

Module 3: Explore Electricity: The Backbone of Modern Inventions

Many of the learning experiences (LEs) in Module 3: Explore Electricity: The Backbone of Modern Inventions rely on knowledge acquired in Module 2: Explain That Again: A Further Investigation. It is, therefore, suggested that Modules 2 and 3 LEs be addressed concurrently (in close proximity) so that concepts can be reinforced shortly after they have been introduced.

Contact another Grade 6 teacher to plan an email exchange of students' experiments and observations during the Module 3 LEs (see ICT.2 Riddle This).

Contact Manitoba Hydro (<<http://www.hydro.mb.ca>>) to obtain the following resources:

- *Energy and You: Middle Years*—an Energy Education kit for Grades 6 to 8
- *Teacher Resource Catalogue*—describes all the grade-appropriate resources mentioned in Module 3, including publications/posters, videos that can be booked, and generating stations that can be visited during field trips.

All electricity resources suggested in this Module 3 are cited in the Selected Bibliography.

Completing all the LEs in Module 3 will enable students to achieve all the specific learning outcomes (SLOs) identified in Cluster 3: Electricity of the Grade 6 Science curriculum.

The six LEs that make up Module 3: Explore Electricity: The Backbone of Modern Inventions are described below.

LE Title	Estimated Time	Overview
Mod.3.1: Static Electricity	150 minutes	Students investigate static electricity in common objects. They construct an electroscope to test a variety of objects for static electricity. They write a definition of static electricity using the appropriate vocabulary they learn throughout this learning experience.
Mod.3.2: Current Electricity	150 minutes	Students explore current electricity. Through experimentation, students learn how simple series and simple parallel circuits work. They write a definition for an electrical circuit.
Mod.3.3: Electrical Circuits	150 minutes	Students improve their electrical circuits and discover what changes make a light bulb brighter. They investigate and invent useful electrical circuits, including switches.
Mod.3.4 Electromagnetism	120 (2 x 60) minutes	Students explore electromagnetism by building an electromagnet. They explore motors and generators by constructing a generator or a motor that can be used to power a simple device they would find useful in their daily life.
Mod.3.5: Awareness of Electrical Energy Consumption	180 (3 x 60) minutes	Students describe factors that affect the consumption of electrical energy, thereby raising their awareness of energy use. They outline an action plan to reduce energy consumption and promote their plan. They describe ways in which electricity has an impact on their daily life.
Mod.3.6: Safety with Electricity	90 minutes	Students design a poster or a web page to promote safety with electricity. Note: Mod.3.6: Safety with Electricity should be undertaken after Mod.2.4: Chindogu: Useless Inventions has been completed.

Static Electricity

Mod.3.1

TIME

150 minutes

OVERVIEW

Students investigate static electricity in common objects. They construct an electroscope to test a variety of objects for static electricity. They write a definition of static electricity using the appropriate vocabulary they learn throughout this learning experience.

LEARNING OUTCOMES

Through this learning experience (LE), students will achieve specific learning outcomes (SLOs) in various subject areas. Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified.

English Language Arts

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- 1.1.1 *Express Ideas* — Engage in exploratory communication to share personal responses, make predictions, and discover own interpretations.
- 1.2.1 *Develop Understanding* — Reflect on prior knowledge and experiences to arrive at new understanding.
- 1.2.2 *Explain Opinions* — Explain personal viewpoints in clear and meaningful ways and revise previous understanding.
- 1.2.4 *Extend Understanding* — Appraise ideas for clarity and ask extending questions; select from others' experiences and ideas to extend ways of knowing the world.
- 2.3.3 *Vocabulary* — Experiment with ambiguity in language [such as puns, jokes based on multiple meanings, poetry...] in a variety of contexts.
- 5.2.1 *Cooperate with Others* — Assist group members to maintain focus and complete tasks; identify and solve group process issues.

Science

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- SLOs related to Scientific Inquiry or the Design Process in Cluster 0: Overall Skills and Attitudes.
- 6-3-01 Use appropriate vocabulary related to their investigations of electricity.
Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.
- 6-3-02 Explain the attraction and repulsion of electrostatically charged materials.
Include: negatively and positively charged materials attract one another; materials of like charge repel one another.
- 6-3-07 Experiment to classify a variety of materials as insulators or conductors.

ICT LITERACY SKILLS AND COMPETENCIES

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which skills and competencies students may achieve, in addition to those identified below:

- basic operating skills
- inquiry using electronic sources
- spreadsheet analysis

SUGGESTED LEARNING RESOURCES**Software**

- spreadsheet

Internet

- IMYM Links Database: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>

Video

- Manitoba Hydro. *A Spark in the Dark: Static Electricity*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1991. (VHS, 12 min.)

Print

- Appendix C: Index of Teaching and Learning Strategies and Tools
- Manitoba Education and Training. *Grades 5 to 8 Science: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 2000.
- Manitoba Hydro. *Electrical Terminology*. Winnipeg, MB: Manitoba Hydro, n.d.

BLM

- BLM Mod.3.1#1: Electrostatics Test

TBLM

- TBLM Mod.3.1#1: Conducting a Fair Test: Observation Checklist

Materials

- balloons
- plastic rulers
- cloth (wool, silk, cotton)
- pieces of paper
- comb
- puffed rice
- plastic bags

SUGGESTIONS FOR INSTRUCTION**Preparation and Set-up**

- Assemble all materials listed in the Suggested Learning Resources.
- Access appropriate websites listed in the IMYM Links Database for this LE. Bookmark the websites on the class computers or ask students to do so before beginning this LE.
- Contact another Grade 6 teacher to plan an email exchange of students' experiments and observations during the LEs in Module 3: Explore Electricity: The Backbone of Modern Inventions (see ICT.3: Riddle This).

Activating Strategies

- **Note:** Explain and demonstrate proper handling techniques and safety procedures for equipment throughout this LE.
- Make and post a class Word Splash of appropriate vocabulary. Start with about six words related to electricity (e.g., repel, attract, charged, static). Students write a definition for the words in their notebooks, based on their prior knowledge. In collaborative groups, they discuss their definitions. Later, all groups share their definitions with the class, to refine their understanding. As they work through the LEs in this interdisciplinary unit, students add more electricity-related words to the class Word Splash.
- Demonstrate an example of static electricity (e.g., quickly removing a wool hat so that hair “stands on end”). Students hypothesize what is happening and try to explain it. Record all their hypotheses on a class Hypothesis Chart.
- Demonstrate the following:
 - Inflate a balloon and hold it up to a wall. (It falls.)
 - Rub the balloon on someone’s hair and hold it up to the wall. (It sticks.)Students hypothesize what happened and record their findings on the class Hypothesis Chart. Use correct terms (e.g., positively charged, negatively charged, attracts) when describing what is happening.
- Students brainstorm for times when they have encountered static electricity (e.g., shuffling feet on a carpet and touching someone, waving a hand near a TV, brushing hair, removing coat and finding clothes stuck to body). Students should use applicable terms (e.g., repel, attract, positively charged, negatively charged, static).

Acquiring Strategies

- Students investigate more static electricity using materials assembled for this LE. They note their observations.
- Students watch the video *A Spark in the Dark: Static Electricity* (Manitoba Hydro). They review their electricity-related terms and definitions.
- Students share their observations related to experimenting with static electricity and explain what is happening using appropriate vocabulary.
- Students review each hypothesis about objects and static electricity on the class Hypothesis Chart. Based on what they have learned so far, they discuss which hypotheses are valid, which are not valid, and why.

