

Reducing Electricity Costs

Science, Grade 9 Applied, SNC1P

Overview

As part of the provincial government's plan for conserving energy and protecting the environment, Ontario has established Time of Use (TOU) rates to encourage all of us to reduce our electricity consumption during peak times.

Students learn about the Energy Star symbol and EnerGuide label information for appliances, the concept of Smart Meters, and TOU rates as they apply to the use of electricity. They research ways to reduce the amount of energy used to run various appliances, including those that are older and less efficient.

Students apply this data to designing a "cost reducing" plan, considering a sample family focused on saving money in their electricity bill, as one example of household expenses (cost of living).

Connections to Financial Literacy

The production cost of electricity is increasing, which is being passed on to the consumer. Therefore, consumer awareness is critical in terms of understanding use and needs as these relate to the cost of living for any family.

Connections to Curriculum

Connections are made to scientific investigation skills related to selecting, organizing, and recording data and drawing conclusions. The content focus is on the strand: *Physics: Electrical Applications*, specifically to investigating and assessing social, economic, and environmental costs and benefits of electrical energy.

The curriculum expectations addressed in each lesson are identified within the lesson plan. The curriculum expectations, including examples and other supporting information, can be accessed through a hyperlink within the lesson.

Considerations for Planning

Ontarians who live in multi-dwelling buildings do not have Smart Meters. Also, if consumers have an electricity contract with an independent provider, they are not required to have Smart Meters.

Be aware that not all students live in homes that are equipped with Smart Meters. Take time during class to explain what a Smart Meter is and how it works. Have a discussion about what the benefits would be of altering times when people use appliances even if their home is not equipped with a Smart Meter.

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Reducing Electricity Costs Lesson

Students learn about the Energy Star symbol and EnerGuide label information for appliances, the concept of Smart Meters, and TOU rates as they apply to the use of electricity. They research ways to reduce the amount of energy used to run various appliances, including those that are older and less efficient. They complete simple cost calculations using different TOU rates based on the time of day and season (summer vs. winter) the electricity is used. Students analyse and compare cost patterns to life style patterns (based on personal experience) and formulate a plan to save money (family budget tied to the cost of living).

Students apply this data to designing a “cost reducing” plan, considering a sample family (determined by the class) focused on saving money in their electricity bill, as one example of household expenses (cost of living). In their plan, they provide strategies for a family to realize some cost savings and consider the environmental and societal benefits of reducing their energy consumption. As a culmination to their investigation, they prepare and submit their plan and write a reflection telling why their plan will help to reduce the amount and cost of electricity the family uses.

Connections to Financial Literacy

The production cost of electricity is increasing, which is being passed on to the consumer. Alternate sources, such as solar panels, are not contributing enough to meet the demands in this province. The current consumption of electricity generated by burning fossil fuels is problematic not only for the consumer but also for the environment. Therefore, consumer awareness is critical in terms of understanding use and needs as these relate to the cost of living for any family.

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Reducing Electricity Costs Lesson	
Curriculum Expectations	Learning Goals
<p>Click here to access expectations in full, with examples.</p> <p>Scientific Investigation Skills</p> <p>A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating)</p> <p>A1.7 select organize and record relevant information on research topics from a variety of appropriate sources ...</p> <p>A1.10 draw conclusions based on inquiry result and research findings and justify their conclusions with reference to scientific knowledge</p> <p>A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats</p> <p>Physics: Electrical Applications</p> <p>E1. assess the major social, economic, and environmental costs and benefits of using electrical energy, distinguishing between renewable and non-renewable sources, and propose a plan of action to reduce energy costs</p> <p>E1.2 propose a plan of action to decrease household energy costs by applying their knowledge of the energy consumption of different types of appliances [PR, AI, C]</p> <p>E2. investigate, through inquiry, the properties of static and current electricity and the cost of the consumption of electrical energy</p> <p>E2.1 use the appropriate terminology related to static and current electricity including, but not limited to: ammeter, ampere, battery, conductivity, current, energy consumption, fuse, kilowatt hours, load, ohm, potential difference, resistance, switch, voltmeter, and volts [C]</p> <p>E2.7 calculate the costs of running common household electrical devices and compare their efficiency [AI, C]</p>	<p>Students will:</p> <ul style="list-style-type: none"> • apply uses of electricity from personal family experience to recommend ways to cut the electricity bill; • complete calculations for cost; compare and analyse the data to synthesize a plan to save money by using TOU rates or less (kWh) electricity; • develop a plan to effectively reduce a family's electricity use and cut costs of electricity. <p>Sample Success Criterion</p> <p>I can create a plan to reduce a family's energy costs by effectively using Time of Use rates and by reducing their electricity use.</p>

