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.