ELECTRICITY

TEACHER'S GUIDE

printed June 2018

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Electricity was produced by Inside Education to provide teachers with information and ready-to-use lessons on electricity in Alberta (Grades 4-9). The activities contained in this guide are linked to the Electricity poster.

This teaching resource is supported by:

Inside Education thanks these supporters for their generous contributions.

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INTRODUCTION

Welcome to *Inside Education's Electricity Poster* educational resource. The poster and teacher's guide are filled with information and activities that can fit a variety of grades and classroom situations. Have fun exploring electricity with your class!

WHY AN EDUCATIONAL RESOURCE ON ELECTRICITY?

Electricity is an integral part of our modern lives. But there are some important questions:

- *Where does electricity come from?*
- *How is it produced and delivered to us?*
- *What are the science-technology-society-environment (STSE) connections related to its prevalent use in our society?*
- *What does the future hold?*

POSTER OVERVIEW

Showcasing science, technology, stewardship, innovation, and careers relating to electricity, this poster can enhance lessons and provide students with creative critical thinking opportunities.

MAJOR THEMES

Natural resources used in Canada to generate electricity *(front)*
Electricity generation *(front)*
Electricity transmission *(back)*
Electricity consumption *(back)*
Electricity safety *(back)*

ELECTRICITY CONNECTIONS - ALBERTA CURRICULUM

The Electricity poster and teaching resource is designed to provide support for Alberta teachers as they address the curriculum requirements listed on page one. The poster and learning resource was developed with grades 5-9 students in mind but can be adapted to fit with a variety of science, social studies and environmental education topics that explore electricity and natural resources.

ALBERTA CURRICULUM OBJECTIVES

SOCIAL STUDIES

Grade 4

General Outcome *4.1 – Alberta - A Sense of the Land*

Students will:

4.1.1 value Alberta's physical geography and natural environment

4.1.2 critically examine the physical geography of Alberta by exploring and reflecting upon the following questions and issues:

- Where is Alberta located in relation to the other provinces and territories of Canada?
- What are the major geographical and natural vegetation regions, landforms and bodies of water in Alberta (e.g., prairie region, forests, rivers, hoodoos, Rocky Mountains, oil sands)?
- What are the significant natural resources in Alberta and where are they located (e.g., mineral deposits, coal, natural gas and oil, forests)?

4.1.4 analyze how Albertans interact with their environment by exploring and reflecting upon the questions and issues:

- In what ways do the physical geography and natural resources of a region determine the establishment of communities?
- How are natural resources used by Albertans (e.g., agriculture, oil and natural gas, forests, coal)?
- How do Albertans deal with competing demands on land use in Alberta (e.g., conservation, solar and wind power, recreation, agriculture, oil exploration, forest)?

Grade 5

General Outcome 5.1 – *Physical Geography of Canada*

Students will:

5.1.1 value Canada's physical geography and natural environment

5.1.3 analyze how people in Canada interact with the environment by exploring and reflecting upon the following questions and issues:

- In what ways do natural resources and the physical geography of a region determine the establishment of communities?
- How are natural resources used, exchanged and conserved in Canada?

SCIENCE

Grade 5

Topic A: Electricity and Magnetism

Students will:

- Recognize and appreciate dangers involved in using electricity.
- Recognize that the amount of electricity we use in our homes is measured in kilowatt hours.
- Demonstrate that a continuous loop of conducting material is needed for uninterrupted flow of current in a circuit.
- Draw and interpret, with guidance, circuit diagrams that include symbols for switched, power sources, resistors, lights and motors.

Topic B: Mechanisms Using Electricity

Students will:

- Identify example applications of electrical devices in the school and home environment, and classify the kind of uses.
- Design and construct circuits that operate lights and other electrical devices
- Demonstrate different ways of lighting two lights from a single power source and compare the results.
- Demonstrate different ways of using two batteries to light a bulb and compare the results.
- Given a design task and appropriate materials, invent and construct an electrical device that meets the task requirements.

