International Baccalaureate
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3D Science Unit Planner

Marietta City Schools

MARIETTA CITY SCHOOLS

Grade & Course: Physical Science	**Topic: Electricity and Magnetism**	**Duration: 5 weeks**
Teachers: Physical Science PLC		

Georgia Standards and Content:

SPS10. Obtain, evaluate, and communicate information to explain the properties of and relationships between electricity and magnetism.

a. Use mathematical and computational thinking to support a claim regarding relationships among voltage, current, and resistance.

b. Develop and use models to illustrate and explain the conventional flow (direct and alternating) of current and the flow of electrons in simple series and parallel circuits. (*Clarification statement:* Advantages and disadvantages of series and parallel circuits should be addressed.)

c. Plan and carry out investigations to determine the relationship between magnetism and the movement of electrical charge. (*Clarification statement*: Investigations could include electromagnets, simple motors, and generators.)

Topics to Cover: **Electricity, voltage, current (alternating and direct), resistance, and circuits (series and parallel)**
Magnetism

Lesson Content:

1. **Electricity - voltage, current (AC/DC), resistance - conductor/insulator**
2. **Circuits (Parallel vs Series)**
3. **Magnetism - magnetic field, permanent magnets, motors and generators**

Narrative / Background Information

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)
Units 1-5 - electrons, energy, and power
SPS7a

GSE 8th grade standards
Link to GSE 8th Grade Science

Teacher Background Info:
https://www.physicsclassroom.com/class/circuits

http://www.nap.edu/openbook.php?record_id=13165&page=87

Unit Phenomena (LEARNING PROCESS) Gravity, magnetism, electricity, and electromagnetism are used in designed systems

Inquiry Statement: Advances in science and technology have allowed humans to design systems that harness the energy and identify the relationship between electricity and magnetism.

Global Context/Exploration:
Scientific and Technical Innovation/Systems & Models

Science & Engineering Practices:	**Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)**	**Crosscutting Concepts: (KNOWLEDGE & SKILLS)**
• Construct explanations • Use mathematical and computational thinking • Develop and use models • Plan and carry out investigations	**PS2.B: Types of Interactions** Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in	Change & Systems Interactions & Energy **Cause and Effect** • Cause and effect

	each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	relationships are routinely identified, tested, and used to explain change. **Key and Related Concepts:** Key: Systems/Relationships Related: Energy **Approaches to Learning (ATLs):** ● Use models and simulations to explore complex systems and issues ● Analyze complex concepts and synthesize to create new understanding

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)
Some of the common ones that you will find include:

- Students may believe that an electrochemical cell (battery) is the source of charge in an electric circuit.
- Students may use the terms current, energy, and potential difference interchangeably with one another, when they are, in fact, different concepts.
- Students may believe that circuit components consume current.
- Students may believe that current comes out of both poles of the battery and meets at a light bulb, causing it to light.
- Students may believe that current is divided equally amongst each line of a parallel circuit.
- Students may believe that a change before a bulb in a series circuit will affect the bulb's brightness, but the same bulb will not be affected by a change in the circuit after the bulb.
- Students may believe that batteries are constant sources of current.

Reference: Secondary School Students' Misconceptions about Simple Electric Circuits
https://files.eric.ed.gov/fulltext/ED564331.pdf

Content/Key Vocabulary: (KNOWLEDGE & SKILLS)

Lesson 1: Electricity	Lesson 2: Circuits	Lesson 3: Magnetism
electric charge **electrical conductor** **electrical insulator** **electric force** **electric field** **repulsion** **attraction** **protons** **electrons** **Coulomb** **transfer** **friction** **static electricity** **electrical potential energy** **potential difference** **cell** **electric current** **resistance** **battery**	**electric circuit** **schematic diagram** **series circuit** **parallel circuit** **electric power** **fuse** **circuit breaker** **switch** **resistor** **Watts** **Kilowatts**	**magnetic pole** **magnetic field** **permanent magnet** **magnetic domains** **magnetic field lines** **compass** **electromagnetism** **right hand rule** **solenoids** **bar magnets** **concentric circles** **electric motor** **electromagnet** **galvanometer** **commutator** **coils** **electromagnetic induction** **generator** **alternating current (AC)**

voltage **current** **Ohm** **Ampere** **semiconductors** **critical temperature**		**direct current (DC)** **electromagnetic force** **oscillation** **Transformers**

These questions are related directly to the key concepts, related concepts, and global context and statement of inquiry. These are taking a step further from the content questions.

Inquiry Questions:

Factual

What is electric potential?

What are the requirements of an electric circuit?

What is the difference between direct current and alternating current?

What is the difference between series and parallel circuits? Pros and cons of each?

What are current, voltage, and resistance and what are the relationships between them?

What types of systems take advantage of the relationship between electricity and magnetism?

Conceptual

How can I illustrate the flow of current/electrons in series and parallel circuits?

How can I use certain components to design a complete circuit and explain the flow of electrons?

How can I use a circuit diagram to predict the flow of current through a circuit?

How can I use Ohm's Law to determine current, voltage, and resistance in a given circuit?

How can I demonstrate the relationship between magnetism and electrical charge?

Debatable

What are some potential applications of electromagnets that have yet to be discovered?