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Reducing Electricity Costs Lesson		
Considerations for Planning		
<p>Readiness</p> <p>Students should know:</p> <ul style="list-style-type: none"> • The significance of renewable and non-renewable energy sources; • How electricity consumption is measured by household meters; • How to estimate the amount of time an appliance or electrical device is used; • How to calculate cost of electricity consumption. 	<p>Terminology</p> <ul style="list-style-type: none"> • Energy sources efficiency • Kilowatt hour - kWh • TOU rates • Energy Star symbol • EnerGuide label • Electricity consumption cost calculation 	<p>Materials</p> <ul style="list-style-type: none"> • Handout: Sample Learning Contract • Handout: Cost Saving Plan for Electricity Use • Handout: Sample EnerGuide Labels <p>Websites</p> <ul style="list-style-type: none"> • Understanding the EnerGuide label • Qualistat Building Performance Consultants – EnerGuide • Energy Efficiency Information
<p>Further Considerations</p> <p>The instructional-learning process outlined in this lesson is best done over the duration of the last half of a study on current electricity. It can be accomplished in short time segments, including 1 library research period and 1–2 production periods.</p> <p>Note: To be sensitive to various life styles and home environments, the task is structured around creating a plan for a family whose electricity use is pre-defined.</p>		

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Reducing Electricity Costs <small>Lesson</small>	
Minds On	Connections
<p>Whole Group/Small Groups → Brainstorming Use of Electrical Energy</p> <p>Students brainstorm appliances and electrical devices, large and small, used by a family (based on personal experience) over a week. Record suggestions that will be used in the group analysis.</p> <p>Working in triads, students review the class-generated list and sort the appliances into different categories, using T-charts: (1) daily vs. once a week use; (2) essential vs. nice to have/use; and (3) used often in a week vs. rarely in a week. From patterns in the T-charts, groups create a list of those appliances and electrical devices that are necessary for a family to function effectively, from their perspective. They post their charts.</p> <p>Students share their lists in a gallery walk and, as a class, discuss the differences and similarities between lists.</p> <p>As a basis for their research, the triads revisit and revise their list.</p> <p>Introduce and explain what is required in the task: research, cost analysis and designing a plan to save money on the family electricity bill, using Handout: Cost Saving Plan for Electricity Use. Working with the teacher, the class co-constructs success criteria to be used in a rubric.</p> <p>Students individually enter into a Learning Contract (See Handout: Sample Learning Contract.) to ensure their success in meeting the timelines and in completing the task. They conference with the teacher about their learning contract and reflect on what they need to do before designing the Cost Saving Plan for Electricity Use.</p>	<p>A¹⁰L Students conference with the teacher about their learning contract.</p>

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Reducing Electricity Costs Lesson	
Action!	Connections
<p>Small Groups/Individual → Researching Information about Electricity Use</p> <p>Students research the concept of Smart Meters and Time of Use (TOU) rates and the billing process (cost per kilowatt hour), using information from an electrical energy provider website. They find information about Energy Star ratings and EnerGuide label information as it applies to new appliances and electrical devices. They also identify “tips” to save electricity with appliances old and new (e.g., a freezer should be very full but a refrigerator should not).</p> <p>Individually, students complete a set of calculations for sample appliances and electronic devices from their list, based on kilowatt hours of use and TOU price rates (e.g., washing machine and dryer on twice a week during meal time) for winter and summer.</p> <p>Students exchange their calculations with the members of their triad group and refine their work based on the feedback.</p> <p>As a class, decide on a “sample family” (based on their community) to determine how appliances and electric devices will be used. Students use the co-constructed success criteria, their research and calculations to design the Cost Saving Plan for Electricity Use.</p> <p>Whole Class/Individual → Project: Cost Savings Plan</p> <p>Students individually select a project format from 3 choices:</p> <ul style="list-style-type: none"> • a) “Did We Do It?” kitchen wall chart (poster or map style) • b) 2- or 3-dimensional floor plan model (only the rooms containing appliances and electric devices) with instructions • c) a narrated video (including a storyboard layout) 	<p>Tip</p> <p>Have a folder with different EnerGuide labels. See Handout: Sample EnerGuide Labels.</p> <p>A¹⁵L Students will provide feedback to their peers on the energy cost calculations.</p> <p>Tip</p> <p>Include important information such as the number of people in the family, information about their lifestyle, the appliances/devices that they have and when they use them.</p> <p>Tip</p> <p>Encourage students to use existing electricity calculators such as the one found at: http://www.ontarioenergyboard.ca/OEB/Consumers/Electricity/Your+Electricity+Bill</p> <p>Note: Students complete most of the assignment during class time to provide opportunities for teacher and peer input.</p>
Consolidation	Connections
<p>Whole Class → Sharing Plans</p> <p>Volunteers share their electricity savings plans, answering questions from peers.</p> <p>In a guided discussion students compare the cost savings identified in the various plans to determine their merit.</p> <p>Individual → Reflection</p> <p>Before submitting their Cost Saving Plan for Electricity Use, students write a brief (100 words) reflection, responding to the question: Why will this cost saving plan work to reduce the cost and amount of electricity used by this family? They also consider feedback from the class discussion.</p> <p>They submit their plan and reflection to the teacher.</p>	<p>A¹⁶L Assess students’ learning based on their product and reflection using the co-constructed success criteria reflected in a rubric.</p>