Applying Strategies

- Students go on the Internet to find directions for constructing an electroscope. Following directions found at a selected website, students construct an electroscope in their collaborative groups. They test a variety of objects found in the classroom and record what happens during each test.
- In collaborative groups, students re-test the objects previously tested, as well as any others they think might be suitable. Using appropriate vocabulary, students complete BLM Mod.3.1#1: Electrostatics Test. They record on a chart or on a spreadsheet which objects share a positive attraction and which ones share a negative attraction. Students post the charts or spreadsheets in the classroom.
- Students do a Gallery Walk, reading the various charts or spreadsheets for findings. Any findings that are different from their own should be noted, investigated, and discussed further.
- Students write a definition of “static electricity” in their science notebook, on an Exit Slip, or in an email to their teacher, using appropriate vocabulary correctly.

Variations/Extensions

- Add the vocabulary on electricity to the class Vocabulary Database (see OLE.2: Daily Edit and ICT.12: Chart This).
- Use students' definitions of "static electricity" or other student-composed text in OLE.2: Daily Edit.

SUGGESTIONS FOR ASSESSMENT

- Read the Hypothesis Chart generated and reviewed by the class. Note gaps in students' understanding and address any issues that are not clear.
- Review BLM Mod.3.1#1: Electrostatics Test to determine students' understanding of the concepts.
- Use the vocabulary on electricity for spelling practice.
- Observe students' work habits and proper handling of equipment using TBLM Mod.3.1#1: Conducting a Fair Test: Observation Checklist.
- Check group charts or spreadsheets for correct use of appropriate vocabulary.
- Check whether students use appropriate vocabulary in their class and group discussions.

CONNECTION TO INVENTION CONVENTION

- Students' experimentation with electricity helps them understand electricity as an important force behind major inventions and helps them think about how they can use electricity in developing their own invention.

TBLM Mod.3.1#1: Conducting a Fair Test: Observation Checklist

Experiment _____ Date _____

A group of students can be selected as a focus for observation on a given day, and/or one or more of the observational areas can be selected as a focus. The emphasis should be on gathering cumulative information over a period of time.

Student Names	Has Safe Work Habits (workspace, handling equipment)	Ensures Accuracy/ Reliability (e.g., repeats measurements)	Works with Group Members to Carry out Plan	Shows Evidence of Perseverance and/or Confidence	Comments
1.					
2.					
3.					
4.					
5.					
6.					
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10.					
11.					
12.					
13.					
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15.					
16.					

Conducting a Fair Test: Observation Checklist: Reproduced from *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training BLM 6-G).

Current Electricity

Mod.3.2

TIME

150 minutes

OVERVIEW

Students explore current electricity. Through experimentation, students learn how simple series and simple parallel circuits work. They write a definition for an electrical circuit.

LEARNING OUTCOMES

Through this learning experience (LE), students will achieve specific learning outcomes (SLOs) in various subject areas. Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified.

English Language Arts

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- 1.1.1 *Express Ideas* — Engage in exploratory communication to share personal responses, make predictions, and discover own interpretations.
- 1.2.1 *Develop Understanding* — Reflect on prior knowledge and experiences to arrive at new understanding.
- 1.2.2 *Explain Opinions* — Explain personal viewpoints in clear and meaningful ways and revise previous understanding.
- 1.2.3 *Combine Ideas* — Search for ways to reorganize ideas and information to extend understanding.
- 1.2.4 *Extend Understanding* — Appraise ideas for clarity and ask extending questions; select from others' experiences and ideas to extend ways of knowing the world.
- 2.3.3 *Vocabulary* — Experiment with ambiguity in language [such as puns, jokes based on multiple meanings, poetry...] in a variety of contexts.
- 2.3.5 *Create Original Texts* — Create original texts [such as letters, short stories, media broadcasts, plays, poems, video presentations, Readers Theatre...] to communicate and demonstrate understanding of forms and techniques.
- 5.2.1 *Cooperate with Others* — Assist group members to maintain focus and complete tasks; identify and solve group process issues.

Science

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- SLOs related to Scientific Inquiry or the Design Process in Cluster 0: Overall Skills and Attitudes.
- 6-3-01 Use appropriate vocabulary related to their investigations of electricity.
Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.
- 6-3-03 Explain current electricity, and compare the characteristics of current and static electricity, by using a model.

- 6-3-06 Develop a definition of an electrical circuit, based on classroom explorations.
Include: an electrical circuit is a continuous path for charges and must contain a power source and a conductor.
- 6-3-07 Experiment to classify a variety of materials as insulators or conductors.
- 6-3-09 Construct and diagram simple series circuits and simple parallel circuits.

ICT LITERACY SKILLS AND COMPETENCIES

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which skills and competencies students may achieve, in addition to those identified below:

- basic operating skills
- inquiry using electronic sources

SUGGESTED LEARNING RESOURCES

Software

- spreadsheet
- *Crocodile Clips Elementary*

Note: This software is available on the CD-ROM version of the *Inventions, Innovations, and Discoveries* interdisciplinary unit.

Internet

- IMYM Links Database: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>

Video

- Manitoba Hydro. *Creating and Controlling Current Electricity*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1991. (VHS, 13 min.)

Print

- Appendix C: Index of Teaching and Learning Strategies and Tools
- Manitoba Education and Training. *Grades 5 to 8 Science: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 2000.
- Manitoba Hydro. *Experiments with Electricity*. Winnipeg, MB: Manitoba Hydro, n.d.
- ---. *Producing Electricity*. Colour brochure. Winnipeg, MB: Manitoba Hydro, n.d.

BLM

- Mod.1.3c#1: Compare and Contrast Frame

TBLM

- TBLM Mod.3.1#1: Conducting a Fair Test: Observation Checklist

Materials

- 4.5-volt batteries
- plastic-coated wires (ends stripped)
- paperclips or alligator clips
- light bulbs and bulb holders
- common classroom objects (e.g., pencil, key, eraser, utensil, ruler, chalk)

SUGGESTIONS FOR INSTRUCTION

Preparation and Set-up

- Assemble all materials listed in the Suggested Learning Resources.
- Access appropriate websites listed in the IMYM Links Database for this LE. Bookmark the websites on the class computers, or ask students to do so before beginning this LE.
- Contact another Grade 6 teacher to plan an email exchange of students' experiments and observations during the LEs in Module 3: Explore Electricity: The Backbone of Modern Inventions (see ICT.3: Riddle This).
- Download the *Crocodile Clips Elementary* software on the class computers.

Activating Strategies

- **Note:** Explain and demonstrate proper handling techniques and safety procedures for equipment throughout this LE.
- Provide collaborative groups of students with a battery, two wires, and a light bulb. Students use the materials to try to make the bulb light up. Students discuss what worked, and why.
- Using a computer and a projection system, introduce students to *Crocodile Clips Elementary* or a similar application. Use appropriate vocabulary when describing what is happening and remind students to do the same.
- Assemble a simple circuit for students, explaining each step during the demonstration. Before completing the circuit, ask students to hypothesize what might happen when the circuit is completed, and why. Record their suggestions on a class Hypothesis Chart.
- Complete the simple circuit to verify whether students were correct in their predictions. Discuss what worked, what did not work, and why.

Acquiring Strategies

- Based on their previous discussion of simple circuits, collaborative groups of students experiment with the circuits found in *Crocodile Clips Elementary*. They draw, on paper, one of the circuits they created online that was successful in lighting a bulb. Students post their drawings on the classroom wall.
- Differentiate between simple series and simple parallel circuits. Students label each of their group's drawings on the classroom wall using appropriate vocabulary.
- In pairs, students build circuits that replicate the diagrams they drew from *Crocodile Clips Elementary*.