Grade 7

Topic C: Heat and Temperature

Students will:

- Identify and evaluate different sources of heat and the environmental impacts of their use (e.g., identify advantages and disadvantages of fossil fuel use; compare the use of renewable and nonrenewable sources in different applications).
- Identify positive and negative consequences of energy use, and describe examples of energy conservation in their home or community.
- Defend a given position on an issue, based on findings (e.g., defend the use of a particular renewable or nonrenewable source of heat energy in a particular application).
- Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds (e.g., recognize that science and technology develop in response to global concerns, as well as to local needs; consider more than one factor or perspective when making decisions on STS issues).
- Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., recognize the distinction between renewable and nonrenewable resources and the implications this has for responsible action; objectively identify potential conflicts between responding to human wants and needs and protecting the environment).

Grade 9

Topic D: Electrical Principles and Technologies

Students will:

- Identify describe and interpret examples of mechanical, chemical, thermal (heat) and electrical energy.
- Investigate and describe evidence of energy transfer and transformation (e.g., mechanical energy transformed into electrical energy transferred through powers grids, chemical energy converted to electrical energy and then to light energy in a flashlight, thermal energy converted to electrical energy in a thermocouple).
- Investigate and describe techniques for reducing waste of energy in common household devices (e.g., using more efficient forms of lighting, reducing overuse of appliances as in "over drying" of clothes).
- Describe and discuss the societal and environmental implications of the use of electrical energy.
- Identify and evaluate alternative sources of electrical energy, including oil, gas, coal, biomass wind, waves and batteries (e.g., identify renewable and nonrenewable sources for generating electricity).
- Describe the by-products of electrical generation and their impacts on the environment (e.g., identify by-products and potential impacts of coal-fired electricity generation).
- Identify example uses of electrical technologies, and evaluate in terms of benefits and impacts (e.g., identify benefits and issues related to the use of electrical technologies for storing and transmitting personal information).
- Identify concerns regarding conservation of energy resources, and evaluate means for improving the sustainability of energy use.
- Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.h., objectively identify potential conflicts between responding to human wants and needs and protecting the environment).

NATURAL RESOURCES & ELECTRICITY BACKGROUNDER

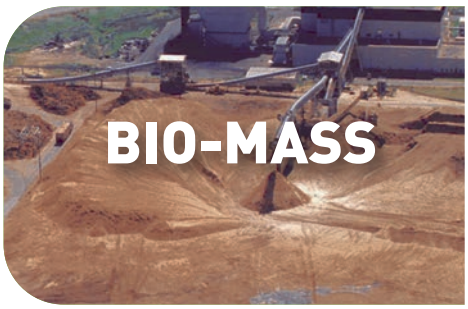
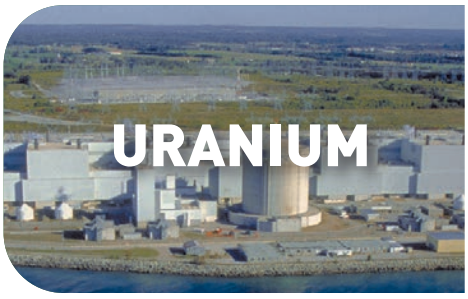
Natural resources used to generate electricity in Alberta and Canada are found in the air, in the water, above ground, and underground.

Many factors are considered before these raw natural resources are changed into electrical energy or electricity. Access to the natural resource, cost to build infrastructure *(e.g. power plants, transmission lines etc.),* the financial market, demand for electricity, and environmental factors are only some of the considerations.

The following chart describe some common opportunities and challenges faced by industries, governments and even consumers when deciding which resource to use to generate electricity.

	OPPORTUNITY	CHALLENGE
	Reservoir can be used for recreational purposes such as canoeing, sailing, and fishing Hydroelectric plants can respond quickly to increases or decreases in electricity demand	High initial costs to construct a hydroelectric dam Land upstream of the dam is often flooded thereby potentially impacting animal habitat, river flow patterns, and access to First Nation, Metis, and Inuit traditional lands
	Comparatively, this resource is inexpensive to extract, because of its abundance and existing infrastructure Power plants are built in close proximity to coal deposits	Greenhouse gas emissions produced when coal is burned to generate electricity Difficult to respond to quick changes in electricity demand
	Accessible fuel source for remote locations Established oil reserves and infrastructure	Exploration techniques (i.e. seismic lines) can impact wildlife predation and movement Water is needed during oil extraction, separation and refining processes