Sample Learning Contract (for Teacher Modification)

A Model of Content and Structure:

My Contract for Developing an Electricity Cost Savings Plan

1. The learning **goal**¹ is:
2. How will I know when I've achieved the learning goal?
What does success look like (refer to the success criteria)?
3. **Format**²: What I need to do to be successful:
(guided thinking for student clarification)
 - A – Research/background information:
(What words will I use to find information?)
 - B – Calculations for the cost of electricity:
(Are they done and peer-reviewed for accuracy?)
 - C - My choice of product is:
(house plan); Materials needed are: (glue, popsicle sticks...)
 - D – Cost saving plan for the family:
(What tips do I have for each appliance in the rooms?)
 - E – Expected Costs Savings
4. **Timeline**³ to meet for Part 3: A _____ B _____ C _____ D _____ E _____
5. **Notes** to self from teacher interview:
(My "to-do" list and things to consider.)

Notes of clarification for the teacher

¹ in student's words to check for understanding

² This will look like a series (3 - 4) of short and simple checklists based on the sample student questions.]

³ Based on those dates/checkpoints set to meet the final due date.

Cost Saving Plan for Electricity Use

How you (and your family) use electricity to run appliances and electronic devices not only has an impact on your family's cost of living but also on the environment.

Follow a 3-step process to design a plan for a family, based on your own experiences and research, to reduce their electricity bill.

Part I – Getting Started

The class will construct a list of appliances and electronic devices to consider as items that can be used differently by anyone in a home e.g., everyone needs to heat food but there are different appliances to do this. You will have a period booked into the library for research. Where might you start to look for information? Concepts to consider:

- New vs. older appliances and electrical devices
- Energy Star ratings
- EnerGuide label information
- Smart Meters
- Time of Use (TOU) rates - the billing process is cost per kilowatt hour
- Recommended "tips" to save electricity

Part II – Cost Analysis

You will be given some data about certain appliances and electronic devices. You will calculate the cost of using them: TOU rate X duration of use (kWh)

In your group, assess each other's work, giving feedback to correct and refine answers. Use this information to design a plan by analysing and comparing differences in cost. A summary chart might be useful!

Part III – Designing a Plan

There are 3 choices for presenting the plan (final product). Use your research and calculation information to design the plan you choose:

(i) A kitchen wall chart created as a poster or map for the family to use like a check list (It could be called: How are we doing?) on a daily or weekly basis. It should be attractive and easy to use. The point is to save money so how will they track this on the chart?

(ii) A floor plan model for only the rooms containing appliances and electric devices – either in a 2D or 3D style. Each room should contain energy saving tips according to the use of electricity.

(iii) A narrated video based on a well organized story board layout including a script. It should be 5 minutes in length, like a mini infomercial.

You will have 2 work periods: _____ and _____. Come prepared with your research and necessary materials on those days. Before submitting your plan, write a reflection (100 words) to respond to the question: *Why will this cost saving plan work to reduce the cost and amount of electricity used by this family?* Submit this reflective writing with your electricity costs savings plan.

The due date is _____.