Applying Strategies

- Students design and build a circuit that can light up one or more bulbs. They draw the working circuit, label it "series" or "parallel," and display their diagram on the classroom wall, post it on the class website, or email it to their key pals.
- Students draft a definition of an "electrical circuit." They share their drafts, discuss the wording, and write a class definition. They add the definition to the class Vocabulary Database (see OLE.2: Daily Edit).

Variations/Extensions

- Students compare the characteristics of static and current electricity, using BLM Mod.1.3c#1: Compare and Contrast Frame.
- Watch the video *Creating and Controlling Current Electricity* (Manitoba Hydro).

SUGGESTIONS FOR ASSESSMENT

- Observe students' work habits and proper handling of equipment, using TBLM Mod.3.1#1: Conducting a Fair Test: Observation Checklist.

- Assess students' labelled drawings of a circuit. Check for gaps in understanding. Confer with students to make suggestions or to clarify concepts when needed.

CONNECTION TO INVENTION CONVENTION

- Students' experimentation with electricity helps them understand electricity as an important force behind major inventions and helps them think about how they can use electricity in developing their own invention.

Electrical Circuits

Mod.3.3

TIME

150 minutes

OVERVIEW

Students improve their electrical circuits and discover what changes make a light bulb brighter. They investigate and invent useful electrical circuits, including switches.

LEARNING OUTCOMES

Through this learning experience (LE), students will achieve specific learning outcomes (SLOs) in various subject areas. Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified.

English Language Arts

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- 1.2.1 *Develop Understanding* — Reflect on prior knowledge and experiences to arrive at new understanding.
- 1.2.2 *Explain Opinions* — Explain personal viewpoints in clear and meaningful ways and revise previous understanding.
- 1.2.3 *Combine Ideas* — Search for ways to reorganize ideas and information to extend understanding.
- 1.2.4 *Extend Understanding* — Appraise ideas for clarity and ask extending questions; select from others' experiences and ideas to extend ways of knowing the world.
- 5.2.1 *Cooperate with Others* — Assist group members to maintain focus and complete tasks; identify and solve group process issues.

Science

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- SLOs related to Scientific Inquiry or the Design Process in Cluster 0: Overall Skills and Attitudes.
- 6-3-01 Use appropriate vocabulary related to their investigations of electricity.
Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.
- 6-3-08 Demonstrate and describe the function of switches in electrical circuits.
- 6-3-09 Construct and diagram simple series circuits and simple parallel circuits.
- 6-3-10 Explore to determine factors that affect bulb brightness in simple series and parallel circuits.
Include: number of bulbs, number of batteries, placement of bulbs and batteries.
- 6-3-11 Use the design process to construct an electrical circuit that performs a useful function.
Examples: doorbell, alarm, motorized toy, game...

ICT LITERACY SKILLS AND COMPETENCIES

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which skills and competencies students may achieve, in addition to those identified below:

- basic operating skills
- inquiry using electronic sources
- electronic publishing

SUGGESTED LEARNING RESOURCES**Software**

- web page authoring
- concept mapping
- *Crocodile Clips Elementary*

Note: This software is available on the CD-ROM version of the *Inventions, Innovations, and Discoveries* interdisciplinary unit.

Internet

- IMYM Links Database: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>

Video

- Manitoba Hydro. *Measuring and Using Electricity*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1991. (VHS, 12 min.)

Print

- Appendix C: Index of Teaching and Learning Strategies and Tools
- Manitoba Education and Training. *Grades 5 to 8 Science: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 2000.
- ---. *Success for All Learners: A Handbook on Differentiating Instruction: A Resource for Kindergarten to Senior 4 Schools*. Winnipeg, MB: Manitoba Education and Training, 1996. (See Anticipation Guides, 6.25, 6.98.)

BLMs

- BLM Mod.3.3#1: Factors That Affect Bulb Brightness
- BLM Mod.3.3#2: Insulator or Conductor?
- BLM Mod.3.3#3: Checklist for Creating and Explaining Switches
- BLM Mod.3.3#4: Experiment Report

TBLMs

- TBLM Mod.3.3#1: Constructing a Prototype: Observation Checklist
- TBLM Mod.3.3#2: Experiment Report: Assessment

Materials

- 4.5-volt batteries
- plastic-coated wires
- paperclips or alligator clips
- light bulbs and bulb holders
- common classroom objects (e.g., pencil, key, eraser, utensil, ruler, chalk)
- cardboard
- thumbtacks

- tape
- circuits designed in Mod.3.2: Current Electricity

SUGGESTIONS FOR INSTRUCTION

Preparation and Set-up

- Have available several extra batteries and light bulbs of various voltages for students to use.
- Prepare an Anticipation Guide for the video that students will watch later. (See *Success for All Learners*, Anticipation Guide, 6.98.)

Activating Strategies

- **Note:** Explain and demonstrate proper handling techniques and safety procedures for equipment throughout this LE.
- Students review their light bulb circuits (from Mod.3.2: Current Electricity) posted in the classroom or on the class website.
- Students brainstorm for possible answers to questions such as the following (including processes they think happen with electricity) and explain their thinking:
 - How do you turn a lamp on and off?
 - Do you have to connect any wires when you turn on a lamp?
- Students watch an appropriate video on electricity, such as *Measuring and Using Electricity* (Manitoba Hydro). They begin to fill out the Anticipation Guide before viewing the video, and complete it after the showing.
- Demonstrate a circuit with a switch. Students discuss advantages of putting a switch on a circuit and describe the function it would serve (e.g., it facilitates turning off lamp, radio).
- Students use concept-mapping software to brainstorm and categorize kinds of switches used in electrical appliances (e.g., on-off, dial, push button, thermostat-controlled). Ask students whether there are electrical inventions that do not use a switch (e.g., kettle, clothes iron, popcorn popper, or any other invention that works immediately upon being plugged into an electrical outlet and stops working only when unplugged).

Acquiring Strategies

- Based on their previous experiments with circuits, both online and hands-on in the classroom, collaborative groups of students hypothesize and test what might make a light bulb brighter. (Consider number of batteries, number of bulbs on the same circuit, placement of batteries, length of wire, and so on.) Remind students that an experiment such as this one needs to have variables introduced and tested one at a time. Students note their observations on BLM Mod.3.3#1: Factors That Affect Bulb Brightness.
- In collaborative groups, students review each of their designed circuits from Mod.3.2: Current Electricity. They brainstorm and draw diagrams for possible parallel and series circuits that would improve on their original designs to make the bulb brighter.

Applying Strategies

- Review BLM Mod.3.3#4: Experiment Report with students to help them understand how to record their information.
- Assign points to each section of TBLM Mod.3.3#2: Experiment Report: Assessment. Review the form, explaining how students will assess themselves and how they will be assessed on their experiment.
- Individual students build their redesigned circuit. They note whether their design worked on the first try and hypothesize why or why not. If needed, they experiment until the design works. They record each modification and improvement on their design and note the results of each.

- Students use the same number of batteries and bulbs to build both a series circuit and a parallel circuit. Students experiment to determine which circuit will be brighter. They explain why in their science notebooks or on the class website.
- Students replace the light bulb with an alarm or a bell, and experiment with the circuit to make it ring.

Variations/Extensions

- Students experiment with including a switch in their model, following the design process described in Cluster 0: Overall Skills and Attitudes of the Grade 6 Science curriculum. Suggestions may be found by searching the IMYM Links Database for suitable websites. Students fill out BLM Mod.3.3#3: Checklist for Creating and Explaining Switches when they think they understand how switches work.
- Students write up their experiments, include conclusions and diagrams, and post them on the class website.
- Students experiment with using a variety of materials as switches, observing which materials carry the current (conductors) and which do not (insulators). They record their information and complete BLM Mod.3.3#2: Insulator or Conductor?
- Review the Word Splash started in Mod.3.1: Static Electricity to ensure that it contains all the applicable electricity vocabulary and that students understand and can appropriately use all the terms recorded.
- Students use their knowledge of switches and circuits to make an invention for the school Science Fair.