NATURAL RESOURCES & ELECTRICITY BACKGROUNDER

	OPPORTUNITY	CHALLENGE
	Cleanest burning fossil fuel Easy to transport through pipelines	Greenhouse gas emissions produced when natural gas is burned to generate electricity Abundance of this resource gives impression of limitlessness
	Photo-voltaic panels require very little maintenance Panels are portable and can be installed close to where the electricity is needed	Expensive equipment is required Solar electricity advancement hinges on battery technology improvements
	No greenhouse gases produced when electricity is generated from wind Small physical footprint on the landscape	Wind speed is variable; therefore, not a reliable source of electricity Wind turbines obstruct views
	Makes use of waste material that would otherwise contribute to landfills Unlimited fuel sources (e.g. manure, wood chips, ethanol, biomedical waste etc.)	Greenhouse gases produced when waste material is burned Transporting waste material to bio-digesters/power plant
	No greenhouse gases are produced when electricity is generated from nuclear energy Efficient source of electricity (e.g. small amount required to create electrical energy)	Toxic waste that slowly degrades and poses a risk to environmental health Uranium is mined in remote locations and transported long distances to nuclear power plants

Note: Electricity generated by geothermal power plants is not currently happening in Canada. However, small scale geo-exchange systems are being utilized by commercial and residential sectors to heat buildings.

ELECTRICITY POSTER QUICK ACTIVITIES

These quick activities are designed to familiarize your class with the Electricity poster and electricity concepts. The list is included to ***'jump-start'*** the process and get you thinking about all the possible uses of this poster.

A. Electricity – What's My Line?

Divide the class into small groups and provide each group with a copy of the Electricity poster. Have each group come up with a sound or catchy word that relates to electricity. For example, "Zap!" This will be their team name and 'buzzer'. Read the following riddles and award points to the first group that correctly comes up with the answer and finds the corresponding item on the poster. Groups can indicate that they have the answer by shouting out their electricity word or sound.

1. I am spun by wind, steam or water. I turn the wire coil of a generator. What am I?
   — ***TURBINE***
2. Breakers and wires control the flow. I'm often found in the basement, don't you know? What am I?
   — ***ELECTRICAL PANEL***
3. I am the high wires that electricity flows through. Make sure not to touch me for I will ZAP you! What am I?
   — ***TRANSMISSION LINE***
4. Electricity goes through me for a voltage reduction, making it safe for your household functions. What am I?
   (Hint: I have the same name as a popular toy/movie)
   — ***TRANSFORMERS***
5. I'm part of the circuit of electricity. Inside your walls and ceiling is where I will be. What am I?
   — ***WIRE***
6. I can be found in sand or deep under the ground. Once refined I do many things including helping get you around. What am I?
   — ***OIL***
7. Flick on the switch and see me glow. I come in LED, fluorescent and incandescent, just so you know! What am I?
   — ***LIGHT BULB***
8. I can be sweet or sour in my gaseous states. I'm the cleanest-burning fossil fuel, at any rate. What am I?
   — ***NATURAL GAS***
9. I am Ontario's main energy source. Uranium atoms splitting apart with great force. My radioactive waste is safely buried of course. What am I? — ***NUCLEAR POWER***
10. Let's be safe and look around. I'll let you know when wires are underground. What am I?
    — ***"DANGER" SIGN OR "CALL OR CLICK BEFORE YOU DIG" SIGN***
11. I am a solid black fuel formed from plant fossilization. I am a large source of Alberta's power generation. What am I?
    — ***COAL***
12. Gases from these fuel sources doesn't have to go to waste. They can create renewable energy all over the place. What am I? — ***WOOD, PLANT, AGRICULTURAL OR FOREST MATERIAL / BIOMASS***
13. My energy comes from a star far away. Photo-voltaic *(or PV)* cells capture my heat in the day. What am I?
    — ***SOLAR POWER***
14. My blades turn around as the wind blows, resulting in electricity flow. What am I?
    — ***WIND TURBINE***
15. Rivers and waterfalls are nice to see, but also forms of energy. The water's pressure moves the turbines creating electricity. What am I? — ***HYDROELECTRICITY (OR 'HYDRO POWER')***
16. Generating electricity from the earth's heat. Turning water to steam is quite the feat! What am I?
    — ***GEOTHERMAL***

ELECTRICITY POSTER QUICK ACTIVITIES

B. You've Got the Power to Conserve Energy!

Using the large house on the back of the Electricity poster, have students note various action/items that are using, saving or wasting electricity.