Sample EnerGuide Labels

ENERGUIDE

123 EnerGuide Street Ottawa, ON K1A 1A1

81

Level of energy efficiency / Niveau d'efficacité énergétique: 65 to 100

Energy Efficiency Target / Objectif d'efficacité énergétique: 80+

Estimated annual energy consumption / Estimation de la consommation annuelle d'énergie

Electricity / Électricité: 9 493 kWh Gas / Gaz: 4 182 m³

File number / N° de dossier: 9901P00001
 Builder / Constructeur: ABC Construction
 Service Organization / Organisme de service: ABC Organization
 Software Version / Version du logiciel: 9.35

Evaluated By: Paul Alliance, 613-555-1234 Date: January 1, 2007
www.homes.gc.ca/maisonsenerguide.gc.ca 1-800-387-2000

Callouts:

- Address:** Identifies the house to which the rating applies.
- Scale:** The low end of the scale represents a house that is built to minimum building code standards. 100 represents a house that is very well insulated, airtight, sufficiently ventilated and that requires no purchased energy (such as solar-powered home).
- Energy Efficiency Rating:** Allows comparison of energy performance with houses of the same size. The more efficient the house, the higher the rating number.
- Estimated Annual Energy Consumption for the House Under Standard Operating Conditions:** Allows comparison of the energy consumption of the house to similar houses, and helps estimate energy costs.
- Software Version:** The EnerGuide rating software edition that was used to determine the home's energy efficiency rating.
- Date:** The date that the energy efficiency evaluation was conducted.

Canada

ENERGUIDE

Energy consumption / Consommation énergétique

125 kWh
per year / par année

▼ This model / Ce modèle

95 kWh to 492 kWh

Uses least energy / Consomme le moins d'énergie | Uses most energy / Consomme le plus d'énergie

Standard / Ordinaire

Model number: 0000

ENERGY STAR HIGH EFFICIENCY HAUTE EFFICACITÉ

The ENERGY STAR® mark on this EnerGuide label signifies that this is an energy-efficient appliance. Its energy performance meets or exceeds the Government of Canada's high efficiency levels. Use the EnerGuide rating to determine how this appliance compares to other similar models.

La marque ENERGY STAR® sur cette étiquette EnerGuide signifie que l'appareil est économe en énergie et que son rendement énergétique satisfait ou dépasse les niveaux de haute efficacité du gouvernement du Canada. Utilisez la cote EnerGuide afin de comparer le rendement de l'appareil avec celui d'autres modèles similaires.

Curriculum Expectations

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Reducing Electricity Costs Lesson	
A. Scientific Investigation Skills and Career Exploration	
Overall Expectations	Specific Expectations
<p>A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating)</p>	<p>A1. Scientific Investigation Skills</p> <p>Initiating and Planning [IP]</p> <p>A1.7 select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., Statistics Canada publications, NASA or EnerGuide websites, personal interviews), using recommended formats and an accepted form of academic documentation</p> <p>Analysing and Interpreting [AI]</p> <p>A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions</p> <p>Communicating [C]</p> <p>A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)</p>
E: Physics: Electrical Applications	
Overall Expectations	Specific Expectations
<p>E1. assess the major social, economic, and environmental costs and benefits of using electrical energy, distinguishing between renewable and non-renewable sources, and propose a plan of action to reduce energy costs;</p>	<p>E1. Relating Science to Technology</p> <p>E1.2 propose a plan of action to decrease household energy costs by applying their knowledge of the energy consumption of different types of appliances (e.g., front-load and top-load washing machines; cathode ray tube [CRT] and liquid crystal display [LCD] computer monitors) [PR, AI, C]</p> <p>Sample questions: Which appliances in the home consume the greatest amount of energy? What are some options for reducing the amount of energy they consume? How cost-efficient is it to purchase a new energy-efficient appliance when a less efficient appliance is still in good working condition?</p>
<p>E2. investigate, through inquiry, the properties of static and current electricity and the cost of the consumption of electrical energy</p>	<p>E2. Developing Skills of Investigation and Communication</p> <p>E2.1 use appropriate terminology related to static and current electricity, including, but not limited to: ammeter, ampere, battery, conductivity, current, energy consumption, fuse, kilowatt hours, load, ohm, potential difference, resistance, switch, voltmeter, and volts [C]</p> <p>E2.7 calculate the costs of running common household electrical devices, and compare their efficiency (e.g., using EnerGuide information) [AI, C]</p>