SUGGESTIONS FOR ASSESSMENT

- Observe the work of students in their groups as they hypothesize and test what makes a bulb brighter, using TBLM Mod.3.3#1: Constructing a Prototype: Observation Checklist.
- Verify students' completed BLM Mod.3.3#1: Factors That Affect Bulb Brightness to check for gaps in understanding. Note concerns and address them individually or with the class.
- Check students' diagrams for accuracy. Confer with collaborative groups as they improve on their designs. Read students' completed BLM Mod.3.3#4: Experiment Report and assess their reports based on TBLM Mod.3.3#2: Experiment Report: Assessment.
- Students fill out TBLM Mod.3.3#2: Experiment Report: Assessment and assign themselves a mark based on the possible points they can achieve. Review each student's self-assessment and assign a mark. Confer with students to discuss any discrepancies between their self-assessment and your assessment.
- Read students' completed self-assessment checklists (see BLM Mod.3.3#3: Checklist for Creating and Explaining Switches). Provide students with feedback.

CONNECTION TO INVENTION CONVENTION

- Students' experimentation with electricity helps them understand electricity as an important force behind major inventions and helps them think about how they can use electricity in developing their own invention.

BLM Mod.3.3#1: Factors That Affect Bulb Brightness

Name _____ Date _____

Carefully note your observations as you change one variable at a time in each electrical circuit.

Change or Variable	Circuit Type	Effect
<i>Example:</i> • Add one light bulb.	Series	The light will be dimmer.
	Parallel	The light will be brighter.
	Series	
	Parallel	
	Series	
	Parallel	
	Series	
	Parallel	
	Series	
	Parallel	

Factors That Affect Bulb Brightness: Adapted from *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training 6.90).

BLM Mod.3.3#2: Insulator or Conductor?

Name _____ Date _____

As you experiment with different materials, note whether they are insulators or conductors.

Material	Insulator	Conductor
Definition of insulator :		
Definition of conductor :		
With which category of materials would you want to cover an electrical wire?		
Name some specific materials from that category that would provide a safe covering for electrical wire.		

BLM Mod.3.3#3: Checklist for Creating and Explaining Switches

Name _____ Date _____

Fill out this checklist when you think you understand how switches work. The teacher will also provide feedback.

Checklist	Student		Teacher	
	Yes	No	Yes	No
• I can connect the materials using a switch to control the electricity flow.				
• I understand that closing the switch (on) allows the electricity to flow.				
• I understand that opening the switch (off) stops the flow of electricity.				
• I provide a clear explanation of how a switch works.				
• I use the correct terminology.				
Teacher Comments				

Checklist for Creating and Explaining Switches: Adapted from *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training 6.85).

BLM Mod.3.3#4: Experiment Report

Name _____ Date _____

Experiment _____

Testable Question:
Independent Variable:
Dependent Variable:
Prediction/Hypothesis: (Identify a cause and effect relationship.)

Planning for a Fair Test
<ul style="list-style-type: none">• Apparatus/Materials: • Variables to Hold Constant: • Method: (Include steps to follow and safety considerations.)

(continued)

Experiment Report: Adapted from *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training BLM 6-H).

Experiment Report (*continued*)

Observations:

Analysis of Data: (Identify patterns and discrepancies)

Note: Attach graph on a separate page, if required.

(continued)

Experiment Report (continued)

Strengths and Weaknesses of Approach: (State what went well and what needs to be done differently next time.)

Conclusion: (Support or reject prediction/hypothesis; pose new question[s].)

Applications/Implications: (Link to daily life or area of study.)

TBLM Mod.3.3#1: Constructing a Prototype: Observation Checklist

Problem/Challenge _____ Date _____

A group of students can be selected as a focus for observation on a given day, and/or one or more of the observational areas can be selected as a focus. The emphasis should be on gathering cumulative information over a period of time.

Student Names	Has Safe Work Habits (workspace, handling equipment)	Works with Group Members to Carry out Plan	Participates in Analysis and Modification of Prototype	Shows Evidence of Perseverance and/or Confidence	Comments
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
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16.					
17.					
18.					

Constructing a Prototype: Observation Checklist: Reproduced from *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training BLM 6-D).

TBLM Mod.3.3#2: Experiment Report: Assessment

Experiment Title _____ Date _____

Team Members _____

Criteria	Possible Points*	Self-Assessment	Teacher Assessment
Making a Prediction/Hypothesis <ul style="list-style-type: none"> The prediction/hypothesis clearly identifies a cause and effect relationship. 			
Planning for a Fair Test <ul style="list-style-type: none"> Required apparatus/materials are identified. Major variables to hold constant are identified. Steps to follow are included. Safety considerations are addressed. 			
Conducting a Fair Test/ Making and Recording Observations <ul style="list-style-type: none"> Detailed data are recorded and appropriate units are used. Data are recorded in a clear/well-structured/appropriate format. 			
Analyzing and Interpreting <ul style="list-style-type: none"> Graphs are included (where appropriate). Patterns/trends/discrepancies are identified. Strengths and weaknesses of approach are identified. 			
Drawing a Conclusion <ul style="list-style-type: none"> Prediction/hypothesis is supported or rejected. New question(s) is (are) identified. 			
Making Connections <ul style="list-style-type: none"> Potential applications to or implications for daily life are identified and/or links to area of study are made. 			
Total Points			
Comments			

* **Note:** The teacher or the class assigns possible points to reflect the particular emphasis(es) of the experiment.

Electromagnetism

Mod.3.4

TIME

120 (2 x 60) minutes

OVERVIEW

Students explore electromagnetism by building an electromagnet. They explore motors and generators by constructing a generator or a motor that can be used to power a simple device they would find useful in their daily life.

LEARNING OUTCOMES

Through this learning experience (LE), students will achieve specific learning outcomes (SLOs) in various subject areas. Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified.

English Language Arts

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- 1.1.1 *Express Ideas* — Engage in exploratory communication to share personal responses, make predictions, and discover own interpretations.
- 1.2.3 *Combine Ideas* — Search for ways to reorganize ideas and information to extend understanding.
- 2.3.3 *Vocabulary* — Experiment with ambiguity in language [such as puns, jokes based on multiple meanings, poetry...] in a variety of contexts.
- 3.2.4 *Access Information* — Use a variety of tools [including bibliographies, thesauri, and technology] to access information and ideas; use visual and auditory cues [such as captions, intonation, staging...] to identify relevant information.
- 3.2.5 *Make Sense of Information* — Use organizational patterns of oral, visual, and written texts [including main ideas and supporting details, explanation, comparison and contrast, cause and effect, and sequence] to construct meaning; skim, scan, and read closely to gather information.

Science

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- SLOs related to Scientific Inquiry or the Design Process in Cluster 0: Overall Skills and Attitudes.
- 6-3-01 Use appropriate vocabulary related to their investigations of electricity.
Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.
- 6-3-12 Demonstrate, using a simple electromagnet constructed in class, that an electric current can create a magnetic field.
- 6-3-13 Explore motors and generators to determine that electromagnets transform electricity into motion, and motion into electricity.
- 6-3-15 Identify the two major sources of electrical energy, and provide examples of each.
Include: chemical sources such as batteries; electromagnetic sources such as turbine motion caused by wind, falling water, and steam.

- 6-3-16 Identify renewable and non-renewable sources of electrical energy, and discuss advantages and disadvantages of each.
Examples: renewable sources such as hydroelectric, wind, geothermal, solar; non-renewable sources such as fossil fuels, nuclear fission...