- Make a list of 5 items/actions that could conserve electricity *(examples: using LED or compact fluorescent (CFL) bulbs instead of incandescent, turning off lights, computers and computer peripherals when not in use, recycling)*
- Make a list of 5 items/actions that are potentially wasting electricity or could use electricity more effectively. (examples: inefficient lamps and bulbs, ceiling fan on when not necessary, unplugging hair dryer and small kitchen appliances when not in use)

C. Power to the People!

On the front of the poster, there are small purple boxes located beside certain communities. Find the community that is the most similar to the one you live in. Have students pick two of the purple boxes and identify the possible electricity needs of the community. What energy source is closest to the community?
(Hint: is the community you picked close to a wind turbine or the oil sands? If not, what energy source is it near?)

Looking at the surrounding environment, what would be some things that could affect the community's electricity consumption? *(Hint: how would needs change depending on the climate or whether you live in a town or city?)*

D. Safety First!

Locate the red triangle danger signs on the back of the poster. Discuss why these situations have been identified as electrical safety hazards, and the importance of being aware of these hazards. Similar to those located on the front of the poster, have students create their own safety slogans or signs for the hazards discussed. Display these signs around the class.

Extension Questions

Broaden your students' understanding of electricity with these extension questions. These questions relate directly to the Electricity poster. Use the Electricity poster as a starting point to generate discussions in your classroom.

A. Many people in Canada and around the world work with electricity both directly and indirectly. Using the poster, what are some jobs that people have that involve electricity? Do you believe these careers will change in 30 years? What predictions can you make about how they may change and why?

B. Draw students' attention to the EnerGuide label located near the large appliances on the house graphic. Discuss the importance of electricity conservation and efficiency programs such as EnerGuide and
ENERGY STAR. Can you find any ENERGY STAR or EnerGuide labelled electronics or appliances within the school? With your students, brainstorm ways the school can become more energy efficient. Create conservation slogans to display around the hallways of your school.

C. Power outages can happen for a variety of reasons (e.g. extreme weather). It may not always be an emergency situation, but it is important to be prepared for such an event. Divide your class into small groups and brainstorm items that would be useful to have during a power outage. Additional points to discuss: storing these items in a central location and ensuring electrical devices (example cordless phones, radio, smoke alarms) have back-up batteries installed.

D. Look at the pie chart on the front of the poster titled 'Alberta's Electricity Sources.' As of 2013:

- What percentage of electricity is created by thermal generation (i.e., combustion) (coal + natural gas + biomass + other (co-generation & diesel fuel) = 87%)
- What percentage of electricity is generated by renewable resources (water + wind + biomass = 17%)
- Discuss how this graph could look 5, 10 or 50 years into the future

Extension Questions

E. Name four kinds of recreational activities occurring on the poster. (cycling, golfing, snowmobiling, hiking, boating, sailing, bird watching, camping) How many of them involve using electricity? Brainstorm ways in which students personally use electricity throughout their day.

F. Using the poster, find three ways that water is used in the process of generating electricity.

- Hydro – water pressure to spin the turbine, connected to generator to make electricity
- Coal, oil – burning these fossil fuels to heat water, which generates steam pressure, used to spin a turbine that is connected to a generator to make electricity
- Geothermal - water that is injected deep underground is warmed by the earth's heat; the water turns to steam as it is pumped back up to the surface, and then used to spin a turbine

G. Across Canada, a variety of different resources are used to make electricity. Using the map on the front of the poster, compare Alberta and Ontario. Compare British Columbia and Manitoba. Compare the Northwest Territories and Nova Scotia. What are the similarities/differences and why? (Geography, topography, availability, environmental, social, and economic factors all determine the electricity sources that will be used in a specific geographic region.)

H. Find the Electricity Story schematic on the back of the poster and follow the flow of electricity from power generation all the way to power retail, also known as consumers.

- Do different sectors of society require amounts of electricity to complete their work? (Certainly, and generally, industry uses the most electricity to process and manufacture goods and materials to consumers)
- How can public spending habits impact the amount of electricity required by large and light industrial consumers? (Making sustainable and responsible spending choices is a positive way to impact the amount of electricity required to process and manufacture goods. Asking yourself if the item is absolutely necessary or if it's possible to rent, lease or even buy it second hand or a refurbished model).

