovery Education" → Educators → Using Plants to Save Energy

PLANTS PROVIDE VITAL ECOSYSTEM SERVICES

This resource is a good 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! (Source: Cary Institute of Ecosystem Studies)
www.ecostudies.org/images/education/cosystem_explorations/PrimaryProducersBR.pdf

ENERGY CONSERVATION

GRADE 4

Big Ecological Idea #1:

The high consumption of energy in North America affects plant and animal habitats and communities.

LEARNING CONCEPTS

- ***Plants and animals depend on their habitats*** and communities for food and shelter.
- ***Humans use different forms of energy*** in their lives, for transportation, manufacturing, and comfort and convenience in their homes, schools, and offices.
- Our production and ***use of energy affects natural communities of plants and animals*** by disturbing their habitat through mining for minerals, and building pipelines, dams (flooding large areas), roads, hydro corridors, and power plants.
- ***Reduce energy use to reduce impact:*** 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.
- ***Impact of choices:*** Exploring the ways in which energy production affects habitats can help remind us of the importance of making wise energy choices.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 4 curriculum on pages 35 – 39.*

SCIENCE & TECHNOLOGY: *Understanding Life Systems — Habitats & 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, evaluate the impacts on the natural community, and propose possible actions for preventing such depletions/extinctions

2.3 use scientific inquiry/research skills to investigate ways in which plants and animals 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; describe/record changes 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 & TECHNOLOGY: *Understanding Earth and Space Systems - Rocks and Minerals (2007)*

1.1 assess the social and environmental costs/benefits of using objects in the built environment that are made from rocks and minerals. Sample issue: 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)*

LEARNING ACTIVITIES

Source: Adapted from: *Shrinking Habitat - Share the Space*, Canada's Forests Teaching Kit Series, Canadian Forestry Association. Visit www.canadianforestry.com for more resources.

Shrinking Habitat – Share the Space

An interactive activity in which students physically map out a diverse forested area in their classroom, then slowly reduce the space to simulate a loss of habitat and the impact this has on various species. Teachers can help students consider ecological impacts from human energy needs.

Learning Skills & Work Habits

- Collaboration, initiative

Background Information

This lesson includes a brief story about a community that has to make a decision about development versus conservation. Please select a species that lives in the forests of your province or territory. You will use that species in Step 3 of the learning activity, and also in the short story. You can refer to the Canadian Biodiversity website (http://canadianbiodiversity.mcgill.ca/english/index.htm) to find species in your region (click on Canada's Ecozones for species in your region).

Habitat supports the food, water, shelter, and space essential for the survival of all living species. And every species – plants, humans, fishes, you name it – has its own specialized habitat, or ecological niche. There are biotic (living) and abiotic (non-living) elements within an ecosystem.

Often species can share habitat. Owls and hawks can both live in a woodland or forested area and hunt the same kinds of prey (moles, voles, mice, etc.) The owl hunts at night, the hawk hunts in the morning – so they can survive in the same setting.

In Canada, forests provide habitat for many species. When we consider a forest habitat, we need to look beyond the trees. It's not just the trees that make a forest diverse: it is the soils, water, mosses, beetles, shrubs, birds, squirrels, hawks...*it's everything!*

Habitat constantly undergoes change. Sometimes change revitalizes habitat, making it even more productive, and sometimes it is degraded. While this can be the result of catastrophic natural events – such as wildfire, flooding, drought, hurricanes or ice storms – it is often due to human impacts. Urban and suburban developments eat up large tracts of land, large-scale agricultural practices remove forests, wetlands and fields from the natural setting, and invasive species can push out original inhabitants. About 80% of species that are designated at risk by COSEWIC are affected by habitat loss or degradation.

Teaching/Learning Strategies

1. ***Start with a brief introduction to the vast variety of life in forest ecosystems***. Ask your students to think about a forest near them and describe its ecosystem – the things found in the forest – and list them on the board. Remind them that forests are made up of trees, shrubs, ferns, soils, water, insects, mammals, birds, slugs, mushrooms, ants, and many more species that we cannot even see with the human eye.

   Note: You might want to break the class into small groups and ask each to produce a list of things that make up a forest, and then produce a class list at the end. You should also include abiotic things like rocks, logs, minerals, etc., which provide important resources for living organisms.

2. ***Ask your students what they think might happen when part of a forest ecosystem is removed.*** For example, if the trees were removed, what would happen to the plants and animals living in the forest? This would increase the light penetration onto the forest floor, radically altering the air and soil temperature, soil moisture, runoff, and erosion. It would remove wildlife shelter and result in the loss of habitat for a significant number of species. Some species might move to a bordering area if their habitat is altered or lost. Other species might begin to colonize this new disturbed area. Ask your students what they think might happen to the mammals, insects, soils, and water?

3. ***Explain to students that you are going to turn the classroom into a forest community*** so that they can explore the effects of the loss of a forest habitat on the species living there. Use pieces of construction paper or cardboard to create signs listing some of the things they identified earlier as part of a forest ecosystem, such as tree, shrub, fern, mole, mouse, coyote and other wildlife species and abiotic features. Tape the signs onto desks and tables around the classroom, where they most expect these species to live. Move these signs around the room to better represent a forest filled with a variety of trees, plants, soils, waterways and wetlands, and other ecosystem components. Then ask the students to decide what role they wish to play in this forest ecosystem. They need to select their species and then determine where that species would most likely live. They can choose to be a plant or an animal, but it must be something that would live in that particular forest community.

4. ***Next, have students select a location in the classroom that they believe would provide ideal habitat for their species.*** If they choose to live near the window, that means more sunlight to help them grow (a young seedling or shade-intolerant tree, such as poplar or aspen) or gain body heat (a snake). If they choose to live under the desk, they might need shade that the forest canopy provides (shade-tolerant seedlings such as sugar maple or red oak), or cover (deer, mice, and other prey species need cover to hide from their predators).
5. ***Once all students have settled into their habitat, read the short story on the following page aloud to them.***
6. ***At the conclusion of the story, ask the students what they think the community should do.*** Generate a few ideas, write those ideas on the board, and then proceed with the rest of the activity.

   Let the students know that your classroom is the community you read about! You will be the community planner, and you have decided to remove one-third of the trees and to dam one-third of the river to allow for the growth of the community. Draw an imaginary line in the room to simulate the removal of trees and consequently, the loss of habitat.

   Ask each student/species what has happened to their habitat, and what they will do in order to survive. You can ask them questions such as:
   - Do you have enough habitat remaining to survive?
   - Can you move to a new habitat?
   - Are you going to have trouble finding food?
   - Will you now be more easily caught by a predator?
   - Have you lost your nesting or birthing area for your young?
   - Has your drinking water supply been lost or damaged?
   - Do you think you could become a species at risk?
   - What happens to all of the people who can't find housing in the community?
   - How does the community continue to provide all the things that make people happy (e.g., soccer pitches, hockey arenas, etc.)?
   - What do you believe would happen if more habitat were removed (e.g., half of the remaining forest ecosystem)?
7. ***Ask each student to graphically represent what happened to their species*** (cartoon, graph, mural, poster), showing the effects of habitat loss – before, during, and after.

EXTENSION

Ask students to write their own story of habitat loss from the perspective of their species.

Outdoor experiential learning extension

Go outside to the schoolyard or local park and identify the plants and animals that inhabit the area. Ask students to think about who would visit the area at night. Make a list and use it during the creation of the forest ecosystem in the classroom.

ONCE UPON A TIME, THERE WAS A COMMUNITY IN

[name your province or territory].

This community was an active, growing community with a vital population of young people and adults. There were plenty of soccer pitches and baseball diamonds, a hockey arena, curling club, and all the things that make people happy.

The community was growing! As its numbers grew, so did the need for more places to live and a place to generate energy for the homes. Soon, there was not enough living space for all the people who wanted to live in the community. So, the community leaders proposed to expand and build a new housing development and to develop a hydroelectric dam to produce energy for the community.

The community was surrounded by lovely woodlands with a river; however, to satisfy the demand for additional housing, community planners had to clear out one-third of the forest and dam one-third of the river for energy. Many wildlife species used the woodland for their habitat, including red oak, sugar maple, white and red pine, ferns, mosses, red squirrels, rabbits, hawks, wood ducks, woodpeckers, owls, small birds, mice, coyotes, porcupines, raccoons, deer, and many others.

A meeting was called in the community centre so that everyone interested in the development could present their opinion. The developer and some of the community leaders felt that it was a good idea because it would provide more housing and energy and also generate more tax dollars for community improvements. Ecologists and conservationists were concerned about the loss of green space and the potential impact on wildlife and their habitat. What steps should be taken to make the right decisions about the development and conservation issues, and how will the community meet its growing demand for housing?

Resources

BILL NYE THE SCIENCE GUY - EPISODE ON ENERGY AND ELECTRICITY

Bill Nye shows students that energy makes things happen, and you can find it almost everywhere. A moving car, falling water, light, sounds, and chemicals all have energy.

www.billnye.com/for-kids-teachers/episode-details/

ENERGY CONSERVATION

GRADE 5

Big Ecological Ideas for Grade 5

1. *The extraction, transportation and processing of natural resources uses a lot of energy.*
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.*
3. *Devices and systems can be designed to minimize energy use and thus reduce our impact on the environment.*

Big Ecological Idea #1:

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

LEARNING CONCEPTS

- ***Energy used for natural resources:*** A great deal of energy is used to extract, transport and process natural resources. About 18% of Canada's power comes from greenhouse gas and pollution emitting fossil fuels. The more natural resources we use, the greater our impact on the environment. (CBC, *Canada's Earth Day Assessment,* 2011)
- ***Choices to minimize impact:*** 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 and how much we buy.
- ***Less things = less energy used:*** The amount of energy we use can be reduced further by minimizing the amount of materials needed to make the things we buy (e.g., a laptop computer uses fewer materials in its manufacture than a desktop computer).
- ***3Rs to save energy:*** Reducing the things we need, reusing the things we have, and recycling materials (aluminum, steel, glass) saves natural resources and energy, and reduces pollution.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 5 curriculum on pages 40 – 44.*

SCIENCE & TECHNOLOGY: *Understanding Earth & Space Systems - Conservation of Energy & Resources*

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

2.2 use scientific inquiry/research skills to investigate issues related to energy and resource conservation