ICT LITERACY SKILLS AND COMPETENCIES

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which skills and competencies students may achieve, in addition to those identified below:

- basic operating skills
- inquiry using electronic sources
- word processing

SUGGESTED LEARNING RESOURCES

Software

- word processor
- graphics

Internet

- IMYM Links Database: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>

Videos

- Manitoba Hydro. *The Magic of Magnets*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1991. (VHS, 12 min.)
- ---. *Pine Falls Generating Station: A Video Tour*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1993. (VHS, 12 min.)
- ---. *Producing Electricity*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1998. (VHS, 25 min.)

Print

- Appendix C: Index of Teaching and Learning Strategies and Tools
- Manitoba Education and Training. *Grades 5 to 8 Science: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 2000. (See Making an Electromagnet, 9.94; Constructing a Simple Motor, 6.96; Making a Simple Generator, 6.98.)
- ---. *Success for All Learners: A Handbook on Differentiating Instruction: A Resource for Kindergarten to Senior 4 Schools*. Winnipeg, MB: Manitoba Education and Training, 1996. (See Excursions, 9.4-9.5; Anticipation Guides, 6.25, 6.98).
- Manitoba Hydro. *Harnessing the Power of Water*. Brochure. Winnipeg, MB: Manitoba Hydro, n.d.
- ---. *Turbine*. Poster. Winnipeg, MB: Manitoba Hydro, n.d. (An artist's illustration that shows a labelled cross-section of the various components of a turbine.)

Materials

- D-cell battery and 6-volt battery
- large nail
- tape
- wire
- 2 square magnets
- pencil

- paper clips, coins, keys
- small block of wood
- construction toys (e.g., Lego or Capsella) that have motors

SUGGESTIONS FOR INSTRUCTION

- **Note:** Explain and demonstrate proper handling techniques and safety procedures for equipment throughout this LE.

PART A: BUILDING AN ELECTROMAGNET

Preparation and Set-up

- Assemble materials needed to build electromagnets, as described in the Suggested Learning Resources for this LE, on page 6.94 of *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training), or in any other print or electronic resource to which students have access.

Activating Strategies

- Students predict and then attempt to pick up metallic objects such as paper clips, coins, or keys using only a large nail. They record their observations of each attempt.
- Students predict which metallic objects might be picked up using a magnet.
- Students view the video *The Magic of Magnets* (Manitoba Hydro). They check whether their predictions are confirmed.

Acquiring Strategies

- Students construct a simple electromagnet following directions outlined on page 6.94 of *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training), or in any other print or electronic resource to which they have access.
- Students use the electromagnet they just built to pick up the same objects they previously tried to pick up. Students record their observations. They predict what will happen when the current is no longer present, and make observations when they stop the current.

Applying Strategies

- Students explain how the nail became magnetized. (Passing an electric current through certain metal objects creates a magnetic field. The field lasts only as long as the current is present.)
- Students use their electromagnet to attempt to magnetize other items (e.g., a tongue depressor, knife, stone). Students explain characteristics of materials that can be used to create an electromagnet.

PART B: BUILDING A MOTOR AND GENERATOR

Preparation and Set-up

- Assemble print or electronic learning resources on electricity.
- Plan a field trip to or watch a video about a generating station. Prepare an Anticipation Guide. For a sample BLM, see *Success for All Learners* (Manitoba Education and Training 6.98).

Activating Strategies

- In Think-Pair-Share groups, students record what they already know about motors and generators.
- Students browse print and electronic learning resources on electricity for information and visuals on how a motor or generator makes a machine work.

- In a whole-class session, each pair of students shares something they learned in their investigation of motors and generators.
- Go on a field trip to a nearby generating station or show the video *Pine Falls Generating Station: A Video Tour* (Manitoba Hydro). Students fill out an Anticipation Guide before participating in the field trip or viewing the video.

Acquiring Strategies

- In collaborative groups, students build a motor or a generator, following directions outlined on page 6.96 (motor) or page 6.98 (generator) of *Grades 5 to 8 Science: A Foundation for Implementation* (Manitoba Education and Training).
- Each group gives a class demonstration of the motor or generator they built to the class. Students discuss each design and provide feedback on possible improvements.

Applying Strategies

- Individual students use paper or graphics software to record a design for a device or an invention that will be activated by a motor or a generator (e.g., a personal fan, a page-turner for books, or any simple device they would find useful).
- In collaborative groups, students select one group member's design for a device or an invention and assemble materials to build it.
- Students use the group-built motor or generator to construct the chosen device or invention and make it work.
- Students return to their Think-Pair-Share groups and revise their notes on motors and generators to explain the difference between motors and generators.

Variations/Extensions

- Students attempt to build the Rube Goldberg invention they designed in Mod.2.3: Rube Goldberg.
- Using print and electronic materials, students research the two major sources (chemical and electromagnetic) of electrical energy and provide examples for each.
- Using print and electronic resources, students research renewable and non-renewable sources of electrical energy. They make a comparative chart listing advantages and disadvantages of each.
- Review the Word Splash started in Mod.3.1: Static Electricity to ensure that it contains all the relevant vocabulary on electricity and to determine whether students understand and can use appropriately all the terms recorded.

SUGGESTIONS FOR ASSESSMENT

- Read students' notes on the role of electromagnets in motors and generators. Look for "electromagnets transform electricity into motion" (motors) and "electromagnets transform motion into electricity" (generators).
- In conferences, students explain how a nail or a metallic object can become magnetized, and why other materials cannot become magnetized.
- Read students' Anticipation Guide to confirm understanding of the subject.

CONNECTION TO INVENTION CONVENTION

- Students' experimentation with electricity helps them understand electricity as an important force behind major inventions and helps them think about how they can use electricity in developing their own invention.

Awareness of Electrical Energy Consumption

Mod.3.5

TIME

180 (3 x 60) minutes

OVERVIEW

Students describe factors that affect the consumption of electrical energy, thereby raising their awareness of energy use. They outline an action plan to reduce energy consumption and promote their plan. They describe ways in which electricity has an impact on their daily life.

LEARNING OUTCOMES

Through this learning experience (LE), students will achieve specific learning outcomes (SLOs) in various subject areas. Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified.

English Language Arts

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- 2.1.1 *Prior Knowledge* — Seek connections between previous experiences, prior knowledge, and a variety of texts.
- 2.3.5 *Create Original Texts* — Create original texts [such as letters, short stories, media broadcasts, plays, poems, video presentations, Readers Theatre...] to communicate and demonstrate understanding of forms and techniques.
- 4.4.1 *Share Ideas and Information* — Share information on a topic with class members in a planned and focused group session using a variety of strategies [such as interactive dialogues, demonstrations, dramatizations, audiovisual and artistic representations...].

Science

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- SLOs related to Scientific Inquiry or the Design Process in Cluster 0: Overall Skills and Attitudes.
- 6-3-01 Use appropriate vocabulary related to their investigations of electricity.
Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.
- 6-3-05 List electrical devices used at home, at school, and in the community, and identify the human needs that they fulfill.
Examples: heat, light, communication, movement...
- 6-3-14 Identify forms of energy that may result from the transformation of electrical energy, and recognize that energy can only be changed from one form into another, not created or destroyed.
Include: light, heat, sound, motion.
- 6-3-17 Evaluate an electrical device using the design process.
Examples: light bulbs, kitchen appliances...
- 6-3-18 Describe factors that affect the consumption of electrical energy, and outline an action plan to reduce electrical energy consumption at home, at school, or in the community.
- 6-3-19 Describe ways in which electricity has had an impact on daily life.