MYP Electricity & Magnetism Unit Assessment (A,D) Circuits Lab (B,C) Electricity and Magnetism Lab (B,C)	**Summative assessment** **CSA over both Electricity and Magnetism** **Relationship between summative assessment task(s) and statement of inquiry:** **Humans consistently rely upon electricity, magnetism, and the relationship between them in their everyday lives. In this unit, students will be tasked with building various circuits in order to demonstrate the movement of charge. Given appropriate materials, they will be tasked with designing circuits, explaining the necessary components of a circuit, articulating their conceptual understanding of the movement of electrical charge in simple series and parallel circuits, as well as using Ohm's law to calculate current, voltage, and resistance. The unit assessment will require students to determine and/or predict what will occur, given various circuitry scenarios, while also calculating current, voltage and resistance. Students will apply their understanding of simple circuitry to discuss and describe the use and applications of electricity and**
Unit Objectives: SPS10abc	

Learning Activities and Experiences	Inquiry & Obtain: (LEARNING PROCESS)	Evaluate: (LEARNING PROCESS)	Communicate: (LEARNING PROCESS)
Week 1	Day 1: 1. Phenomenon: Flipping a Switch or Electric Cars (TRL) 3. PhET: Exploring a Battery https://phet.colorado.edu/en/simulation/legacy/battery-voltage Day 2: 1. Notes: Lesson 1: Electric Potential Difference https://www.physicsclassroom.com/class/circuits Day 3: 1. Notes: Lesson 2: Electric Current Day 4: 1. Notice & Wonder: PhET: Battery-Resistor Circuit https://phet.colorado.edu/en/simulation/legacy/battery-resistor-circuit 2. Notes: Lesson 3: Electrical Resistance	Day 3: 2. Review and Edit "Building and Explaining a Simple Circuit (from Day 1) Day 4: 3. Ohm's Law Practice Problems	Day 1: 2. Assess Prior Knowledge: Anticipation Guide: Common Misconceptions Regarding Electric Circuits https://www.physicsclassroom.com/class/circuits/Lesson-2/Common-Misconceptions-Regarding-Electric-Circuits Building and Explaining a Simple Circuit (motor, alligator clips, battery, light or fan) Day 2: 2. Electrical Potential Simulation: Students as Charges in a Simple Circuit (Model Series, AC, DC) Day 5: 1. Review Ohm's Law Practice 2. Student Modeling: Journey of a Typical Electron
Week 2	Day 2: 1. Notes: Circuit Connections	Day 2: 2. Interpreting Circuit Diagrams Practice Day 3:	Day 1: Formative Assessment: Lessons 1-3

		1. Hands-On Circuitry Labs/SIMs (also see TRL for specific examples) -Simple Circuit w/Various Wire Diameters -Simple Circuit w/Switch -Series Circuit w/Switch -Series Circuit w/One Non-Working Bulb -Parallel Circuit w/Switch -Parallel Circuit w/One Non-Working Bulb Day 4: 1. Hands-On Circuitry Labs/SIMs Day 5: 1. Circuit Lab Wrap-Up	Day 5: Circuit Lab: Formal Data Analysis, Diagramming, and Write-Up
Week 3	Day 1: <u>Electromagnet Components and How They Work</u> 1. DE Video: Electromagnetic Force at a Junkyard (see resources): Purpose: What is needed to make an electromagnet? How are electromagnets useful? **2.** <u>Building & Testing Electromagnets</u> (see Resources – Pages 3 & 4 of S8P5 Electrostatics doc.) Day 2: 1. Student Research/Reading: DE Science Techbook: Unit 5: Electricity and Magnetism: Concept 5.2: Electricity and Magnetism Relationship Day 4:	Day 2: 2. Designing the Strongest Electromagnet Planning (<u>Electromagnet Inquiry Lab</u> can be used as a guide) Day 3: 1. Designing the Strongest Electromagnet Challenge (<u>Electromagnet Inquiry Lab</u> can be used as a guide) Day 4: 2. Compare/Contrast: Motors and Generators Venn Diagram Day 5: 1. Building a Simple Motor Lab https://www.education.com/science-fair/article/no-frills-motor/	Day 1: 3<u>. Discussion:</u> How did changing the number of coils affect the strength of your magnet? What else might impact an electromagnet's strength?

	1. Research: Investigating Motors and Generators		
Week 4		Day 1: 1. DE or PhET: Building a Generator https://app.discoveryeducation.com/learn/player/a65b9f27-ef18-47a3-8349-c644d749adec	Day 1: 2. Write-Up: Building Motors and Generators & Their Uses Day 2: E&M Wrap-Up/Review Day 3: E&M Review Day 4: E&M Unit Assessment Day 5: Flex Day

Resources (hyperlink to model lessons and/or resources):
TRL Instructional Segment: Current Electricity: Limit the Resistance to Learn About Electricity!
*Voltage-Current-Resistance Relationship Graphic Organizer

Physics Classroom
https://www.physicsclassroom.com/class/circuits

DE Science Techbook: Unit 5: Electricity and Magnetism: Concept 5.2: Electricity and Magnetism Relationship

DE: Model Lesson for Circuits and Switches
https://app.discoveryeducation.com/learn/player/1c83e094-b4a0-4035-9c9c-7f87d93a4037

DE Interactives:
Virtual Lab: Getting Connected
Exploration: Getting Wired
Exploration: Volts and Jolts
Skill Builder: Series and Parallel Circuits
Science Sleuth: The Alarming Episode

PhET: https://phet.colorado.edu/en/simulations/category/physics
Battery-Resistor Circuit
Battery Voltage
Charges and Fields
Circuit Construction Kit
Circuit Construction Virtual Lab
Electric Field Hockey
Electric Field of Dreams
Generator
John Travoltage
Magnets and Electromagnets
Ohm's Law

TRL: Electric Experiments
http://www.abc.net.au/science/surfingscientist/pdf/lesson_plan11.pdf

Electromagnets:

Electromagnet Phenomenon Video
https://app.discoveryeducation.com/learn/videos/881e6fde-3bfd-4ca6-9207-24a68053e939/

Electromagnet Inquiry:
https://www.teachengineering.org/activities/view/van_cleanupmess_act4