3.2 identify renewable and non-renewable sources of energy

SCIENCE & TECHNOLOGY: *Understanding Matter & Energy - Properties of & Changes in Matter (2007)*

1.1 evaluate the environmental impacts of processes that change one product into another product through physical or chemical changes

1.2 assess the social and environmental impact of using processes that rely on chemical changes to produce consumer products, taking different perspectives into account and make a case for maintaining the current level of use of the product or for reducing it

SOCIAL STUDIES: *Heritage & Citizenship – Early Civilizations*

- identify and compare the ways in which people in various early civilizations met their physical and social needs, including how they interacted with and used the natural environment

Resources

BIRDSEED MINING

Mining is a complex process in which relatively small amounts of valuable or useful minerals or metals (e.g., gold or coal) are extracted from very large masses of rock. This activity will illustrate how this needle-in-a-haystack process works. Students will be able to experience hands-on the difficulty that miners face in locating valuable mineral deposits.

www.enviroliteracy.org/article.php/1199.php

BROKEN LINK? *Google search* "Birdseed Mining Activity"

EXTENSION – PRECIOUS MINING

After completing the birdseed mining activity, students will graphically represent the relative values of each metal compared to the amount of waste created in a bar graph, construct meaning from their results by drawing logical conclusions, and present their results to their classmates. Through discussion and reflection, assess the usefulness of these minerals to humans as opposed to the costs of extraction. (Source: EcoKids, Earth Day Canada)

www.ecokids.ca/pub/teachers/resources/lesson_plans/metal_mining/precious_metal_mining.pdf

BROKEN LINK? *Google search* "EcoKids.ca" → Login/Sign-up (for free access to resources) → Grade 4: Math and Science → Precious Metal Mining

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.

LEARNING CONCEPTS

- ***Energy Star program helps make wise choices:*** Energy is used most sustainably when we choose the least polluting form of energy production available, and 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 designed to identify and promote energy efficient products to help reduce greenhouse gas emissions. This program has made it easier for consumers to identify more sustainable choices when purchasing products.
- ***Burning non-renewable fossil fuels contributes to climate change:*** Coal, oil, and natural gas give 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.
- ***Renewable resources*** can be defined as those that are consumed at or below the rate at which they are created.
- ***Impact of renewable sources of energy:*** 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.
  - Wind: The same is true of wind turbines – they also require energy to produce, but do not emit greenhouse gases when operating.
  - Biomass: The burning of wood and biomass (plant fuel) releases carbon dioxide into the air.
  - Hydro: 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.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 5 curriculum on pages 40 – 44.*

SCIENCE & TECHNOLOGY: *Understanding Earth & Space Systems - Conservation of Energy & Resources*

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 evaluate the effects of various technologies on energy consumption

3.1 identify a variety of forms of energy

3.2 identify renewable and non-renewable sources of energy

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

LEARNING ACTIVITIES

Source: Adapted from *Is it Renewable or Non-Renewable Energy?*, Earth Day Canada's EcoKids Program.
For additional free resources, visit www.ecokids.ca or www.earthday.ca

IS IT RENEWABLE OR NON-RENEWABLE ENERGY?

Students work individually, with a partner, and in small cooperative learning groups to understand a variety of energy forms. They learn to identify renewable sources of energy by playing the Energy Trivia game and, as a culminating task, they play the Sunlight Rays and Pipelines game (based on Snakes and Ladders).

Time Allotment

115 minutes total

- 40 minutes: Activation – Prior Knowledge
- 40 minutes: Enhancing Activity (Hook – Energy Trivia game)
- 35 minutes: Culminating Activity (Sunlight Rays and Pipeline game)

Learning Skills & Work Habits

- Collaboration, self-regulation, responsibility

Teaching/Learning Strategies

Activation - Is it Renewable or Non-renewable Energy? (40 minutes)

Activate Prior Knowledge: Whole Class Discussion

1. Ask students to define what energy is. Record responses on chart paper or on a white board.
2. Ask students to give examples from everyday life of how that energy is used. Record responses.
3. Introduce the topic of renewable energy. Define the word renewable and record the suggestions given.
4. Think-pair-share. Have students identify various renewable energy sources and how they are used, share with a partner, and record their responses.
5. Depending on responses, discuss different renewable energy sources, such as solar, wind, geothermal, biomass, tidal, wave, and hydro power. The discussion can be very brief.
6. Introduce the topic of non-renewable energy. Think-pair-share. Have students brainstorm the definitions of renewable and non-renewable energy. Record responses on chart paper or on a white board.
7. Lists sources of energy (coal, hydro, nuclear, tidal, wind, solar, petroleum [fossil fuels], biomass, geothermal, oil, natural gas) and ask students to place them under the headings "renewable" and "non-renewable." Have students compare notes with a partner. Take up the answers with the class.

Enhancing Activity: Energy Trivia Game (40 minutes)

- Divide students into small cooperative learning groups of five or six students to play the Energy Trivia game. These groups will make up the teams.

Energy Trivia Game (can be conducted outside):

1. One student from each team plays one round of the Energy Trivia game. The rest of the team members wait in line or at their desks, and are challenged to answer the questions for themselves. A new team member comes to the front to answer each round/question.
2. Students stand behind a taped line on the floor or asphalt. Lined up across from them are six plastic buckets with the following labels (see p. 38):
   - Ocean (tidal & wave) energy
   - Solar energy
   - Geothermal energy
   - Hydro power energy
   - Wind energy
   - Biomass energy
3. Each player is given a numbered tennis ball that represents their team.
4. Students hold their tennis ball in their hand and listen to the trivia question being read. Either the teacher or selected students can read the questions. Make sure that you indicate to the class that they can't throw their tennis ball until the entire question has been read.
5. When students know the answer, they throw their tennis ball into the correct bucket. Students who have the correct answer and successfully throw the ball so it remains inside the bucket earn a point for their team.
6. Once a question has been answered, the next student gets up to play. Encourage students to stay positive and be supportive of team members. You can award points for best team spirit.
7. Remind students that if they step over the line or throw the tennis ball before the entire question is read, they will be disqualified.
8. Also, to make the game flow better and eliminate cheating, have one or two students be the scorekeepers. Their responsibility is to identify which numbered balls land in the correct buckets and make sure students remain behind the taped line.
9. To consolidate learning, have students prepare a chart with the following column headings: Type of renewable energy; One thing I learned about this type of energy; One thing I would like to know more about.

Outdoor experiential learning extension

1. Students will line up facing each other 1-2 metres apart (like in a game of British Bulldog). One line will be the True team; the other will be the False team.
2. A statement is read aloud, for example, "Ice cream is made out of potatoes." If the statement is false, the False team runs to tag the True team before the True team reaches the safety line.
   (10-15 metres away). If the True team members are tagged, they join the False team for the following round. If the statement is True, the opposite happens. Play the game until all of the statements have been read.
3. At the end of each round, the two teams line up facing each other again to hear the next statement.

TIP Mark the safety line with pylons. Explain that students only need to tap the shoulder of another student to tag them and that they will be disqualified for rough play. If you notice that one team getting really large, try to ask a few questions that allow the other team to tag them to balance the lines.

Culminating Activity: Sunlight Rays and Pipelines (Snakes and Ladders) (35 minutes)

1. Students work in a small groups of five or six to play the Sunlight Rays and Pipelines game, which is similar to Snakes and Ladders.
2. Each group is given a game board, a task card containing the rules of the game, and a deck of trivia cards.

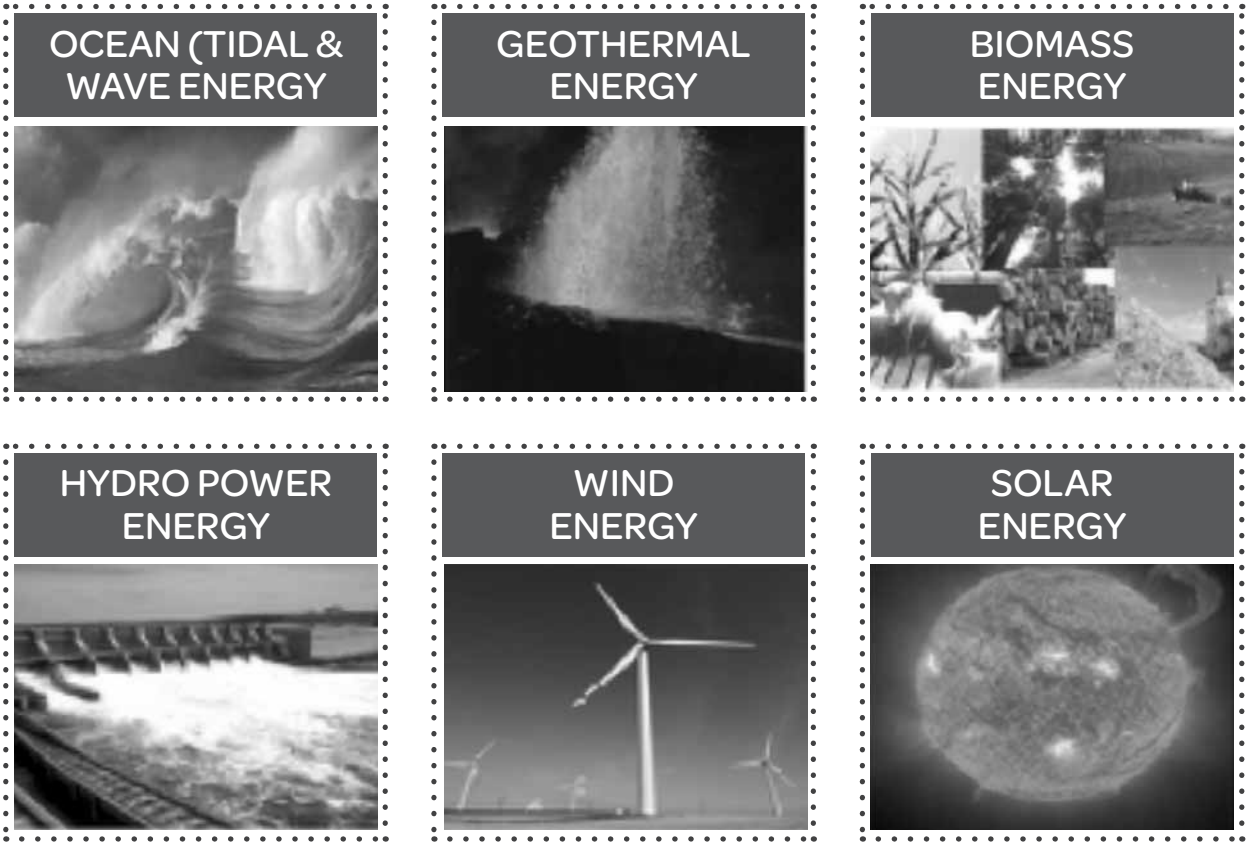
Task Card – Rules of the Game (reproduce for each group)

1. Choose a game piece and place it on the start space of the game board.
2. Take turns rolling the die to determine who will play first. The person with the highest number goes first. Continue taking turns in a clockwise order from the first person.
   - If you land on a ***pipeline***, you must slide down because you are drilling for fossil fuels and this contributes to the greenhouse effect.
   - If you land on a ***ray of sunlight***, you must slide up because you are using solar energy, which is renewable energy.
   - When you land on a ***trivia card*** space, a group member selects a card from the top of the card deck and reads the trivia question. If the player answers the question ***correctly***, they can roll the die again and have another turn. If they answer ***incorrectly***, the player remains on the same space. The trivia card is placed at the bottom of the pile.