ICT LITERACY SKILLS AND COMPETENCIES

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which skills and competencies students may achieve, in addition to those identified below:

- basic operating skills
- electronic publishing
- spreadsheet analysis
- word processing

SUGGESTED LEARNING RESOURCES**Software**

- word processor
- spreadsheet
- web page authoring

Internet

- IMYM Links Database: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>

Videos

- Manitoba Hydro. *Simple Things You Can Do to Save Energy*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1993. (VHS, 15 min.)
- ---. *Simple Things You Can Do to Save Energy in Your School*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1993. (VHS, 15 min.)

Print

- Appendix C: Index of Teaching and Learning Strategies and Tools
- Manitoba Hydro. *Middle and Senior Years Power Smart Poster*. Winnipeg, MB: Manitoba Hydro, n.d.

BLMs

- BLM OLE.4#6: Reading Circle Response Log (see OLE.4: Reading Circles)
- BLM Mod.3.5#1: Changing One Form of Energy to Another
- BLM Mod.3.5#2: The Effect of Closing Doors on Home Heating
- BLM Mod.3.5#3: The Effect of Using a Fireplace on Home Heating
- BLM Mod.3.5#4: Comparing Window and Wall Heat Loss
- BLM Mod.3.5#5: Boiling Water with or without a Lid
- BLM Mod.3.5#6: Bath Versus Shower

TBLMs

- TBLM Mod.2.4#2: Examples of Advertising Strategies
- TBLM Mod.3.5#1: Cooperative Group Learning: Teacher Assessment
- TBLM Mod.3.5#2: Brief Facts on Energy Consumption
- TBLM Mod.3.5#3: What Can You Do to Save Energy?

Materials

- survey generated in Mod.2.5: Tally-Ho
- hydro-consumption bills
- Signal or Transitional Words wall chart created in Mod.2.3: Rube Goldberg

SUGGESTIONS FOR INSTRUCTION

Preparation and Set-up

- Assemble a list of library resources containing information on energy consumption.
- Inform students that they will be asked to keep track of their electricity consumption in the coming days.
- Have available the survey generated in Mod.2.5: Tally-Ho.
- Bring to class one year's worth of hydro bills. Ask students to do the same, if possible. Photocopy one set of records for each collaborative group, removing the consumer information to protect the privacy of the owner, but recording the size of home and number and age of the occupants.
- Have available the Signal or Transitional Words wall chart created in Mod.2.3: Rube Goldberg.

Activating Strategies

- Students list all the electrical appliances they used before coming to school that morning (e.g., lamp, stove, microwave oven, toaster, hair dryer, kettle). They imagine how their life would differ without electricity. Students write a paragraph about a morning without electricity.
- If the survey (generated in Mod.2.5: Tally-Ho) is being used, review the contents with students.
- Students brainstorm how electricity is used in the classroom. To guide discussion, refer to TBLM Mod.3.5#3: What Can You Do to Save Energy?

Acquiring Strategies

- Examine the hydro bills available. Select one set of records and, using a spreadsheet, chart electrical consumption for each month. Review the skills acquired in ICT.12: Chart This.
- In collaborative groups, students examine the resources assembled and identify brief facts about energy consumption. They create a group poster highlighting five facts, which they illustrate or add to a class list posted on the wall (see TBLM Mod.3.5#2: Brief Facts on Energy Consumption).
- Brainstorm for factors that might have the most significant impact on consumption (e.g., size of home, number of people in household, age of people in household, seasonal temperature, special events).
- In collaborative groups, students conduct tests to identify simple factors that might affect energy consumption.

Examples:

- Closing doors (use BLM Mod.3.5#2: The Effect of Closing Doors on Home Heating)
 - Using a fireplace (use BLM Mod.3.5#3: The Effect of Using a Fireplace on Home Heating)
 - Comparing heat loss through windows versus walls (use BLM Mod.3.5#4: Comparing Window and Wall Heat Loss)
 - Boiling with or without covering the pan (use BLM Mod.3.5#5: Boiling Water with or without a Lid)
 - Taking baths versus taking showers (use BLM Mod.3.5#6: Bath Versus Shower)
- Students may wish to design a test of their own to test energy efficiency.
- In collaborative groups, students select three households, two of which have one characteristic in common, such as
 - two are the same households but have a different number of occupants
 - two have the same number of occupants but are of different sizes

- two have the same number of occupants but of different ages
- two are the same size but use a different heating system and/or have air conditioning
- Students use a spreadsheet to chart the monthly electrical consumption of the three households for a full year.

Applying Strategies

- Based on previous discussion, students describe factors that affect the consumption of electricity in general (e.g., hosting guests, using air conditioner on hot days, using hot water for washing and cleaning, using entertainment devices on rainy days).
OR
Students examine the charts of electrical consumption and identify patterns of use (e.g., according to seasons).
- Students record daily electrical consumption of their household for one week by using the reading of their hydro meter. In collaborative groups, students compare their readings and the survey of each group member's home (using the surveys generated in Mod.2.5: Tally-Ho and BLMs Mod.3.5#2 to BLM Mod.3.5#6), to see whether a pattern of use can be discovered. They select three electrical appliances or circumstances from the survey.
- Students select an electrical appliance for which there is a non-electrical equivalent (e.g., stove, toothbrush, clothes dryer). Using a word processor (or using BLM OLE.4#6: Reading Circle Response Log), students write a paragraph about the impact that owning the electrical version of the invention can have on their daily life.
- In a class forum, students discuss the value of electricity as a time-saving factor when creating an invention.

Variations/Extensions

- Referring to the list of electrical household appliances generated in Mod.2.5: Tally-Ho, or any other list they brainstorm, students identify the form of energy that results from the transformation of electrical energy in the appliances (e.g., heat, sound, light, motion). Introduce the task with questions such as the following:
 - What happens when you touch a light bulb that has been on for a while? (It feels hot.)
 - What happens when you turn on the electrical switch on the radio? (It makes sounds.)
 - What happens when you turn on the switch on the blender? (It whirls.)
- Students record their findings on BLM Mod.3.5#1: Changing One Form of Energy to Another.
- Each collaborative group evaluates an electrical device from their Tally-Ho survey using the Design Process outlined in Cluster 0: Overall Skills and Attitudes of the Grade 6 Science curriculum.
- Students prepare an Energy Awareness presentation based on the questions on TBLM Mod.3.5#3: What Can You Do to Save Energy? and share it with students in other classrooms in the school or at a school assembly.
- Review TBLM Mod.2.4#2: Examples of Advertising Strategies. In collaborative groups, students develop action plans to reduce consumption of electricity. They make posters entitled You Can Be Energy Efficient, offering simple suggestions for energy saving, and display the posters around the school. They add a page to the class website with their plans.

SUGGESTIONS FOR ASSESSMENT

- Read the paragraph students wrote on the impact of owning the electrical version (innovation) of an invention. Look for references to ease of use, improved access, faster use, or better results. Consider whether signal or transitional words have been used appropriately and effectively.

- Read students' work recorded on BLM Mod.3.5#1: Changing One Form of Energy to Another and look for gaps in understanding.
- Use TBLM Mod.3.5#1: Cooperative Group Learning: Teacher Assessment to observe and assess students' work within their collaborative groups.
- Create a peer-assessment tool with students (based on TBLM Mod.3.5#1: Cooperative Group Learning: Teacher Assessment), and have them assess the work of their peers in their collaborative group.

CONNECTION TO INVENTION CONVENTION

- In becoming aware of ways in which electricity affects their lives, students can plan for an invention that would benefit them the most.
- In preparing presentations or posters on energy efficiency, students prepare for marketing their own invention.

