Madison Public Schools

Grade 8 - Unit 3 - Electricity and Magnetism

Unit Focus

Students will gain a great deal of experience working with the Engineering Design Process during this unit on Electricity and Magnetism. Students will explore both concepts primarily through an inquiry model where they will be asked to build a variety of tools with the materials and constraints provided. Students will need to not only apply the Engineering Design Process, but also learn to persevere and reflect on their learning process. Throughout each experience, students will be gaining knowledge and understanding of the magnetism, static electricity, electrons, circuits, to name just a few relevant and useful concepts.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science
Middle School Engineering Design: 6 - 8

- Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. *MS-ETS1-4*

Middle School Physical Science: 6 - 8

- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. *MS-PS2-3*
- Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. *MS-PS2-5*

Next Generation Science Standards (DCI)
Science: 8

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *ETS1.6.B1*
- Models of all kinds are important for testing solutions. *ETS1.6.B5*
- Electric and magnetic (electromagnetic) forces can

Transfer

T1 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.
T2 Make observations and ask questions to define a problem based on prior knowledge and curiosity that stimulates further exploration, analysis, and discovery.

Meaning

Understanding(s)

U1 Electric and magnetic forces can be attractive or repulsive and are dependent on the strength of the charge or magnetic strengths and the distance between them.
U2 Each form of energy can be converted into other forms of energy or into work (e.g. kinetic to potential, mechanical to electrical).
U3 Energy can be described on a microscopic level which describes the motion/behavior of the particles.
U4 Attractive and repulsive interactions at a distance (e.g., gravitational, magnetic, electrical and electromagnetic) can be described by using the concept of fields.
U5 The configuration of a circuit indicates its potential electric flow.
U6 Models provide an opportunity to test predictions and ideas in simulations and in real-world situations.

Essential Question(s)

Q1 How can I control electricity?
Q2 How do electrons behave to produce electricity?
Q3 What do the results tell me? What patterns do I see or what conclusions can I draw?
Q4 Based on these resources, how do I develop a design that I can test?

Stage 1: Desired Results - Key Understandings

	Acquisition of Knowledge and Skill	
	Knowledge	**Skill(s)**
be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. *PS2.6.B1* • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). *PS2.6.B3* **Student Growth and Development 21st Century Capacities Matrix** *Creative Thinking* • Innovation: Students will be able to take an existing solution or object in order to consider limitations and possible transformations. *MM.2.1* • Design: Students will be able to engage in an appropriate process to refine their product. *MM.2.3* *Self-Direction* • Reflection: Students will be able to analyze their performance to evaluate progress toward learning goals in order to determine next step(s). *MM.4.1* • Perseverance: Students will be able to identify problem(s) and use appropriate strategies to continue toward a desired goal. *MM.4.2*	**K1** Electricity can be measured in terms of voltage, amperage and resistance. **K2** Static electricity can be developed through friction, conduction, and induction. **K3** An electric chemical cell is composed of two electrodes and one electrolyte. **K4** Schematics are drawn using universal symbols **K5** Electrons are attracted to the surface of the planet Earth **K6** Magnets can be temporary or permanent. **K7** Magnets can be created by aligning the domains of ferromagnetic materials (nickel, iron, cobalt). **K8** Alternating current is caused by electromagnetism. Direct current is generated by electrochemical cells. **K9** Correlation between magnets and electricity (electromagnetism). **K10** Generators work by converting one energy source into electrical energy. **K11** Transformers are devices to step up or step down electric current. **K12** Vocabulary: static, current, friction, conduction, induction, voltage, amperage, resistance, Ohm's law, Coulomb's law, series, parallel, schematic, electrochemical cell, electrode, electrolyte, battery, load/device, magnetism, domain, electromagnetism, Earth as a Magnet, ferromagnetic, temporary magnet, magnetosphere, generator, transformer, alternating current, direct current, circuit	**S1** Design and test circuits (parallel and series) **S2** Draw schematics to represent successful circuit designs **S3** Predict the impact of changing voltage, amperage, or resistance on a given circuit **S4** Use Coulomb's law to determine how the strength of electrical forces will change/can be influenced