- The first person who lands directly on the ***finish space*** wins the game. To land directly on the finish space, the student must roll the exact number needed to move there.

3. When students are finished playing the first round, have them develop trivia questions of their own to use during the game. Depending on students' abilities, this step could be completed prior to playing the game.
4. Whole Class Discussion – Have students sitting at their individual desks for wrap-up discussion.
5. Review the importance of renewable energy sources and discuss the long-term impacts on society and the environment of human use of non-renewable energy sources.

Energy Trivia bucket labels



Energy Trivia Game Questions. ***Mix up the questions for best results.***

1

The oldest machines used for capturing this type of renewable energy were water wheels. What energy source am I talking about?

Answer: Hydro power

2

Many of Canada's freshwater (rivers and lakes) have been used to produce this type of energy.

Answer: Hydro power

3

This renewable energy source may cause significant environmental damage, such as flooding and the destruction of fish and wildlife habitats if not used carefully. What type of energy am I?

Answer: Hydro power

4

Since Canada has more fresh water in its lakes and rivers than any other country in the world, we use this form of renewable energy more than any other to produce electricity.

Answer: hydro power

5

This form of energy is made by using the heat from the Earth's core. Which type of renewable energy am I talking about?

Answer: geothermal

6

Usually this type of energy source depends on a dam to raise the level of water in the reservoir. Which renewable energy am I?

Answer: hydro power

7

This energy is one of the most economical sources of renewable energy because it can be set up quickly and cheaply. What type of energy am I talking about?

Answer: wind

8

Which energy source captures the energy from the air?

Answer: wind

9

One of the oldest uses of this type of renewable energy is for transportation over oceans. Which am I?

Answer: wind

10

Which energy source uses the light and heat from the sun?

Answer: solar

11

This energy source depends on the wind blowing across the sea.

Answer: ocean (wave)

12

Which energy source makes your car hot when it is parked in the sun?

Answer: solar

13

What energy type makes the wind blow and the ocean currents flow?

Answer: solar

14

This energy source uses the pressure acting on the rocks and minerals of the Earth's core to make heat. Which renewable energy am I?

Answer: geothermal

15

What kind of energy uses geysers, hot springs, and steam vents to gather hot water and steam to heat our homes?

Answer: geothermal

16

This energy source gives us more energy in one second than people have used since the beginning of time.

Answer: solar

17

Which kind of energy sometimes find its way to the surface of the earth in the form of volcanoes and fumaroles (holes where volcanic gases are released)?

Answer: geothermal

18

One way to use this kind of energy is to bend or force waves into a narrow channel, increasing their power and size, which can then spin turbines.

Answer: Ocean-Wave

19

Which energy source uses wood, straw, manure, and other natural materials that contain stored energy?

Answer: biomass

20

Which type of renewable energy uses any form of plant or animal tissue?

Answer: biomass

21

Which type of renewable energy uses the power of waves and tides to make electricity?

Answer: ocean (wave)

22

One of the oldest energy sources that humans have used is wood burning – which renewable energy is this?

Answer: biomass

23

Ethanol and methanol are alcohols, made from plant sugars. They are good examples of which type of renewable energy?

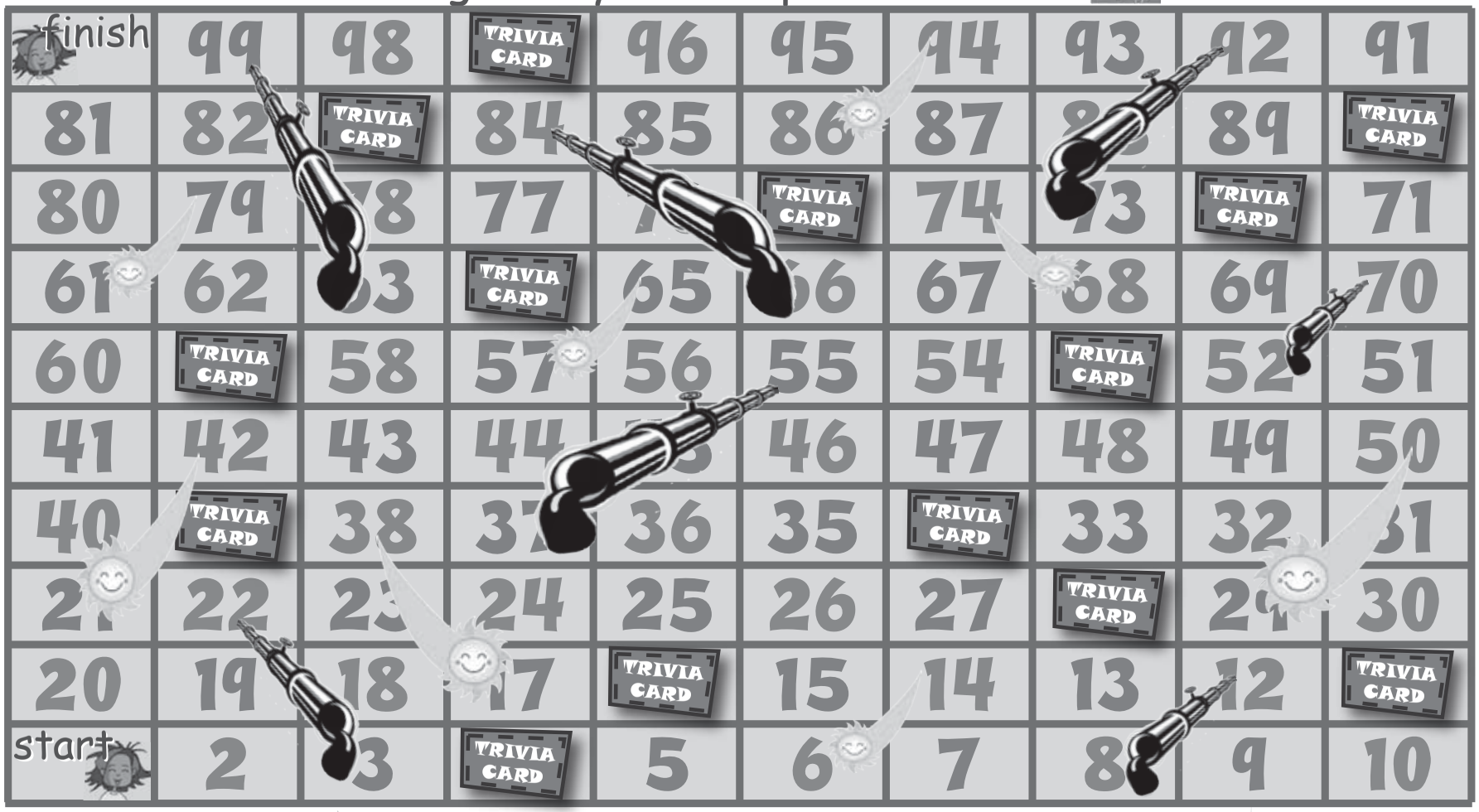
Answer: biomass

24

Which type of energy depends on the gravitational pull of the moon and sun, and the rotation of the Earth?

Answer: ocean (tidal)

Sunlight Rays and Pipelines Game



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TRIVIA CARDS for Sunlight Rays and Pipelines

Hydro power produces _____ of Canada's electricity? a. 25% b. 61% c. 87% *Answer: b*	Hydroelectricity is generated using the energy from _____ water. *Answer: falling/stored*	What kind of damage can the use of hydro power cause? *Answer: flooding; loss of habitat*	Water wheels are the oldest type of machine for capturing what type of renewable energy? *Answer: hydroelectrical*
Geothermal energy is produced using heat from where? *Answer: the Earth's core*	What kind of energy uses geysers, hot springs, and steam vents to gather hot water and steam to heat our homes? *Answer: geothermal*	What kind of renewable energy source can be harnessed using small, portable chargers? *Answer: solar*	Solar energy is captured and turned into _____ or electricity. *Answer: heat*
What kind of energy makes plants grow, helping them make food and oxygen? *Answer: solar*	Solar energy produces both the wind and _____ currents. *Answer: ocean*	Biomass energy is made from _____ and _____ tissue. *Answer: plant, animal*	True or False? Landfill gas is a form of biomass energy. *Answer: true*
True or False? There are no negative impacts caused by biomass energy. *Answer: false – biomass energy adds greenhouse gases to our air*	Oil, coal, and natural gas are examples of _____ energy, whose use contributes to global warming. *Answer: non-renewable energy*	Wind energy is captured by large _____ that are placed high on towers and are turned by the wind. *Answer: windmills/ turbines*	Low costs, quick set up, and only a small environmental impact have made _____ power the fastest-growing new energy source. *Answer: wind*
True or False? Offshore and high-altitude locations are best for wind turbines. *Answer: true*	What type of renewable energy was first used for transportation? *Answer: wind - sailboats*	The blowing wind generates wind power, and when it blows across the sea it also creates _____ energy. *Answer: ocean – tidal/ wave*	Which of these energy sources comes from the ground? a. Coal b. Oil c. Geothermal energy d. Natural gas e. All of the above *Answer: e*

Resources

COAL, OIL, OR NATURAL GAS?
This quick worksheet gets students thinking about different fossil fuels.
(Source: EcoKids Earth Day Canada)
http://ecokids.ca/pub/downloads/printables/assets/energy/ffactivitysheet.pdf

BROKEN LINK? *Google search* "EcoKids.ca" → Login/Sign-up (for access to free resources) → Activities: Puzzles & Games → Theme: Energy → Fossil Fuel Activity

ENERGY: MAKING THE RIGHT CHOICES
Teaching About Climate Change, Green Teacher. pages 20-21. Changes to the Global Climate, Evergreen: Teachers Corner Lesson Plans.
www.evergreen.ca/en/lg/lessons/global-climate.pdf

BROKEN LINK? *Google search* "Evergreen.ca" → Resources → School Ground Greening → Teacher's Corner → Grade 5: Changes to the Global Climate

Big Ecological Idea #3:

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

LEARNING CONCEPTS

- ***Efficiency:*** Using devices and practices that require the smallest amount of energy to produce the most work and create the smallest amounts of polluting wastes is one of the best forms of conservation.
- ***Devices:*** Design ideas to achieve greater energy efficiency might include prevention of heat loss (insulation, double windows, weatherstripping), dematerialization (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 heating system.
- ***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 on which to build.)