BLM Mod.3.5#2: The Effect of Closing Doors on Home Heating

Question

- Is energy saved by closing doors to unoccupied rooms?

Materials

- thermometer
- Data-Recording Chart

Method

- Set the home heating system at a constant temperature for several hours.
- Set the heating system at the same constant temperature for each day data is being recorded.
- Record the data for two days (e.g., Saturday and Sunday).
Note: The weather and/or sun conditions should be fairly constant so as not to invalidate the data being recorded.
- Record data at the same time each day.
- Record data for several rooms of different sizes (e.g., bedrooms, bathroom).
- Record the first temperature data when the doors to the rooms are opened. Then close them, and take a second reading after the doors have been closed for at least four hours. The reverse will also work.

Room Temperature: Data-Recording Chart

The thermostat for the home is set at _____

Room	Date	Temperature Door(s) Open	Temperature Door(s) Closed

What do you conclude about closing doors to unoccupied rooms for energy conservation?

If you have air-intake vents, do you think opening or closing them would make a difference?

BLM Mod.3.5#3: The Effect of Using a Fireplace on Home Heating

Questions

- Can energy be saved by using a fireplace while a forced-air central heating system is operating?
- Is there a difference in energy saving between using a wood fireplace and using a gas fireplace?

Materials

- wood fireplace and gas fireplace (the test should be done using both kinds)
- watch
- Data-Recording Chart

Method

- Leave the thermostat for the home heating system set at a constant temperature.
- Be prepared to record data for at least one hour. Data recorded over a longer period of time will provide more information.
- Ask an adult to verify that the damper in the fireplace is closed at the start of the test.
- With no fire in the fireplace, record the time on your watch each time the heating system turns on and off (in minutes and seconds).
- Ask an adult to open the damper and supervise as you build a fire in the fireplace.
- When the fire is established, record the time on your watch each time the heating system turns on and off (in minutes and seconds).
- Keep a record over the same amount of time in each instance. (If you keep records for 1.5 hours without fire, then you must keep records for 1.5 hours with fire.)

Effect of a Fireplace on Home Heating: Data-Recording Chart

Kind of fireplace _____

Damper Closed—No Fire in Fireplace		Damper Open—Fire in Fireplace	
Start Time	Stop Time	Start Time	Stop Time
Number of times heating system started _____		Number of times heating system started _____	
Total time heating system worked _____		Total time heating system worked _____	

What do you conclude? Is the furnace cycle affected by having a fire in the fireplace?
 For a (kind of fireplace), _____

Why do you think this?

BLM Mod.3.5#4: Comparing Window and Wall Heat Loss

Question

- How does glass compare to wall material in conserving energy?

Materials

- thermometer
- Data-Recording Chart
- access to a window on the north, south, east, and west sides of a home

Method

- Put the thermometer in the centre of the pane of glass for each window (north, south, east, and west) and record the reading on the Data-Recording Chart.
- Identify a spot on the outside wall adjoining each window, at least three feet away from the window or any door. Put the thermometer on that spot and record the reading on the Data-Recording Chart.
- Go outside and record the temperature near each window (north, south, east, and west).
- In the Temperature (T) Difference column, calculate the difference between the inside temperature and the outside temperature, for each window and wall.

Window Versus Wall: Data-Recording Chart

How many window panes are there? _____ What is the thickness of the wall? (cm) _____

Outside	T (C)	Inside Window	T (C)	T Difference	Inside Wall	T (C)	T Difference
North		North			North		
South		South			South		
East		East			East		
West		West			West		

Which material (wall or window) has the greatest variation in temperature from outside to inside?
Does compass direction make any difference? Why or why not?
If you were designing an energy-efficient home, how would you apply this data?

BLM Mod.3.5#5: Boiling Water with or without a Lid

Question

- Does water boil sooner when there is a lid on the pot?

Materials

- pot with a see-through lid
- measuring cup
- stove
- watch (it needs to be able to measure seconds)
- Data-Recording Chart

Method

- Add a cup of water to the pot until it is about half full. Record how many cups of water were needed.
- Put the pot, without a lid, on a stove element that is about the same size as the bottom of the pot.
- Turn up the heat to high and immediately record the time, in minutes and seconds, on the Data-Recording Chart.
- As soon as the water comes to a rolling boil, record the time, in minutes and seconds, on the Data-Recording Chart.
- Empty the water in the sink and let the pot cool completely.
- Allow the element on the stove to cool completely.
- Using the same pot, add the same amount of water as in the first part of the test.
- Put the lid on the pot, place the pot on the same element as before, turn the heat to high, and immediately record the time, in minutes and seconds, on the Data-Recording Chart.
- As soon as the water comes to a rolling boil, record the time, in minutes and seconds, on the Data-Recording Chart.
- Repeat the test with a much larger pot.

Water Boiling: Data-Recording Chart

Diameter of pot used (cm) _____

	Time Element Turned On	Time Element Turned Off	Time Difference
Small Pot without Lid			
Small Pot with Lid			
Large Pot without Lid			
Large Pot with Lid			

Is the boiling time the same with and without the lid? Explain.
Is there a change in the boiling time difference for the small pot and the large pot? Explain.
What is your suggestion to people who cook?

BLM Mod.3.5#6: Bath Versus Shower

Question

- Which uses less water, a bath or a shower?

Materials

- waterproof adhesive tape
- two-litre plastic container
- bathtub with shower

Method

- Calibrate the tub by pouring exactly 20 litres of water into it.
- Mark the top of the water level.
- Add another 20 litres and again mark the top of the water level.
- Repeat this process until the tub is nearly full.
- Empty the tub to the level where a person would normally fill it with water for a bath. Record the number of litres this represents. Empty the tub.
- For the next few days, plug the tub when you take showers. Ask other family members to do the same.
- After a normal shower time, record the amount of water that accumulated in the tub (once the person is out of it) next to the family member’s name.

Bath Versus Shower: Data-Recording Chart

Amount of water used for bath (litres) _____

Date	Amount of Water Used for Shower (Litres)			
	Me	Person A	Person B	Person C

What can you conclude about the amount of water you and your family use in bathing and showering?

TBLM Mod.3.5#1: Cooperative Group Learning: Teacher Assessment

Task _____ Date _____

Rating Scale: High _____ Low _____ 5 4 3 2 1	Names of Group Members							
Criteria								
The student								
• negotiates roles and responsibilities of each group member								
• contributes ideas and suggestions								
• encourages involvement of all group members								
• is receptive to questions of all group members								
• listens to others' suggestions								
• modifies thinking to incorporate new information or others' ideas								
• respects and accepts contributions of each group member								
• completes individual commitment to the group								
Additional Comments								

Cooperative Group Learning: Teacher Assessment: Adapted, by permission, from *English Language Arts: A Curriculum Guide for the Elementary Level*. Copyright © 1992 by Saskatchewan Education.

Reference:
 Manitoba Education and Training. *Grades 5 to 8 English Language Arts: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 1998. BLM-89.

TBLM Mod.3.5#2: Brief Facts on Energy Consumption

Have students identify facts related to energy consumption in their examination of resources. Consider posting facts such as the following on the classroom wall and invite students to add to the list. The list can be divided into home use and school use.

Did You Know?

- Schools spend more on energy than on computers and textbooks combined.
- Compact fluorescent bulbs use $\frac{1}{4}$ of the energy of incandescent bulbs, last 10 times longer, are just as bright, and are more cost efficient.
- Only 10% of the energy used by the basic incandescent bulb results in light. The remaining 90% forms heat energy.
- Most of the time a computer is on, it is not in use. It just sits there and uses up energy.
- Using a water-saving showerhead can save up to 15% of your home's hot water use.
- The standard recommended temperature for heating a room is 20°C.
- People in Canada use more energy per capita than anyone else in the world. If we were to use energy-efficient buildings, cars, appliances, and machines, we would greatly reduce our energy consumption.