ELECTRICITY AND THE ENVIRONMENT

CO_2 Challenge

OBJECTIVE

This activity will help students understand how their electrical consumption patterns can have an effect on CO2 emissions. This will be done through an investigation of household electrical consumption patterns and the amount of carbon dioxide produced from this.

Students will calculate the amount of carbon dioxide that their family produces through electrical consumption. Students will link their electrical energy consumption to the natural environment.

MATERIALS

- One copy of a home monthly electrical bill per student

TIME: 1 CLASS PERIODS

ALBERTA CURRICULUM CONNECTIONS

Grade 4 Social Studies: *Alberta – A Sense of the Land*
Grade 5 Social Studies: *Physical Geography of Canada*
Grade 5 Science: *Electricity and Magnetism*
Grade 7 Science: *Heat and Temperature*
Grade 9 Science: *Electrical Principles and Technologies*

Introduction

The earth has its own temperature regulation system - the "greenhouse effect". The greenhouse effect is a natural warming of the earth's atmosphere caused by gases that trap the sun's heat near the earth's surface. These gases include carbon dioxide (CO2), water vapour and methane. Without the greenhouse effect, the earth would be too cold and unable to support life.

Many human activities release carbon dioxide into the atmosphere; as the concentration of these gases increase, the natural greenhouse effect intensifies and becomes more efficient at trapping heat near the earth's surface. The warming of the earth caused by this over efficient greenhouse effect results in changes in the naturally occurring weather patterns. This process is known as climate change.

The burning of fossil fuels, such as coal and natural gas, to create electricity releases carbon dioxide into the atmosphere. CO2 is the leading gas contributing to the acceleration of the greenhouse effect.

Activity

1. Students will need to bring in an electrical bill from their home or be provided with a copy of an electrical bill.

2. Discuss the terms watt and kilowatt hours.
   Watt (W): A unit used to measure amounts of electrical energy used. One watt is a very small amount of electricity.
   Kilowatt (kW): One kilowatt is equal to 1000 watts.
   Kilowatt hour (kWh): A unit used to measure how much energy is required are used by 1000 W working for one hour (Example: The average household uses 55 kWh per month for the television).

3. Use the graph on the electricity bill to estimate the kWh used each month. Add the monthly totals together to get an approximate number of kWh of electricity consumed in the past year. Alternatively, students can take the monthly total and multiply it by 12 to get a rough annual total.

In Alberta, for every 100 kWh of electricity consumed approximately 86 kg of carbon dioxide is produced*. In order to determine the amount of carbon dioxide each household produces per year, divide the kWh of electricity consumed per year by 100 and then multiply by 86.

E.g. Average Electricity Consumption per year: 7200 kWh

$$\frac{7200\ \text{kWh}}{100\ \text{kWh}} = 72.00 \quad \text{------} \quad \textit{72.00 x 86 kg = 6126 kg}$$

6126 kg of carbon dioxide are released when 7200 kWh of electricity is consumed.
**Source: Environment Canada National Inventory Report 2013.*

According to the United States Environmental Protection Agency (EPA), approximately 52kWh/year can be saved by replacing a 60 Watt incandescent bulb with a compact fluorescent (CFL) or light emitting diode (LED) bulb. Have students count the number of CFL or LED bulbs in their homes. Use the formula below to discover the reduction in CO2 emissions made by their households each year.

Example: 10 bulbs x 51 kWh = 520 kWh
(510 kWh / 100) x 86kg = 438.6 kg

4. Discuss the effects of carbon dioxide, greenhouse gases and global warming.
   - Why is it important to be aware of our consumption patterns?
   - What are some things that students can do in their daily lives to reduce the production of carbon dioxide?

Extension

Calculate the amount of carbon dioxide that is produced by the school. How could this be reduced? As a class, plan a CO2 Challenge Day where students try to reduce energy consumption.

Using the pie charts on the inside of the poster and a map of Canada, have students come up with reasons why different provinces would rely on different sources of energy. Would this effect the amount of CO2 produced??
Consider the following questions:

- *Which provinces are located close to major water courses (especially large rivers)?*
  Hint: Large rivers = better chance for hydroelectricity to be important electricity source
- *What are the major natural resources in each of the provinces?*

Have students investigate their home appliances.