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 5 curriculum on pages 40 – 44.*

SCIENCE & TECHNOLOGY—*Understanding Earth & Space Systems – Conservation of Energy & Resources (2007)*

1.2 evaluate the effects of various technologies on energy consumption and propose ways in which individuals can improve energy conservation. Sample problem: Conduct an energy audit of your home 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

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

Resources

20/20 PLANNER TOOL KIT FOR GRADES 5 AND 6

Developed by Toronto Public Health, 20/20 The Way to Clean Air, offers grade 5 and 6 teachers a way to help students apply their learning about energy conservation at home. Also available in French.
http://ontarioecoschools.org/curriculum_resources/20_20.html

ENERGY HOG CAMPAIGN

The Energy Hog website contains a number of resources for students and teachers. Created by the Alliance to Save Energy: Green Schools program.
www.energyhog.org

WATTWIZE PROGRAM

Wattwize enables EcoTeams to excel at electricity conservation by helping them run a conservation campaign in their schools.
www.ecospark.ca/wattwize

KID'S CLUB AT NRCAN

Visit Natural Resources Canada's clubhouse and watch the adventures of NRCat, Inspector Joules, and Simon to learn more about energy conservation. There are teacher's guides and student resources related to energy conservation.
http://oee.nrcan.gc.ca/calendar-club/activity/17105

FUTURE CAR: FUEL CELLS

An introduction to the use of hydrogen as an automobile power source, accompanied by a hands-on activity in generating hydrogen through electrolysis.

www.pbs.org/saf/1403/teaching/teaching3.htm

BROKEN LINK? *Google search* "PBS" → Teachers → Grades 3-5 → Search "Fuel Cells" → Future Car: Fuel Cells

EVERY KILOWATT COUNTS

A fun, kid-friendly website to introduce energy and electricity concepts. Also available in French.

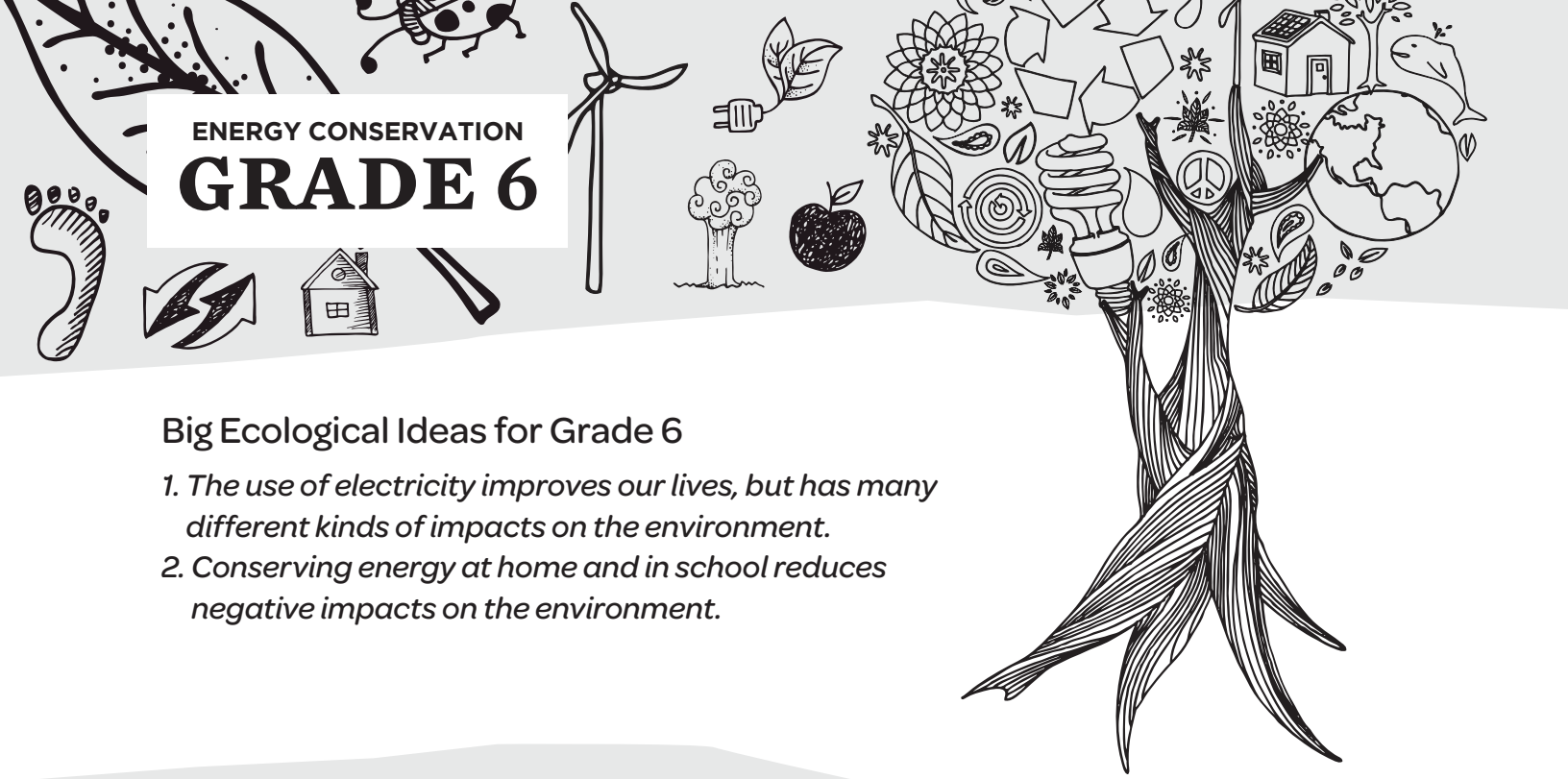
http://kids.everykilowattcounts.com/

BROKEN LINK? *Google search* "Ontario Power Authority" → For Home → Kids Corner

SOLAR CAR SPRINTS: TEACHING ABOUT CLIMATE CHANGE

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 parts of many cities in the world are designed to work well without cars. This website 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.

www.carfree.com



ENERGY CONSERVATION

GRADE 6

Big Ecological Ideas for Grade 6

1. *The use of electricity improves our lives, but has many different kinds of impacts on the environment.*
2. *Conserving energy at home and in school reduces negative impacts on the environment.*

Big Ecological Idea #1:

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

LEARNING CONCEPTS

- ***Ontario's energy generation:*** In Ontario, nearly all of our electricity is generated from three principal sources: water (hydroelectricity), fossil fuels (coal and oil, as well as mining for coal and uranium, (which causes natural gas), and nuclear fuel (uranium). All of these have environmental impacts.
- ***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)
  - clearing land for hydro-corridors, and pipeline-, road-, and dam-building (possibly causing displacement of human and/or natural communities).
- ***Ontario's newest energy - renewable:*** In recent years, more attention has been paid to generating electricity in more environmentally friendly ways. Ontario has begun to invest in power generation from wind. Some new development is happening in small decentralized hydro projects. A small amount of power is generated from solar panels.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 6 curriculum on pages 45 – 49.*

SCIENCE & TECHNOLOGY: *Understanding Structures & Mechanisms – Electricity & Electrical Devices*

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 problem: 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.

2.4 design, build, and test a device that produces electricity (e.g., a battery built from a lemon or potato; a wind turbine)

Resources

RENEWABLE AND NON-RENEWABLE ENERGY

Students research which sources of renewable and non-renewable energy are used for energy in various provinces. (Source: SEEDS Foundation)
www.seedsfoundation.ca/els/Lobby/index.html

20/20 PLANNER TO CLEAN AIR

Renewable Energy - Is it worth the cost? (p. 29) and Here today, gone tomorrow! (p. 27) promote thinking about the financial and environmental costs of renewable and non-renewable energy. Provides an opportunity for group presentations.
www.ontarioecoschools.org/curriculum_resources/downloads/20_20_In_Class_Lessons_2009.pdf

BROKEN LINK? *Google search* "Ontario EcoSchools" → Curriculum resources → 20/20 Planner to Clean Air → Renewable Energy - Is it worth the cost? p. 29

Big Ecological Idea #2:

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

LEARNING CONCEPTS

- ***Being aware that there is an impact:*** 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).
- ***School practices to conserve energy:*** We can conserve energy in school by working to have everyone:
  - do a "lights-off" test to see if it is bright enough to turn off all or some of the lights
  - turn off all computer monitors when they are not in use
  - turn off all electronics promptly when they are no longer needed
  - turn off all lights when leaving a room
  - 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*.)

LEARNING CONCEPTS, CONTINUED

- ***Energy-saving devices help conserve and so can our actions:*** Energy-saving appliances and devices, such as motion-control lights outside buildings, compact fluorescent bulbs in lamps, and kettles and irons with automatic off buttons help reduce energy use. We can conserve heat energy by turning down the heat and closing all windows, closing curtains or drapes when it is dark outside to keep in the heat, and 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

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 6 curriculum on pages 45 – 49.*

SCIENCE & TECHNOLOGY: *Understanding Structures & Mechanisms – Electricity & 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

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, 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 have a plan to pay consumers to reduce their electricity consumption, especially during peak hours.