TBLM Mod.3.5#3: What Can You Do to Save Energy?

Questions such as the following can initiate discussion to help students become more aware of energy-efficient behaviours at school. Use the questions to generate a checklist that can be used to save energy in the classroom. Students may also use them to prepare a presentation to encourage other classes or the whole school to be involved in energy conservation.

Lighting

- Do the classroom (library, gymnasium) lights need to be on?
- Do all the lights need to be on at all times?
- Do we turn off the lights if the space is to be unoccupied for more than 10 minutes?
- What kind of lighting do we use? Do we use energy-efficient fluorescent or incandescent light?
- Do we turn off lights during recess?
- Can we turn off some lights while others stay on?
- Do we turn off the classroom lights when leaving for the day?

Computers

- Does the computer monitor need to be left on?
- Is the computer set to go to sleep automatically after a period of inactivity?

Heating and Cooling

- Is there a stand-alone space heater in the classroom? Is it needed?
- Is air circulating freely through heating ducts or air-intake grills? Is air circulation being blocked by materials such as posters, books, or articles of clothing?
- Are there window coverings to reduce the sun's heat when the air conditioning is on?
- Do we use window coverings to reduce heat loss at night?

Safety with Electricity

Mod.3.6

TIME

90 minutes

OVERVIEW

Students design a poster or a web page to promote safety with electricity.

Note: Mod.3.6: Safety with Electricity should be undertaken after Mod.2.4: Chindogu: Useless Inventions has been completed.

LEARNING OUTCOMES

Through this learning experience (LE), students will achieve specific learning outcomes (SLOs) in various subject areas. Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified.

English Language Arts

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- 1.2.3 *Combine Ideas* — Search for ways to reorganize ideas and information to extend understanding.
- 2.3.4 *Experiment with Language* — Alter words, forms, and sentence patterns to create new versions of texts for a variety of purposes [such as humour...]; explain ways in which figures of speech [such as similes, metaphors...] clarify and enhance meaning.
- 2.3.5 *Create Original Texts* — Create original texts [such as letters, short stories, media broadcasts, plays, poems, video presentations, Readers Theatre...] to communicate and demonstrate understanding of forms and techniques.
- 4.1.1 *Generate Ideas* — Focus a topic for oral, written, and visual texts integrating ideas from experiences and a variety of other sources.
- 4.2.4 *Enhance Artistry* — Choose language, sounds, and images [including transitional devices] to enhance meaning and emphasis.
- 4.2.5 *Enhance Presentation* — Prepare detailed and organized compositions, presentations, reports, and inquiry or research projects using templates or pre-established organizers.
- 5.2.1 *Cooperate with Others* — Assist group members to maintain focus and complete tasks; identify and solve group process issues.

Science

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which SLOs students may achieve, in addition to those identified below:

- SLOs related to Scientific Inquiry or the Design Process in Cluster 0: Overall Skills and Attitudes.
- 6-3-01 Use appropriate vocabulary related to their investigations of electricity.
Include: positive charge, negative charge, current electricity, static electricity, electrical circuit, insulator, conductor, switch, series circuit, parallel circuit, electromagnet, magnetic field, motor, generator, transformation, electrical energy, renewable, non-renewable, energy consumption.
- 6-3-04 Identify dangers associated with static and current electricity, and demonstrate and describe appropriate safety precautions.

ICT LITERACY SKILLS AND COMPETENCIES

Consider the intent of this LE and your choice of instructional and assessment strategies to determine which skills and competencies students may achieve, in addition to those identified below:

- basic operating skills
- graphics creation
- inquiry using electronic sources
- electronic publishing

SUGGESTED LEARNING RESOURCES**Software**

- graphics
- web page authoring

Internet

- IMYM Links Database: <<http://www.edu.gov.mb.ca/ks4/tech/imym/resources/links.html>>

Videos

- Manitoba Hydro. *Appliance Safety Quiz*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1989. (25 min.)
- ---. *Electrical Safety at Home and at Work*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1996. (VHS, 17 min.)
- ---. *Watching for Wires: Electrical Safety on the Farm*. Videocassette. Winnipeg, MB: Manitoba Hydro, 1992. (VHS, 20 min.)

Print

- Appendix C: Index of Teaching and Learning Strategies and Tools
- Manitoba Education and Training. *Grades 5 to 8 Science: A Foundation for Implementation*. Winnipeg, MB: Manitoba Education and Training, 2000.
- Manitoba Hydro. *Electrical Safety at Home and Work*. Colour brochure. Winnipeg, MB: Manitoba Hydro, n.d.
- ---. *Electrical Safety First*. Activity booklet. Winnipeg, MB: Manitoba Hydro, n.d.
- ---. *Farm Safely around Electricity*. Winnipeg, MB: Manitoba Hydro, n.d.
- ---. *Middle and Senior Years Safety Poster*. Winnipeg, MB: Manitoba Hydro, n.d.

BLMs

- BLM Mod.2.4#1: Peer Assessment of an Advertisement
- BLM Mod.2.4#2: Advertisement Planning

TBLM

- TBLM Mod.2.4#2: Examples of Advertising Strategies

Materials

- poster paper and/or bristol board
- markers

SUGGESTIONS FOR INSTRUCTION**Preparation and Set-up**

- Access appropriate websites listed in the IMYM Links Database for this LE. Bookmark the websites on the class computers, or ask students to do so before beginning this LE.

Activating Strategies

- With a partner, students brainstorm for safety issues based on their prior knowledge of electricity or on their experiences during Module 3: Explore Electricity: The Backbone of Modern Inventions.
- Students access websites and read information about how to use electricity safely. They consider both current electricity and static electricity.
- Invite an Education and Safety representative from Manitoba Hydro to talk to students about safety issues with electricity.
- As a class, discuss, and record on a wall chart, safety issues that could be represented on a poster or on a website.
- Review advertising strategies, as discussed in Mod.2.4: Chindogu: Useless Inventions (see TBLM Mod.2.4#2: Examples of Advertising Strategies).

Acquiring Strategies

- With a partner, students choose a safety issue identified on the wall chart, and decide whether they will represent the issue on a poster or on a website.
- Students brainstorm for slogans, phrases, and catchwords that will appropriately represent the electricity safety concept to be promoted. They decide on an appropriate illustration, sketch it, and, if they are creating a web page, scan it using a digital scanner.
- Students agree on the advertising strategy that best carries the message they want to convey. They complete BLM Mod.2.4#2: Advertisement Planning.

Applying Strategies

- Students design a poster (using their scanned illustration and a graphics program) or create a web page promoting their chosen concept for safety with electricity. (See ICT.11: Make It: Creating an Effective Web Page.)

Variations/Extensions

- Students watch a video such as *Appliance Safety Quiz* (Manitoba Hydro). They create a safety game with questions and answers related to safety with electricity. Students can make the game with cards and a playing board, or they can create it online, using a game that can be downloaded from a website (see IMYM Links Database).
- Hold a safety week at school. Students from the school display posters on various safety issues. Grade 6 students display their posters or websites on safety with electricity.

SUGGESTIONS FOR ASSESSMENT

- In Think-Pair-Square groups, each pair of students assesses the poster of another pair, using BLM Mod.2.4#1: Peer Assessment of an Advertisement.

CONNECTION TO INVENTION CONVENTION

- Students' experimentation with electricity helps them understand electricity as an important force behind major inventions and helps them think about how they can use electricity in developing their own invention.
- Making posters gives students practice in publicizing and promoting their invention.

