07_Magnetism

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **2 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is about the nature of basic things such as motion, force, energy, matter, sound, light, electricity and the composition of atoms. Laboratory experiments, demonstrations, applications to daily life and current topics in physics provide students with an appreciation of this most basic science.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Essential question:

- How do magnets and moving electric charges interact with other magnets and moving electric charges?

Students will understand:

- Electrical and magnetic forces are different aspects of a single electromagnetic force
- Earth has magnetism
- Magnetism and electricity are interrelated with each affecting the other
- Magnetism is a useful tool in generating power

CONTENT AREA STANDARDS

SCI.HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
SCI.HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

SL.11-12.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

LA.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of

	the subject under investigation.
LA.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
LA.WHST.11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
PFL.9.1.K12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.4	Demonstrate creativity and innovation.
TECH.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will know:

- Magnetic, electrical, and gravitational forces can act at a distance
- Magnets do not have monopoles
- Opposite poles attract and same poles repel
- How to solve for forces on moving charges in magnetic fields
- A magnetic field does not produce a force on a current that is parallel to the magnetic field. It only produces a force when the current is nonparallel to the magnetic field lines.

Procedural Knowledge

Students will be able to:

HS-PS2-5

- Students describe the phenomenon under investigation, which includes the following idea: that an electric current produces a magnetic field and that a changing magnetic field produces an electric current.

- Students develop an investigation plan and describe the data that will be collected and the evidence to be derived from the data about 1) an observable effect of a magnetic field that is uniquely related to the presence of an electric current in the circuit, and 2) an electric current in the circuit that is uniquely related to the presence of a changing magnetic field near the circuit. Students describe why these effects seen must be causal and not correlational, citing specific cause-effect relationships.
- In the investigation plan, students include:

1. The use of an electric circuit through which electric current can flow, a source of electrical energy that can be placed in the circuit, the shape and orientation of the wire, and the types and positions of detectors
2. A means to indicate or measure when electric current is flowing through the circuit
3. A means to indicate or measure the presence of a local magnetic field near the circuit
4. A design of a system to change the magnetic field in a nearby circuit and a means to indicate or measure when the magnetic field is changing.

- In the plan, students state whether the investigation will be conducted individually or collaboratively.
- Students measure and record electric currents and magnetic fields.
- Students evaluate their investigation, including an evaluation of the accuracy and precision of the data collected, as well as limitations of the investigation
- The ability of the data to provide the evidence required.
- If necessary, students refine the investigation plan to produce more accurate, precise, and useful data such that the measurements or indicators of the presence of an electric current in the circuit and a magnetic field near the circuit can provide the required evidence.

HS-PS3-5

- Students develop a model in which they identify and describe the relevant components to illustrate the forces and changes in energy involved when two objects interact, including:

1. The two objects in the system, including their initial positions and velocities (limited to one dimension).
2. The nature of the interaction (magnetic) between the two objects.
3. The relative magnitude and the direction of the net force on each of the objects.
4. Representation of a field as a quantity that has a magnitude and direction at all points in space and which contains energy.

- In the model, students describe the relationships between components, including the change in the energy of the objects, given the initial and final positions and velocities of the objects. Students use the model to determine whether the energy stored in the field increased, decreased, or remained the same when the objects interacted.
- Students use the model to support the claim that the change in the energy stored in the field (which is qualitatively determined to be either positive, negative, or zero) is consistent with the change in energy of the objects.
- Using the model, students describe the cause and effect relationships on a qualitative level between forces produced by magnetic fields and the change of energy of the objects in the system

EVIDENCE OF LEARNING

Formative Assessments

Strategic questioning

Class/small group discussions

Homework and classwork assignments

Conducting and analyzing labs

Summative Assessments

- Benchmarks – departmental benchmark given at the end of MP1, MP2, and MP3
- Alternative Assessments
    - Lab inquiries and investigations
    - Lab Practicals
    - Exploratory activities based on phenomenon
    - Gallery walks of student work
    - Creative Extension Projects
    - Build a model of a proposed solution
    - Let students design their own flashcards to test each other
    - Keynote presentations made by students on a topic
    - Portfolio

RESOURCES (Instructional, Supplemental, Intervention Materials)

The Physics Classroom - http://www.physicsclassroom.com/

PhET simulations - https://phet.colorado.edu/

Pivot - https://www.pivotinteractives.com/

Edpuzzle - https://edpuzzle.com/

Vernier labs - teacher lab manual available in classroom

INTERDISCIPLINARY CONNECTIONS

Calculations drive connections with mathematics courses

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.