LEARNING ACTIVITIES

Source: Adapted from TDSB's *Heat in the Environment*. Find more resources at www.ecoschools.ca.

Lesson Overview

- 10 minutes for the hook: Energy Match-Up
- 10 minutes to read the Introduction and discuss
- 2 minutes for testing incandescent vs. fluorescent lighting (may vary depending on how many light bulbs you test)
- 15 minutes for the lesson closure-think-pair-share, class discussion and review.

Learning Skills & Work Habits

- Collaboration, organization, initiative

Materials needed

- Lamp (two if available)
- two or three incandescent bulbs
- two or three compact fluorescent bulbs
- Big piece of white paper or a white towel
- Ruler

Teaching/Learning Strategies

Hook – Energy Match-Up!

1. Print out the sheet or save paper by using a smart board or overhead printout. Have students guess how much wattage each item uses. Students can draw a line from the item to the average wattage (joules/sec). Have students compare their results with a partner before taking it up.

GUESS HOW MUCH ENERGY EACH ITEM USES!	
Appliance	**Average Wattage (J/s)**
Hairdryer	22
Toaster	30
Refrigerator	50
Computer (desktop)	80
CD player	115
Microwave	200
Clothes washer	500
Clothes dryer (electric)	500
Stereo	750
Air Conditioner (window)	1000
Television	1000
Dishwasher	1050
Computer (laptop)	1150
Furnace	2000
Fan	5000

ANSWERS	
Appliance	**Average Wattage (J/s)**
Hairdryer	1000
Toaster	1150
Refrigerator	500
Computer (desktop)	200
CD player	22
Microwave	1000
Clothes washer	500
Clothes dryer (electric)	5000
Stereo	30
Air Conditioner (window)	1050
Television	80
Dishwasher	2000
Computer (laptop)	50
Furnace	750
Fan	115

Discussion

What was surprising? What appliances do we use on a regular basis? Which item uses the most energy on a typical day at your home or at school (hint: the appliances we use continuously need energy for the whole day; suggested answer: refrigerator, dryer). What would help save energy? (answer: behaviour/practice changes such as hanging clothes to dry or efficiency changes such as improvements in technology – Energy Star appliances).

Activity

1. To start the lesson, have students read the introduction:

> **Introduction**
> Energy-efficient, compact fluorescent lighting (CFL) has been on the market for several years. Today's lower costs, easy availability, and variety of configurations make CFL more appealing to homeowners. Energy- and cost-saving claims by CFL manufacturers are typically based on the difference in power consumption between CFL and incandescent bulbs with similar lighting performance. Lighting can make up anywhere from 5% to 45% of the total energy consumed at home or at school. By reducing demand, especially during peak times, consumers can have a significant positive effect on the environment.

DID YOU KNOW?

A quick lighting fact! The average residential lighting energy use is 3.4 kWh per day or roughly 1,350 kWh/year — about 15% of total electricity use! That is a lot! Lighting accounts for 5% to 8% of annual utility bills. Average peak demand is about 0.65 kW per house during winter months and about 0.5 kW during summer months.

"Benchmarking Home Energy Savings from Energy-Efficient Lighting" (www.cmhc-schl.gc.ca/odpub/pdf/65830.pdf?lang=en)

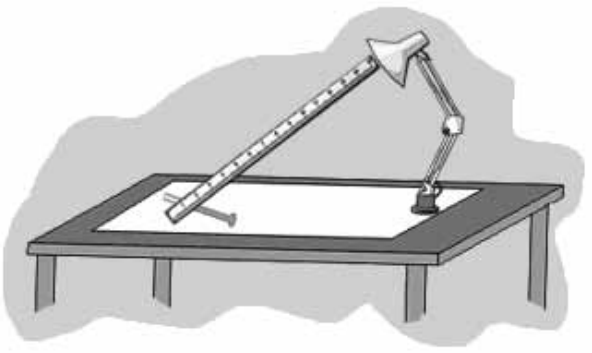
2. After reading the introduction, ask students at what time of day they think the most electricity is used? Explain to the students that electricity in the home is used frequently in the morning and the evenings. (5 minutes)
3. Show the two light bulbs: incandescent and fluorescent. Let students see and hold the bulbs, noting the differences between them. Pose a question to the class: Which of the two light bulbs produces more heat? To find out, the class is going to conduct an experiment.

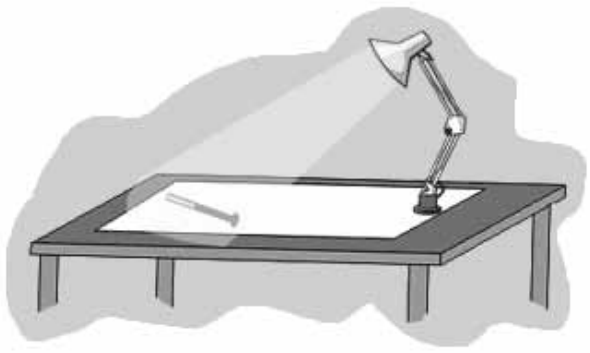
Experiment

Preparation: Have students prepare an observational chart or provide a sheet with the following information:

LIGHT TYPE	HYPOTHESIS	STARTING TEMPERATURE	LIGHT WATTAGE	TIME (MIN)	TEMPERATURE
Incandescent				1	
				2	
				3	
				4	
				5	
Compact Fluorescent				1	
				2	
				3	
				4	
				5	

To start the experiment, have students either sit or stand around a table or desk. This may be difficult with a large class, so you may want to set up two tables.





Steps for the Experiment

1. Place the white towel/paper on the desk and put the lamp on the end of the desk. The paper has to be white so the light can be observed. Light colours also don't attract as much heat.
2. Place the thermometer on the paper and measure the distance from the bulb to the thermometer (30 centimetres is recommended).
3. Put in the lowest wattage light bulb (make sure the lamp is unplugged).

***(Emphasize to students that before you plug in or unplug something, the item must be turned off to avoid electric shock).*

4. After you put in the light bulb, but before you turn on the lamp, measure the start temperature. Have the students record this in their observational chart.
5. Turn on the lamp.
6. Leave the lamp shining on the thermometer for at least 5 minutes. Now wait and watch.

While waiting for the 5 minutes to pass, explain to students what is occurring to the thermometer. (Bulb thermometers rely on the simple principle that a liquid changes its volume relative to its temperature. Liquids take up less space when they are cold and more space when they are warm. You can also talk about different types of thermometers such as bulb thermometers and electronic thermometers and how they are used to measure body temperature, air conditioning systems, refrigerators, heaters, thermostats, etc.).

7. At the end of 5 minutes, mark down the final temperature resulting from the heat from the light bulb. The lamp must remain in the same spot throughout to ensure accurate and consistent results.

Note: You may want to repeat the experiment with light bulbs of several different wattages. However, to get accurate results, you should let the lamp cool between testing the light bulbs (wait about 30 minutes). Keep the distance between the thermometer and the light bulb the same at all times, and make sure the thermometer is in the same spot for each experiment.

This experiment may take a while, so prepare to set aside several segments of class time. We suggest you test at least two to three incandescent light bulbs and two to three fluorescent light bulbs, so students can actually see the difference in their observations and findings. If you choose to do two to three light bulbs for each and each experiment takes approximately 10 minutes, you will need about 40-60 minutes to conduct the experiments.

What You'll Discover!

Incandescent lights give off heat as well as light energy. The higher the wattage of the light bulb, the higher the temperature.

In a home or office, lots of incandescent lights means that the air conditioner would have to use more energy during the summer to cool the extra heat given off by lights.

Closure

After conducting all of the experiments, have students do a think-pair-share of what occurred during each experiment. Then, have a class discussion about what occurred.

Clarify that the experiment proved that compact fluorescent lighting is more energy efficient because it does not produce as much heat as incandescent lighting. Record the students' observations.

The reason that fluorescent lighting does not give off as much heat energy is because the light is dispersed by mercury vapours that create luminescence. Incandescent light bulbs create light by heating a filament (thin wire) of copper that emits light and heat.

EXTENSION

Compare the true cost of light bulbs

Context: Choosing light bulbs can be overwhelming – there are so many choices! Energy prices are going up, so the best choice is light bulbs that consume less energy. How will you know which bulb is really the cheapest? Ask the question: Which type of bulb is the most expensive to purchase? Which bulb lasts the longest? Which uses the least amount of energy/power?

Fluorescent lights last about 9,000 hours. Ask the question: What is the total cost of lighting a room for about 9,000 hours with a compact fluorescent (CFL) vs. an incandescent light bulb? Brainstorm what information students need to gather (cost of light bulb + cost of electricity).

Total cost = Price of bulb ($ bulb) + cost of energy used ($ energy)

- **Price of bulb ($ bulb)** = # of bulbs needed to light a room for 9,000 hrs x price of bulb
  - Cost of compact fluorescent bulb = $8.00
  - Compact fluorescent lasts 9,000 hrs

  Price of CFL bulb = 1 bulb x $8.00 = $8.00
  - Cost of incandescent bulb = $1.00
  - Incandescent bulb lasts 750 hrs
  - 750 hrs x 12 bulbs = 9,000hrs

  Price of incandescent bulb = 12 bulbs x $1.00 = $12.00
- **Cost of energy ($ energy)** = power used x the number of hours x price of electricity (5 cents or $0.05/kWh) 2012 electricity rates
  - Power used for incandescent for regular lighting in a room is 75 W (watts). To convert into a kW (kilowatt), divide by 1,000 = 0.075 kW.
  - Power used by a CFL for regular lighting in a room is 15 W or 0.015 kW

Type of bulb	Energy used	Price of energy	Energy cost	Total cost = $ bulb + $ energy
Incandescent	0.075 kW x 9,000h	$0.05/kWh	$33.75	$12.00 + $33.75 = $45.75
Fluorescent (CFL)	0.015 kW x 9,000h	$0.05/kWh	$6.75	$8.00 + $6.75 = $14.75

Making connections: Explain to students that saving energy is important because over-consumption of electricity negatively affects our environment. For example, hydroelectricity development impacts many ecosystems, including rivers, wetlands, and grasslands. Also, hydro fields require large spaces to accommodate the hydro towers, which often requires clearing the land.