- *How many watts do different household appliances use?*
- *What is the difference in energy consumption between appliances that have an Energy Star rating and those that do not?*
- *Develop an inventory of appliances that students use and how much they use them per week. Using the ratings from appliances and the cost of electricity in your area, have students figure out how much it costs to use these appliances per week.*

ELECTRICITY AND STEWARDSHIP

Awareness to Action

OBJECTIVE
This activity will increase students' awareness of their household electrical use and encourage stewardship action.

MATERIALS
- Awareness to Action Audit worksheet
- Electricity poster

TIME: 2 CLASS PERIODS

ALBERTA CURRICULUM CONNECTIONS
Grade 5 Science Topic A: *Electricity and Magnetism*
Grade 9 Science Topic D: *Electrical Principles and Technology*

Introduction

As shown on the Improving Efficiency graph located on the back of the poster, Canadians have been making energy efficient choices when purchasing new major appliances. However between 1990 and 2010, the amount of energy used by small appliances has increased by 148%; this increased use of small appliances and electrical devices in Canadian households essentially causes the overall home electricity savings made by the major appliances to be null and void.

Activity

1. As a class, brainstorm small appliances (including all electronic devices) currently used in the average home. (small kitchen appliances, video game devices, desktop computer, cable box, personal video recorder, cellular phone chargers, tablets, personal music players, hair dryer, curling iron, etc.)
2. Distribute "Awareness to Action Audit" page. Have students estimate their household electricity use.
3. In small groups, consider the following:
    - Identify any appliances from the brainstorm list that are non-essential to your every day life (example: two appliances that have similar functions)?
    - What can be done with these extra or underused appliances? (donate or sell the appliance, pass them onto a friend)
    - Identify which appliances and electronic devices are essential to your every day life. How can you re-think your personal electricity use in order to conserve the amount of electricity used by small appliances? (unplug appliances when not in use, use power bars, charge electronic devices for the recommended amount of time, sharing electronic devices with family members etc.)
    - Would your stewardships actions differ if the electricity used was generated by a renewable resource?

ELECTRICITY AND STEWARDSHIP

Awareness to Action audit | Student Worksheet

Appliance	Watts Used by Appliance (W)		Hours Used/Day		Average Days/Month		kWh/month (divide by 1000)
Cell Phone Charger	4	x		x	30	=	
Cable Box	20	x		x	30	=	
Microwave	1500	x		x	30	=	
LCD TV	213	x		x	30	=	
Computer and Monitor	270	x		x	30	=	
Video game system	195	x		x	30	=	
Fridge	188	x		x	30	=	
Dishwasher	1800	x		x	30	=	
Washing Machine	425	x		x	30	=	
Dryer	3400	x		x	30	=	
Hair Dryer	1538	x		x	30	=	
Compact Fluorescent Light bulb (CFL)	18	x		x	30	=	
						Total kWh/month	

** Average Albertan household uses 600 kWh/month (Source: Alberta Energy, 2014)*

Take action on your energy audit

You may be surprised at how energy efficient you are already being. Take a look around your home for Energy Star labelled appliances, compact fluorescent *(CFL)* or light emitting diode *(LED)* bulbs.

List two ways you can improve your home's energy efficiency.

Standby power or phantom power is the electricity that an appliance uses when it is in standby mode or switched off. Identify which appliances in your home require standby power. *(Hint: these appliances may have a display screen, a small light, or a sleep/power saving mode)*

List two ways you can reduce standby power use in your home.

ELECTRICITY AND NATURAL RESOURCES

Generating Perspective

OBJECTIVE

This activity will explore energy resources in Alberta and Canada that are used to generate electricity and evaluate electricity generation from social, economic and environmental perspectives.

There are eight different energy sources used for the generation of electricity displayed on the Electricity Poster. Have your class study the poster to find all 8 sources.

