SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Exceptional Electromagnets Part 1 **Grade 9 Applied – Electrical Applications**

Lesson Plan

Assessment	AFL,Observations, Exit cards
Cross-curricular	Health, Phys.Ed., Technology

Big Ideas

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

Learning Goals

- Learn terms related to electrical devices
- Understand how to build and use an electromagnet
- Learn some of the types of technology that use electromagnets.
- Learn that electricity and magnetism are connected

Materials

For each Pair or Quad of students:

- 1 D battery
- 1 large iron nail
- 150 cm very thin copper wire
- 2 Alligator clips (not strictly necessary but makes connection easier
- 1 box of paper clips
- Exceptional Electromagnets 1 (Jumbled Instructions and and Exit Card)

Safety Notes

Always disconnect battery between tests.

Specific Expectations

A1.4 apply knowledge and understanding of safe practices and procedures when planning investigations
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
A2.1 identify and describe a variety of careers related to the fields of science under study
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
D3.3 identify the factors that make Earth well suited for the existence of life (e.g., a magnetosphere that protects the planet from solar wind; Earth's distance from the sun; the ability of Earth's atmosphere to trap heat, preventing extreme fluctuations in temperature)

Description

This is **lesson one** of a series of three lessons on electromagnets. The students will be making their own electromagnets and then performing experiments with them in later lessons.

Introduction

- This lesson begins with a description of terms that may not be familiar to students. Use slides 2-4 in the 'Exceptional Electromagnets Visuals' presentation.
- The teacher will conduct a guessing game with the class in order to help students learn about the myriad ways that electromagnets are used in everyday technology.
    - Slides 5-17 of the Visuals Presentation contain a close up picture* of a part of a piece of technology that relies on an electromagnet immediately followed by a wider view of the same picture.
    - Object by object, students should try to guess what they are looking at to then have it revealed by the teacher.
    - It is suggested that students record their answers on whiteboards, chart paper, etc. before revealing their guess. Questions regarding the technology should be encouraged and could be recorded on a 'Big Questions' board for later discussion.
- Slide 18 presents the main scope of the lesson for students.
- Slide 19 presents the learning goals and might be shared here or at the end of the lesson. These learning goals are tied directly to the exit card self-assessment.

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Action

Students will be building electromagnets to gain a working knowledge of the technology. Much of their learning is designed to be experiential. Students should be divided into working groups of 2-4 students.

- The teacher will provide each group with a set up 'Jumbled Instructions'.
    - Students must cut up the instructions and place them in what they believe is the correct order.
    - Solutions for the 'Jumbled Instructions' are provided as the second page of 'Jumbled Instructions' and on slide 20 of the visuals presentation to be shared with the class.
    - The teacher must make a special point of discussing the safety issues listed in the 'Jumbled Instructions' (also shown on slide 25).
- Once groups have arranged and understood the instructions and safety concerns they should retrieve their materials and follow the instructions to build their electromagnet.
    - If visual instructions are preferred or needed for differentiation, they are included on slides 21-24.

- NOTE: The number of loops of wire referenced in the 'Jumbled Instructions' may depend on the diameter of both the nail and the wire used.
- Teachers should practice with materials first to ensure that the length of wire and number of loops will match with the particular materials.

- Students will begin by placing the head of the nail in their electromagnet over the edge of their desk or lab station.
- They will connect the alligator clip to their battery to complete the circuit and apply one paper clip to the nail head (see slide 24).
  - They will then break their circuit by removing the alligator clip and observe the paper clip fall.
- Students should hook another paper clip on to the first and see if their magnet will still hold the clip.
  - They will continue this until their magnet fails to hold the clip with the added mass. Students should record their results on a communal table (likely on the front classroom board).

Group #	Number of paper clips held
1	
2	
3	

- Discuss, as a class, why the number of paperclips held was similar or different.
- If there were differences, brainstorm a list of 'experimental errors' that might lead to the same experiment giving varying results.
  - This is an ideal opportunity to discuss the messy nature of science and experimental repeatability.
  - Discussion could also centre on whether or not the initial paper clip was included in the count and whether or not it should be (a tricky question with no clear right answer).

Consolidation/Extension

- Students will complete, individually, the 'Exit Card – Self-Assessment'

- If time remains, students should read the following:

- Article about how earth's magnetic field is an electromagnet (space connection)
- http://www.universetoday.com/27005/earths-magnetic-field/