EcoSchools program: Talk about others ways to save electricity in the school, such as having a light monitor, not having all the lights on during a bright day, turning off the computers at night, etc. Use the EcoSchools program EcoReviews to assess how effective your classroom and school practices are at conserving energy (www.ontarioecoschools.org).

Resources

ENERGY CONSERVATION AUDIT

This audit focuses on educating students to become responsible energy users by having them conduct an energy audit at school and at home. Students analyse the long-term impacts of energy and resource use on society and the environment and suggest ways to reduce these impacts. (Source: EcoKids Earth Day Canada)
www.ecokids.ca/pub/teachers/resources/lesson_plans/energy_conservation/lesson_energy_conservation.pdf

BROKEN LINK? *Google search* "EcoKids.ca" → Login/Sign-up (to access free resources) → Lesson Plans → Grade 5, English: Energy Conservation Audit

ELECTRIC LIGHTING AND HEAT: REDUCE THE WATTAGE, REDUCE THE ENERGY

Students 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. (Source: Eco Kids: Earth Day Canada)
www.ecokids.ca/pub/teachers/resources/lesson_plans/electricity/lesson_electricity.pdf

BROKEN LINK? *Google search* "EcoKids.ca" → Login/Sign-up (to access free resources) → Lesson Plans → Grade 6, Science – Electric Lighting and Heat: Reduce the Wattage, Reduce the Energy

20/20 PLANNER TO CLEAN AIR: CONSERVING ENERGY IN SCHOOL

Provides an easy-to-use energy use survey worksheet that encourages students to pledge their commitment to conserving energy in school.
www.ontarioecoschools.org/curriculum_resources/downloads/20_20_In_Class_Lessons_2009.pdf

BROKEN LINK? *Google search* "Ontario EcoSchools" → curriculum resources → 20/20 Planner to Clean Air → Conserving Energy in School, p. 17

ENERGY CONSERVATION

GRADE 7

Big Ecological Idea #1:

Heat is a form of energy. This energy is becoming more costly, both economically and environmentally.

LEARNING CONCEPTS

- ***Efficiency*** is one of the best forms of energy conservation.
- In cold northern countries such as Canada, ***conserving our heat energy is important***.
- ***3 ways to lose heat***: There are three ways in which heat can escape from a building:
  - ***conduction*** of hot air to cool air 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 weatherstripping)
  - ***radiation*** heat passing through a medium (which can be reduced by using an infrared reflective surface in walls and windows with an infrared reflective coating)
- Understanding the ***thermal properties of heat*** and the ways in which systems can be designed for maximum energy savings is important to promoting energy conservation.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 7 curriculum on pages 50 – 56.*

SCIENCE AND TECHNOLOGY: *Understanding Earth & Space Systems – Heat in the Environment (2007)*

1.1 assess the social and environmental benefits of technologies that reduce heat loss or transfer

2.3 use technological problem-solving skills to identify ways to minimize heat loss

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

LEARNING ACTIVITIES

Source: Adapted from *Trapping Energy: Building a Solar Oven,* Grade 7 Integrated Unit: Heat in the Environment, TDSB 2009.

TRAPPING ENERGY: BUILDING A SOLAR OVEN

In this activity, students construct a pizza box solar oven and use it to bake a snack. The activity needs to be done on a sunny day, in a place that receives direct sunlight. The purpose is to help students understand the greenhouse effect by experiencing the basic idea of heat being trapped. The activity leads to discussion about greenhouse gases and the consequences of their increase.

Pizza Box Oven Construction Materials (per group)

- Clean, used pizza box
- Black construction paper
- Aluminum foil or inside-out potato chip bags
- Clear plastic (heavy plastic laminate works best)
- Non-toxic glue, tape, scissors, ruler, magic marker
- Wooden dowel or stiff straw

Learning Skills & Work Habits

- Initiative, collaboration, organization

Planning Notes

- Review the background material below and the process for making the pizza box ovens.
- Send home a letter to parents/guardians several weeks in advance so that students can bring the necessary materials to class.
- Find out about any food allergies in the class.
- Gather the materials required. Decide on the student groupings you will use, and photocopy the necessary number of handouts.

Prior Knowledge

- Review the key ideas about greenhouse gases and climate change.

Background

A common analogy to explain global warming is the greenhouse. Anyone who has ever walked into a greenhouse, or entered a car parked in the sun on a hot day has felt the greenhouse effect. Why is it hotter inside the car than outside? Because the air inside the car cannot circulate with the outside air and get dispersed, the heat inside the car increases. That's why opening all the windows cools the car. This is exactly how a greenhouse works.

A greenhouse admits the sun's energy, and then reduces or eliminates cooling by cutting off air circulation that would allow for the cooling process. As a result, the greenhouse heats up. This idea of heat being trapped is the basis for the comparison of the greenhouse to the Earth's atmosphere. Although the actual process is quite different, the analogy helps people understand the basic idea of heat being trapped, which is what building the solar oven will allow students to do.

The outputs of many human activities are gases such as carbon dioxide and methane. Once in the atmosphere, these gases (greenhouse gases) block heat from escaping into space. They are increasing the temperature on our planet. The consequences for ecosystems and societies may be severe.

Teaching/Learning Strategies

1. Introduce the activity by asking students why a Thermos works and why car interiors get really hot in the summer. Then ask how they think a pizza box could be transformed into a solar cooker or oven.
2. Organize students into their groups and hand out copies of "How to Make Your Pizza Box Oven" (see p. 58). Review the instructions with them and then invite them to construct their ovens. Circulate to assist as required. As am alternative, consider the option outlined below.
3. Invite students to think of improvements they could make to the basic design to increase the inside temperature of the pizza box to make it more effective for baking.
4. Expect cooking times to be at least twice as long as normal cooking times. While the food is cooking, have students complete the "Pizza Box Oven Summary" (below).
5. Eating the food "fresh from the oven" is a great reward!
6. To end the activity, have a class debriefing. Invite students to discuss their oven's temperature and performance and their ideas for improving the design. Ask some questions, such as:
   - What did you learn about heat from making the pizza box oven?
   - What type of heat transmission was demonstrated?
   - Why do you think black construction paper was used? Aluminum foil?
   - What other types of heat transmission do we use to cook food?

Alternative Option

Do not provide detailed instructions as outlined on "How to Make Your Pizza Box Oven." Instead, have students assemble and examine their materials. Provide students with questions that will be the basis for the construction project, e.g., "How could you use the materials collected to build an oven that used the sun's rays to cook food?"

Direct your students to brainstorm a solar oven design. Have them get permission before proceeding to the construction phase.

When students are testing their ovens, encourage them to use a two-column format to record their observations and questions.

Pizza Box Oven Summary

Have students create a sheet with the following information:

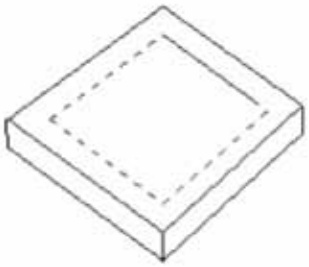
- Names of group members
- Special materials used
- A table with the columns "Observations" and "Questions." Record your findings.
- What worked well in your design?
- In what ways could you change or redesign your model to increase the temperature?

How to Make Your Pizza Box Oven

Materials

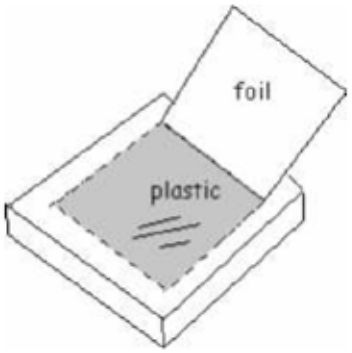
- Clean, used pizza box
- Black construction paper
- Aluminum foil or inside-out potato chip bags
- Clear plastic (heavy plastic laminate works best)
- Non-toxic glue, tape, scissors, ruler, magic marker
- Wooden dowel or stiff straw

Diagram 1



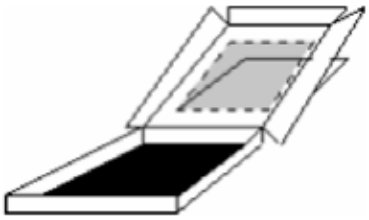
- Draw a 3-centimetre border around the sides and the top of the pizza box.
- Cut along the dotted lines shown to make a large flap. The solid line at the back of the box is uncut.
- Score the back solid line by drawing over it with a sharp pencil

Diagram 2



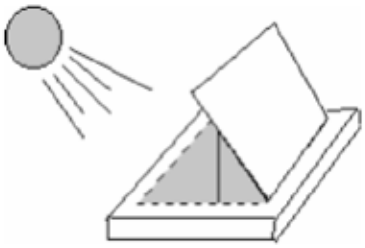
- Fold the flap back along the solid line.
- Cut a piece of aluminum foil to fit on the inside of the flap. Smooth out any wrinkles and glue into place.
- Cover the opening with transparent plastic. Tape it down so that the top of the pizza box can still be opened. The plastic cover should be tightly sealed so air cannot escape through the window when the top of the pizza box is closed.

Diagram 3



- Cut another piece of aluminum foil to line the bottom of the pizza box and carefully glue into place.
- Cover the aluminum foil with a piece of black construction paper and tape into place.

Diagram 4



- Close the pizza box top (window), and prop open the reflecting flap of the box with a wooden dowel or straw and face towards the sun.
- Adjust the reflecting flap until the aluminum reflects the maximum sunlight through the window into the oven interior.
- Your oven is ready! You can try heating s'mores, English muffin pizzas, or hot dogs, or even baking cookies or biscuits. Test how hot your oven can get using two thermometers, one inside and one outside the pizza box.