TIME: 3 CLASS PERIODS FOR RESEARCH AND 1 CLASS PERIOD FOR PRESENTATION

ALBERTA CURRICULUM CONNECTIONS

Grade 4 Social Studies: *Alberta: A Sense of the Land*
Grade 5 Social Studies: *Physical Geography of Canada*
Grade 9 Science: *Electrical Principles and Technologies*

Sources

RENEWABLE - Wind, Water/Hydro, Geothermal, Solar, Biomass

NON-RENEWABLE - Coal, Natural Gas, Uranium/Nuclear

Activity

In Canada we use a combination of all of these sources to meet the demand for electricity. Each source has opportunities and challenges associated with its production and use. Encourage your students to learn more and evaluate energy sources by conducting a research project. Get creative in how the research is presented by encouraging your students to use posters, multi-media or models. Use the assessment rubric and natural resources and electricity backgrounder as a reference.

Suggested questions for guiding research:

- *What is the energy source, is it renewable or non-renewable and where is it found in Alberta/Canada?*
- *How is the source used to generate electricity? Describe the process.*
- *Investigate the environmental costs and benefits of developing the source for electricity.*
- *What are some of the challenges of the energy source that might limit its widespread use?*
- *Compare the use of the energy source across Canada, which provinces use it the most and why?*
- *Explore technology and innovation in the generation of electricity from the energy source.*
- *Identify stewardship actions (personal, school, community, provincial, federal, and/or global) that contribute to energy conservation and efficiency in relation to the energy source.*

Generating Perspective — Assessment Rubric

	Exemplary 4	Accomplished 3	Developing 2	Beginning 1
Research	Demonstrates a thorough, thoughtful and insightful understanding of the topic	Demonstrates a thorough understanding of the topic.	Demonstrates an incomplete understanding of the topic.	Demonstrates a lack of understanding of the topic.
Research	Includes a full exploration of values and perspectives related to generation of electricity and natural resource development	Begins to explore values and perspectives related to generation of electricity and natural resource development	Identifies values and perspectives but does not explore them in relation to generation of electricity and natural resource development	Does not identify or explore values and perspectives.
Presentation	Presented content clearly and concisely with a logical progression of ideas and effective supporting evidence.	Presented most of the content with a logical progression of ideas and supporting evidence.	Presented content which failed to maintain a consistent focus, showed minimal organization and effort, and lacked an adequate amount of supporting evidence.	Presented content which was unfocused, poorly organized, showed little thought or effort and lacked supporting evidence.
Evidence Based Research	Skillfully incorporated evidence from appropriate sources to reinforce arguments and/or ideas.	Evidence from mostly appropriate sources is used to strengthen arguments and/or ideas.	Insufficient evidence is used and has minimal connection to the arguments and/or ideas presented.	Insufficient or lack of evidence is used and does not related to the arguments and/or ideas presented.

**Rubric adapted from Alberta Education Social Studies 8 Exemplar Rubric and University of Wisconsin - Research Process Rubric for Middle School*

Extension

Using the information gathered from all the energy sources have a class discussion responding to the question ***"If you could choose which energy source your power comes from, which source would you choose and why?"*** Remember that there is no perfect energy source. In Canada and Alberta we rely on a variety of natural resources to meet our electricity wants and needs.

ELECTRICITY LAB

Lights On!

OBJECTIVE

- Students will have the opportunity to use scientific inquiry to compare incandescent, fluorescent and light emitting diode *(LED)* bulbs.
- Students will be able to identify incandescent, fluorescent and LED lightbulbs.
- Students will understand the difference in the way that the three types of bulbs create light.
- Students will research the differences in the three types of bulbs from scientific, economical and environmental perspectives.

TIME: 2 CLASS PERIODS

MATERIALS

- A variety of fluorescent, incandescent
- and LED lightbulbs – one of each per group Lamps to test the bulbs
- Electricity poster
- Thermometers
- Light meters

ALBERTA CURRICULUM CONNECTIONS

Grade 4 Social Studies: *Alberta – A Sense of the Land*
Grade 5 Social Studies: *Physical Geography of Canada*
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Activity

1. As a class, brainstorm ways that the lightbulbs may be compared. *(e.g., amount of heat released, the time each lightbulb lasts, amount of light energy emitted, cost of each lightbulb)*.

2. Divide students into groups. Remove packaging from the lightbulbs and distribute one fluorescent lightbulb, one incandescent lightbulb, one LED lightbulb, a lamp and the student worksheet to each group. Students will need approximately 30 minutes to compare the lightbulbs.

