SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Exceptional Electromagnets Part 2 **Grade 9 Applied – Electrical Applications**

Lesson Plan

Assessment	AFL, observe, peer assess.
Cross-curricular	Technology

Big Ideas

- Static and current electricity have distinct properties that determine how they are used.

Learning Goals

- Asking testable questions
- Making a hypothesis
- Coming up with a method to test our questions

Materials

- Working electromagnet (from previous class) for demonstration and prompting
- Exceptional Electromagnets 2 (Frayer Model and Inquiry Plan)
- Smarter Science Inquiry Framework – Level 2

Safety Notes

Always disconnect battery between tests.

Specific Expectations

A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research
A1.2 select appropriate instruments and materials for particular inquiries
A1.4 apply knowledge and understanding of safe practices and procedures when planning investigations; ... safe operation of electrical equipment, ... with the aid of appropriate support materials.
A1.5 conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data
A1.6 gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams
A1.8 analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty
A1.9 analyse the information gathered from research sources for reliability and bias
E2.1 use appropriate terminology related to static and current electricity
E2.4 design, draw circuit diagrams of, and construct simple series and parallel circuits
E3.3 identify the components of a simple direct current (DC) electrical circuit (e.g., electrical source, electrical load, switch, fuse), and describe their functions

Description

This is **lesson two** of a series of three lessons on electromagnets. The students create a plan to test a dependent variable of their choosing. Students should have a basic understanding of series circuits, electric current, battery function, and properties of conductors. They should have completed Exceptional Electromagnets Part 1, making an electromagnet.

Introduction

- Students will consolidate their previous learning of electromagnets using the 'Frayer Model' as a framework.
- Students should each receive a copy of the 'Frayer Model' template and should work individually or in small groups to complete by leveraging their understanding from the previous lesson (see Exceptional Electromagnets! Part 1).
    - If possible, projecting the Frayer Model on a whiteboard or smartboard and having groups come up to add their "best" information may be valuable.
    - Students may benefit from the teacher providing examples as prompts (see the teacher solutions on page 2 of the 'Frayer Model'). For further consolidation, answers may be discussed as a class.

Action

- Students will be formed into groups for completing an inquiry project. Groups of 3 are likely ideal while groups of 4 or greater are likely too large.
- Each group will be provided with some green sticky notes and some blue sticky notes as well as with paper copies of the Smarter Science Inquiry Framework, level 2 posters which can be found here: http://smarterscience.youthscience.ca/, or see link in Additional Resources.
    - If possible, the teacher should project the Smarter Science Framework or hang as large posters throughout this exercise.
- The teacher will instruct students to take their green sticky notes and write something that they observed when using their electromagnets the previous day.
    - Examples may be "The paperclips stuck to the nail", "the magnet didn't make any noise", "the battery warmed up", "when the wire was disconnected, the paperclips fell" etc.
    - Students will write ONE observation per sticky note and place it on the communal class poster (if available) in the step 1 box titled "what did I observe".
    - If students see a nearly identical observation they should cover it with their own sticky note. The teacher should read aloud the class observations.
    - This will form the basis for developing a Dependent Variable to test.
- Students will take their blue sticky notes and write a "What am I wondering" response for the blue box in step 1.
    - Responses may require prompting and may include "Does the number of wire loops change how strong the magnet is?", "Can you put something else in for the nail?", "Does the size of the battery matter?", "Does an electromagnet work on all metal?".
    - The teacher should discuss and prompt as necessary.

- Considering their responses to "What did I observe", students should fill out green sticky notes for box 2a, possible dependent variables.
    - The teacher may choose to lead a preemptive discussion about "what are we able to measure with our electromagnet".
    - Students should be guided to consider the number of paperclips held as one of the possible measurements.
- Students will consider box 2b, and what they might change to affect an electromagnet.
    - The teacher may grab blue sticky notes from step 1 to move directly to box 2a if they are in a form that fits (ex. "Can you put something else in for the nail?" suggests changing the object inside of the wire loops).
    - Students will fill out blue sticky notes to place in box 2b of things that could be changed to affect the electromagnet. These might include:
        - Number of wire loops
        - Thickness of wire
        - Length of wire
        - Voltage of battery
        - Number of batteries
        - Object inside the wire loops
        - Plastic insulation on the wire
        - Teacher prompts are encouraged.
- In their groups, students will fill out (on paper) steps 3a and 3b using their sticky notes.
    - They should be instructed that all groups will be measuring the same dependent variable (number of paper clips held) as this allows for them to more easily compare and discuss their results.
    - They should consider all of the blue sticky notes in box 2b, choose ONE to be their Independent Variable, and from the rest select the most important controlled variables that they will ensure do NOT CHANGE. (Ex. One group might choose to change the number of batteries used (IV) but will ensure that number of wire loops, the type of wire, how long the electromagnet is hooked up, etc., all remain the same).
- Groups will fill out steps 4 and 5 on their Smarter Science framework sheets and, when ready, bring it to show the teacher.
    - If the teacher approves their basic hypothesis they will be given an 'Inquiry Plan' to fill out in pencil.

Consolidation/Extension

- The group will fill out the inquiry plan then trade their plan with another group for peer assessment. The other group will provide written feedback (one good thing, one thing to improve, and circle in pencil any confusing parts) and verbally describe this feedback.
- Groups will use the peer feedback to make improvements to their Inquiry Plan then submit to the teacher before leaving class for formative assessment comments (returned during the next period).