Resources

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. (Source: Energy Quest)

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

BROKEN LINK? *Google search* "Energy Quest Projects" → Science Projects → Saving Energy: Insulation

ENERGY CONSERVATION IN THE HOME

Students learn about ways to conserve energy in the home through building materials such as insulation, windows, shading techniques, and by using efficient appliances. The focus of the lesson is the significant causes of heat loss in the home. (Source: Infinite Power of Texas)

www.infinitepower.org/pdf/No14%2096-813B.pdf

BROKEN LINK? *Google search* "Infinite Power of Texas" → Lesson Plans for Teachers → Middle School Units of Study: Energy Conservation in the Home

PASSIVE SOLAR DESIGN FOR HOMES

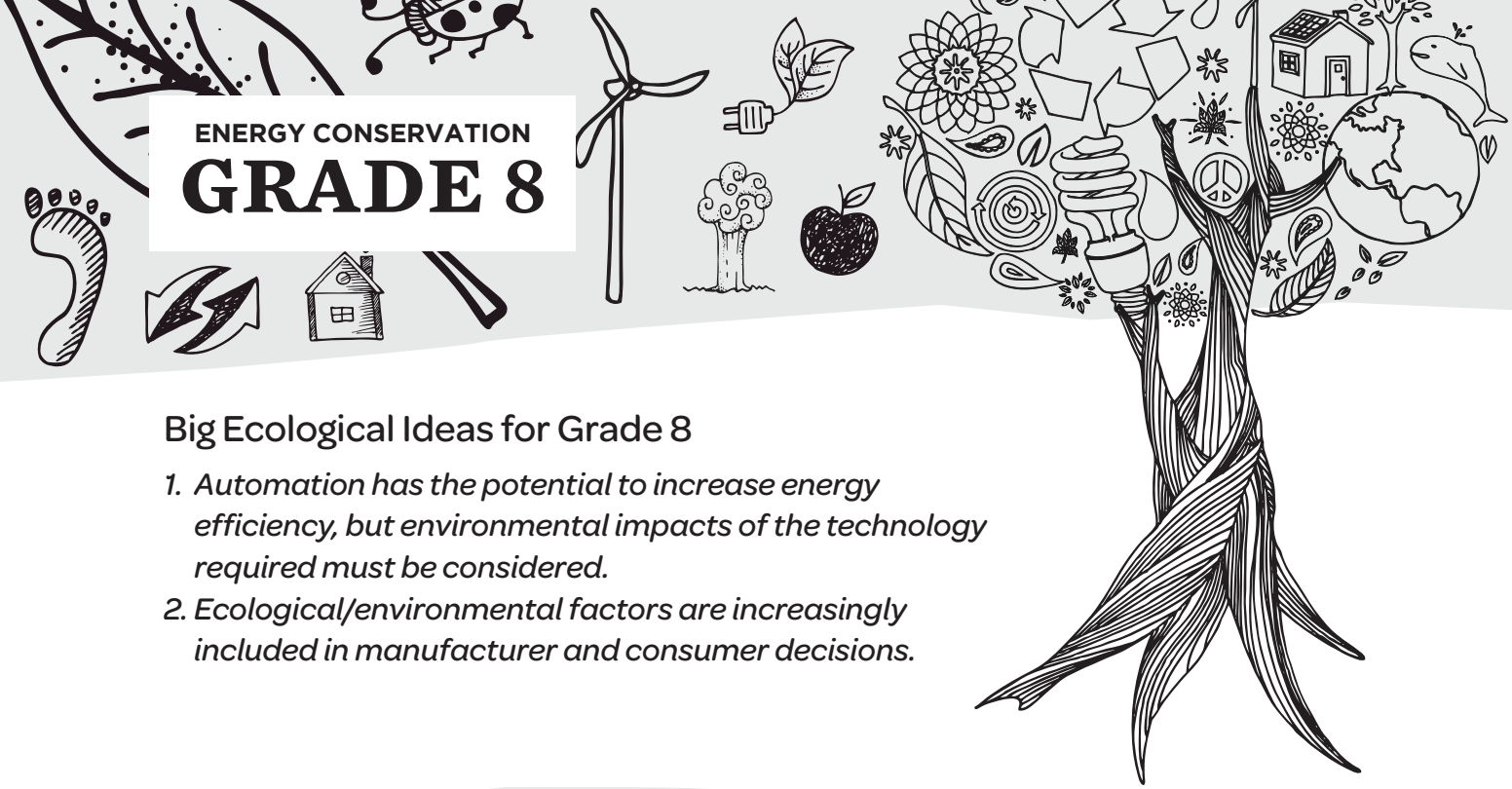
Students learn about using the right type of materials in a home to conserve energy and the importance of building orientation and window sizing. Students will learn that simple measures, such as landscaping and installing thermal storage, make a big difference in energy consumption. (Source: Infinite Power of Texas)

www.infinitepower.org/lessonplans.htm

BROKEN LINK? *Google search* "Infinite Power of Texas" → Lesson Plans for Teachers → Middle School Units of Study: Passive Solar Design for Homes

ENERGY CONSERVATION

GRADE 8



Big Ecological Ideas for Grade 8

1. *Automation has the potential to increase energy efficiency, but environmental impacts of the technology required must be considered.*
2. *Ecological/environmental factors are increasingly included in manufacturer and consumer decisions.*

Big Ecological Idea #1:

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

LEARNING CONCEPTS

- ***Some technology has led to more energy efficiency:*** Some mechanisms and structures have been designed to be more energy efficient, such as:
  - well-insulated buildings that don't lose and waste heat energy
  - compact fluorescent bulbs (as opposed to incandescent bulbs) that don't waste energy as heat
  - motion-detection light sensors and automatic shut-off devices and timers that prevent unnecessary use of energy
  - co-generation that can use heat waste to generate electricity
  - Energy Star rating that identifies appliances and devices that are energy efficient
- ***Factors that contribute to energy efficiency*** are things such as reducing friction between moving components, reducing the weight of parts by using alternative materials, and using components in devices with lower power demands (e.g., solid state LEDS rather than incandescent bulbs).
- A consistent effort to ***buy efficient electrical appliances and use appliances only when needed*** can save a lot of energy.
- ***Less demand results in fewer power stations, which reduces our impact:*** 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

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 8 curriculum on pages 57 - 64.*

SCIENCE & TECHNOLOGY: *Understanding Structures & Mechanisms – Systems in Action (2007)*

1.1 assess the social, economic, and environmental impacts of automating systems
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
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
3.9 identify social factors that influence the evolution of a system

Resources

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. (Source: National Teacher Enhancement Project)

www-ed.fnal.gov/ntep/f98/projects/nrel_energy_2/lightinglab.html

BROKEN LINK? *Google search* "National Teacher Enhancement Project" → Home Energy Audit

Big Ecological Idea #2:

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

LEARNING CONCEPTS

- Consider these ***questions about the environmental factors that affect the manufacturing of a product:*** 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?
- An increasing number of ***manufacturers committed to sustainability*** are attempting to minimize the impact of their businesses on the environment. The "***cradle to cradle***" perspective takes into account the entire life cycle of their products which includes asking how they 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 production that allow products to be taken apart easily for recycling.

CLUSTERING OF EXPECTATIONS

EE SCOPE & SEQUENCE *lists environmental education opportunities in Grade 8 curriculum on pages 57 - 64.*

SCIENCE & TECHNOLOGY: *Understanding Structures & Mechanisms – Systems in Action (2007)*

1.1 assess the social, economic, and environmental impacts of automating systems
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
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

LEARNING ACTIVITIES

Source: Adapted from *Life Cycle Analysis: Embedded Energy*, Grade 7 Integrated Unit: Heat in the Environment, TDSB 2009.

LIFE CYCLE ANALYSIS: EMBEDDED ENERGY

This activity has students consider the environmental impacts of product manufacturing and the energy inputs that manufacturing entails. In three related tasks, students explore life cycles by studying the kit's three laminated posters on life cycles of products. They research the life cycle of another product. They also make paper to get hands-on experience in the cycle of a product.

Background

To more clearly understand the impacts of manufacturing products and to see how much energy is needed, students will learn that the most basic pattern of making anything can be described in terms of the inputs and outputs required. In reviewing the 3Rs, students will learn that when they save product materials (matter inputs) they are also saving energy inputs at every stage of the manufacturing process. The energy needed to make a product can be considered to be embedded in each stage of its making, hence the term "embedded energy." Students will focus on energy inputs or embedded energy as they become familiar with life cycle analysis by studying the life cycle of a soccer ball, a cellphone, and a DVD.

The students then apply their learning by researching the life cycle of another product. Students become equipped to transform their new knowledge into a 3Rs information campaign for promoting general understanding of what is involved in making the stuff around us, directed at one or more audiences in the school. Or it could be used more specifically to promote their school's greening efforts.

The experiential dimension of learning about energy inputs or embedded energy will come through when the students make paper. We know that paper comes from trees, but how does it get from one form to the other? Students will learn more about paper-making by making the paper, then reading a short article about one of the fibres found in wood. The focus is quite deliberately on the energy required to make the paper.

The order in which these learning activities take place may not be strictly linear. The paper-making may occur over time as the other activities are pursued.

Planning Notes

- Read over the lesson BLMs. Decide on the student groups for the various activities. Make copies of BLMs.
- Note that the paper-making activity can be spread out over several days, or even weeks as students discover the process and work it requires.
- Gather the materials and look at the suggested websites for any additional resources. Find a source of wood chips and recycled paper to prepare eight to ten large zip-lock bags, depending on your class size. Half the bags should contain only wood chips, and other half should contain only recycled paper. Make sure that the bags have roughly the same mass.

Learning Skills & Work Habits

- Responsibility, organization, independent work, initiative, self-regulation

Prior Knowledge

- Understanding the terms "consumption" and "life cycle." Review the 3Rs.

Materials

- Life cycle posters: cellphone, soccer ball, CD/DVD (from www.epa.gov/epawaste/education/mad.htm)
- Wood chips (from a garden centre or hardware store; enough for four or five large zip-lock bags)
- Recycled paper (enough for four or five large zip-lock bags)
- Materials for making paper (see Part 3, Step 2)
- Various tools for crushing wood chips (hammers, mortar and pestle)
- Goggles
- Materials Fact Sheets from Recycling Council of Ontario – www.rco.on.ca

Teaching/Learning Strategies

Part One: Product Inputs and Outputs

1. Teach students the terms "input" and "output." Focus on a product familiar to students such as bread or a chocolate chip cookies. Ask students to list:
   - The inputs (ingredients in the baked good)
   - The method of manufacturing (baking, which uses fuel and requires an oven, made mainly of metal)
   - The outputs (waste heat, waste water [from washing]), and the baked good for consumption
2. Help students understand input-output diagrams, which allow them to compare an industrial process to a natural process. Use visuals and charts such the ones in BLM1.