3. Have students list their hypothesis about the efficiency of lightbulbs focusing on how they might be able to tell which bulb is more efficient and how each light bulb works.

4. Using the student worksheet as a guide, have groups develop and conduct an experiment to test their hypothesis.

5. Once experiment is complete have students examine the packaging to gain further information and complete the summary chart on the worksheet. Discuss how the hypotheses and experiments that each group generated were similar/different. Was there a consensus as to which lightbulb was the most efficient? Would different lightbulbs be more appropriate for different areas?

Lights On!

Extension

1. Calculate the cost per watt of each bulb. Compare the cost per year to use each bulb. Compare the price of each bulb. Which bulb would be less expensive in terms of original cost and energy costs?
2. Have students evaluate school or home lighting. What types of lights are used? Would there be a more efficient option? How much energy would be saved by using these more energy-efficient options?

ELECTRICITY LAB

Lights On! | *Student Worksheet*

Instructions

Using the scientific method and the discussions held in class, predict the results of an experiment that compares incandescent lightbulbs, compact fluorescent lightbulbs and light emitting diode bulbs. Conduct the experiment and record your results.

CAUTION: *Be careful when handling electrical equipment. Unplug lamps before changing bulbs, do not touch exposed electrical circuits and allow hot bulbs to cool down before touching them.*

Background information

There are three main types of light bulbs on the market today: incandescent, compact fluorescent *(CFL)*, and light emitting diode *(LED)*. These light bulbs differ in appearance, purchase price, and energy efficiency. Each of these types of light bulbs can be found by examining the Electricity Poster.

Question:

Which light bulb is the most energy efficient *(produces the most light using the least amount of energy)*?

Hypothesis: _____

Develop an experiment to test your hypothesis.

Experimental Design:

Materials:

Results:

Using the information from the lightbulb packages, the Electricity poster and the background information, complete the following chart:

Type of Light Bulb	**Watts**	**Light output** *(Lumen)*	**Life Span** *(in hrs or yrs)*	**Average Cost**	**Other Notes**
Incandescent					
Compact Fluorescent					
Light Emitting Diode					

Conclusion:

ELECTRICITY LAB

Electromagnetic!

OBJECTIVE

- Students will be introduced to the relationship between electricity and magnetism by building an electromagnet.
- Students will investigate the properties that make a strong electromagnet.
- Students will be introduced to the relationship between electricity and magnetism.

TIME: 1 CLASS PERIOD

MATERIALS

- D-Cell batteries (2 per group)
- #22 insulated copper wire/wire with enamel
- coating (can be purchased at a local hardware store)
- Paper clips
- Nails (iron)
- Tin foil
- Electrical tape

ALBERTA CURRICULUM CONNECTIONS

Grade 5 Science: *Electricity and Magnetism*
Grade 9 Science: *Electrical Principles and Technologies*

Introduction

Many modern devices and appliances including electric motors, computers, telephones, doorbells and televisions use electromagnets. Magnetism is an attraction between particles with an electrical charge. This attraction creates fields of force known as magnetic fields. When a metal core, such as iron, is placed inside of a coil of wire that is carrying an electrical current, as electromagnet is formed. The strength of the magnet depends on the strength of the electrical current. The magnetic field exists only as long as the electrical current flows.
Discuss the relationship between magnetism and electricity. Tell students that they will have the opportunity to develop a magnet using electricity. Distribute materials to each group.

Activity

Provide students with the following instructions:

How to Build an Electromagnet:

1. Leaving extra wire at each end, wrap the wire tightly around the nail in loops.
2. Attach one end of the wire to each end of the battery and tape it in place with electrical tape.
3. Touch the end of the nail to a paper clip – the nail should be able to pick up the paper clip.
   - How many paper clips are you able to pick up?
   - Experiment with the following to se the maximum number of paper clips that you can pick up with a magnet:
     - Wrap more/less coils around the nail
     - Change the tightness of the coils
     - Use different sizes of nails
     - Wrap tin foil around the magnet before wrapping the wire around
     - Join 2 batteries together *(do not use more than 2 batteries)*

Discuss as a class how many paper clips students were able to pick up and what the best strategies were for increasing the magnetism of the nail.

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