Part Two: Learning about a Product's Life Cycles

1. Display BLM 1, *No Fish Story!: The Making of an Aluminum Can* and use it to explain the basic process of making an aluminum can. Emphasize the fact that between each stage, there is consumption of fossil fuels for transportation, since each manufacturing stage occurs in a different place. Most of the damage to Earth is done during the first two stages: mining the bauxite and processing the ore. At each stage, energy, water, and chemicals are inputs. At each stage, waste water and waste heat are outputs.
2. Print 1 to 3 of the life cycle posters from www.epa.gov/epawaste/education/mad.htm. Invite students to scan the posters, moving in groups from poster to poster. Then assign pairs or small groups of students to study the poster more closely. One group could use the aluminum-can life cycle instead of a poster. As a way to focus their thinking about the energy embedded in these products, have them map out the stages of the product's life cycle on a piece of paper and identify the energy inputs (machines, transportation, storage, etc.) and the energy outputs (waste heat). With their partner or group have students answer the question, What is embedded energy? Have them compare their responses with another pair or group.

   Embedded Energy: When you buy a product, you are not only buying the materials used to make the product, you are also buying all the energy that was used to make and assemble the parts of the product, as well as the energy used to transport all the parts and final product to the store. The energy that you are buying is called embedded energy.

Part Three: Making Paper Takes Energy!

1. Tell students that they are going to learn first-hand about the energy involved in making paper.
2. Explain to students that you want them to think about how they can make their own paper from scrap material. In this section, explain that some groups will receive wood chips, and others will receive recycled paper. Treat their ideas seriously as they brainstorm how to achieve the end result. Let them carry out their plans as far as possible, ensuring their safety at the same time. This might be done over several days, or even weeks. This activity has the potential to change the way students think about paper for the rest of their lives. Anticipate the kinds of materials and tools that students might need, for example, hammers for crushing, blenders and water for mixing, rollers, trays for drying. The point is for students to feel how much energy is required to mash up pieces of wood. Realize that usable paper will likely not be a product of students' efforts.
3. When students have finished their paper-making efforts, display and read aloud the story: *Lignin? Yeah, Lignin!* The information furthers their understanding of why paper production is so energy intensive. Then have

students work in pairs to interview each other about the paper-making process and how successful they were. As part of the interview, students should ask whether the process has made them think differently about paper. As an alternative to the interviews, you could have students write about the experience in a paragraph, journal entry, or comic strip.

Lignin? Yeah, Lignin!

The building blocks of plants are plant cells. Plant cells are very different from animal cells. Plants don't have bones, but their structures are able to support a lot of weight – just think of a sunflower stem. What makes the stem so stiff? The answer is found by looking carefully at plant cells. Thet are surrounded by a thick cell wall. Two important fibres found in the cell wall are cellulose and lignin.

Lignin is the second-most abundant organic compound on Earth after cellulose. Lignin makes up about one-quarter to one-third of the dry mass of wood.

Lignin provides the cell wall with a lot of strength. It also plays an important role in forming vessels or tubes that allow water to reach the tops of trees through the trunk from roots in the ground. Lignin does not break down easily. It makes wood durable, and protects trees from fungus and bacteria. This is great news for trees, but bad news for some papers. When lignin is left in paper, the paper changes colour pretty quickly. Newsprint usually contains lignin, and newsprint changes colour when exposed to sunlight. In order to make many kinds of paper, the lignin must be removed. This requires a lot of energy and a lot of special chemicals.

Wood is mashed up into a pulp and chemically treated to remove the lignin. It is then washed away to leave paper-friendly fibres such as cellulose, from which the paper is made. Recycled fibres do not need to be treated for lignin – the lignin has already been removed, so a gentler (less energy-intensive) process is all that is needed to break the fibres apart. They can be broken apart about a dozen times before they are too short to be made into more recycled paper.

Part Four: Researching the Life Cycle of a Product

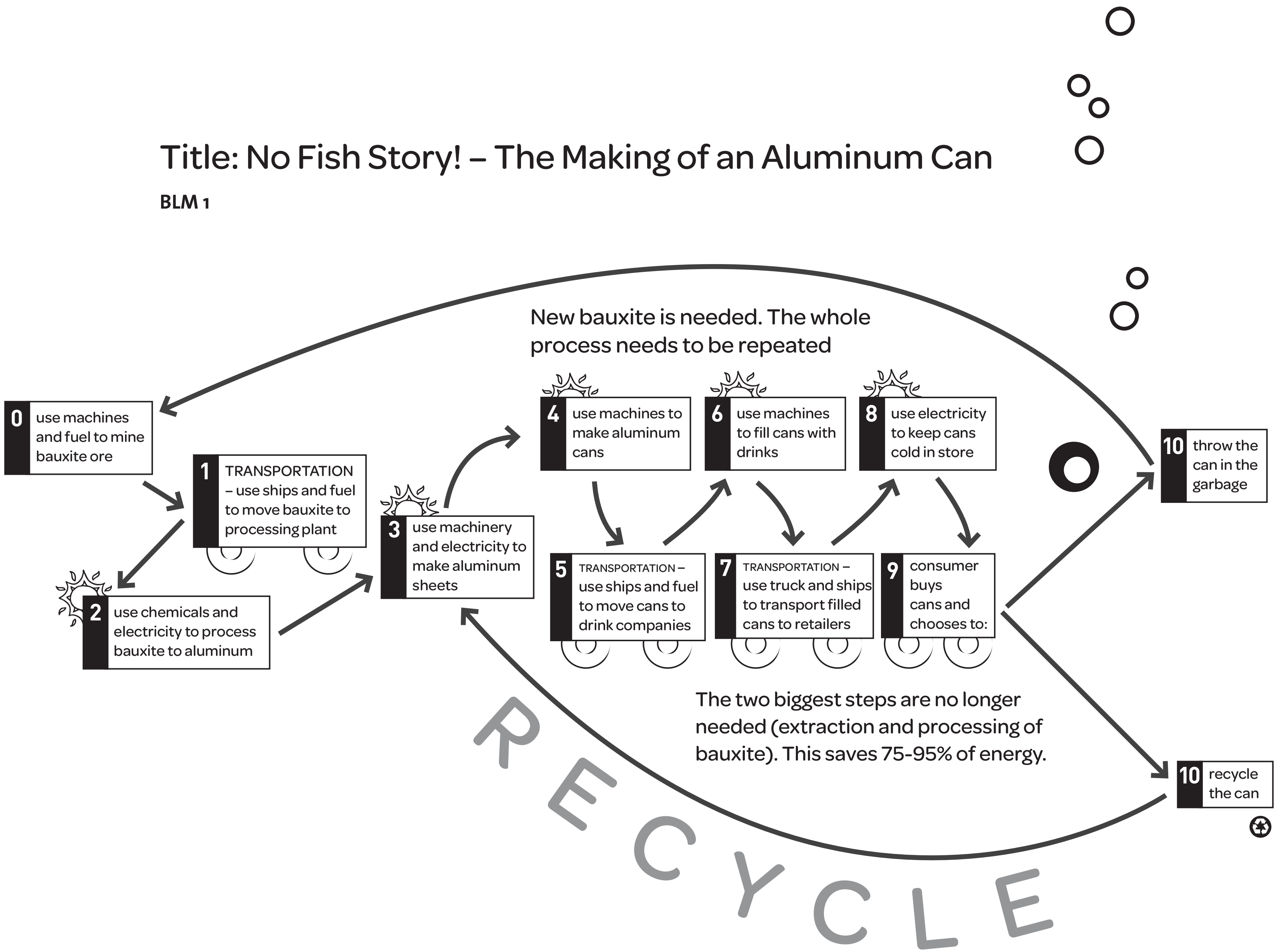
1. Have students work in partners or small groups to research a product of their choice. This activity will help solidify their understanding of matter and materials, how energy is part of the production process, and their own awareness of these processes.
2. Use the following guiding questions to help students organize their information for their research:
   a. What product (matter) have you chosen to learn more about?
   b. What natural resource or raw material is needed to make this product?
   c. Where is energy needed in the life cycle of this product?
   d. What is the effect of taking this raw material from the environment?
   e. Can this product be recycled? How is it done?
   f. What is the recycled product made into after recycling? What are benefits of recycling this product?

Part Five: Review the 3Rs

1. To conclude this series of activities, have a class discussion about the meaning of the 3Rs so that students understand the connection between each "R" and matter cycles and energy flows.
   - **Reducing** the number of products that we purchase means we save not only materials (matter), but also the energy that is embedded in them. This reduces the energy and materials extracted from the Earth, and the fuel used to transport the energy and materials. Before purchasing an item, it is important to consider whether or not the item is really needed.
   - **Reusing** items rather than buying new items also reduces the need for new items. Purchasing used items for yourself or donating your used items to organizations that will reuse them is a good way to reduce the need to produce new items, thus saving both materials and energy.
   - **Recycling** is an industrial process that uses energy, so this "R" saves the least energy of the three. Making products using recycled instead of new materials conserves energy. It is important to be aware of the growing number of materials that are being collected for recycling in one's community.
2. With the class, generate a list of questions related to the 3Rs for discussion and further research. For example:
   - Why do we need to reduce our energy consumption?
   - Who should recycle?
   - What kinds of products can be recycled?
   - Why do we need to reduce our use of paper?

Title: No Fish Story! – The Making of an Aluminum Can

BLM 1



- What does 30% recycled paper mean? What does 100% recycled paper mean?
- What do we need to do to reduce our purchase of plastic products?
- What are toner cartridges? What are they made of?
- How can toner cartridges be reused?

Resources

INDUSTRY AND THE ENVIRONMENT

In this lesson plan, students learn about industry's effect on Earth's ecosystems. Students research a product and evaluate negative environmental impacts and alternatives for companies to use in manufacturing to alleviate these negative environmental impacts. (Source: Earthwatch)

www.earthwatch.org/downloads/lessons/Industry_and_the_Environment.pdf

BROKEN LINK? *Google search* "EarthWatch" → About us → Education → Educator opportunities → Classroom Resources: View Curriculum Ideas and Lesson Plans → Industry and the Environment

This resource 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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