06: Electricity and Circuits

Content Area: **Science**
Course(s): **Physics**
Time Period: **April**
Length: **15 days**
Status: **Published**

Unit Overview:

In this unit of study, students' understanding of how forces at a distance can be explained by fields, why some materials are attracted to each other while other are not, how magnets or electric currents cause magnetic fields, and how charges or changing magnetic fields cause electric fields. We will also look at the nature of moving charges leading to the relationship between current, voltage and resistance described by Ohm's law. The crosscutting concept of *cause and effect* is called out as an organizing concept. Students are expected to demonstrate proficiency *in planning and conducting investigations and developing and using models*.

Enduring Understandings:

- Batteries convert chemical energy into electrical energy
- Capacitors are built to store charge and to create fields
- Current can be predicted from voltage and resistance
- electrical Forces are similar to gravity in their structure but can be either attractive or repulsive
- Series circuits have a single path for electron flow, whereas parallel circuits have multiple pathways.
- There are two types of charge: Positive and Negative

Essential Questions:

- How can we predict the amount of electricity and energy we will use in a given situation?
- How can we use electrical charges to make life easier for us?

Standards/Indicators/Student Learning Objectives (SLOs):

- SWBAT calculate the magnitude of the electrostatic force between two objects
- SWBAT define current, voltage and resistance, and identify the relationship between them.
- SWBAT define electrical power and calculate the cost of using electricity
- SWBAT define Ohm's Law and apply it to a variety of unique situations.
- SWBAT define resistance and calculate the resistance in a wire

- SWBAT describe the nature of an electric field and determine its affect on a test charge placed within it.
- SWBAT describe the purpose and uses for capacitors and calculate the capacitance and charge stored on one.
- SWBAT determine if an object will become positively or negatively charged when rubbed against another object
- SWBAT explain how batteries differ from capacitors and identify their uses.
- SWBAT identify the various types of charges and what causes them
- SWBAT read the color code of a resistor and determine the total resistance in series and parallel circuits

9-12.HS-ETS1-4.4.1	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.
9-12.HS-ETS1-2.6	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
9-12.HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
9-12.HS-PS1-3.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-1.2	Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
9-12.HS-PS1-4.2.1	Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS2-1.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-PS1-1.2.1	Use a model to predict the relationships between systems or between components of a system.
9-12.HS-PS3-2.2.1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS2-3.2.1	Systems can be designed to cause a desired effect.
9-12.HS-PS2-5.3	Planning and carrying out investigations to answer questions or test solutions to problems

	in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.
9-12.HS-PS2-5.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-PS2-2.4.1	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.
9-12.HS-PS3-1.4.1	Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
9-12.HS-PS1-2.6	Constructing Explanations and Designing Solutions
9-12.HS-PS2-3.6.1	Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
9-12.HS-PS2-6.8.1	Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
9-12.HS-PS1-1.PS1.A.1	Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
9-12.HS-PS2-4.PS2.B.1	Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
9-12.HS-PS2-4.PS2.B.2	Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
9-12.HS-PS2-5.PS3.A.1	“Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents.
9-12.HS-PS2-3.ETS1.A.1	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
9-12.HS-PS2-3.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Lesson Titles:

- Capacitors
- Electric Fields
- Electro Statics
- Ohm's Law
- Power and Cost of Electricity
- Resistance and Resistors
- Series and Parallel Circuits
- Voltage and Current

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.RST.11-12.10	By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.1.B	Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
LA.WHST.11-12.1.C	Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.11-12.2.E	Provide a concluding paragraph or section that supports the argument presented.
LA.WHST.11-12.10	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Instructional Strategies/Learning Activities and Levels of Blooms/DOK:

- Activity: Introduction to Circuits Stuff. Some background on the things you need to know to be able to deal with simple circuits.
- Battery Introduction: Notes and Practice on all you need to do with batteries
- Classwork: Capacitor Problems and Answers
- Classwork: Learning Activity for Wire Resistance. This activity will allow you to learn all the key things about the resistance of a wire.
- Comments and Notes about Ohm's Law

- Comments and Notes on Electric Power
- Homework: Click Here to answer questions on some of the properties of series and parallel circuits.
- Homework: Basic Electricity Ideas. A series of multiple choice questions based on the ideas we have learned thus far about electricity.
- Homework: Electrostatic Force Problem. A single problem to show that you are able to solve problems with the electrostatic force formula.
- Homework. Learning to Read a Resistor. This program sees how quickly you can convert the colors of a resistor into its resistance.
- In Class Problems: Battery, Current, Voltage Problems: NOW WITH ANSWERS
- Lab Activity: Electric Field Lab. This activity will let you examine the properties of an electric field.
- Lab Activity: Electricity Costs. This activity will have you calculate the costs of running some different appliances around your house.
- Lab Activity: Intro to Electrostatics Lab. This activity will let you examine some of the properties of charged objects.
- Lab Activity: Measuring Voltage Lab. This activity will let you see how to use a Craftsman Multimeter to measure the voltage of many different types of batteries.
- Lab Activity: Resistance of a Wire Lab. This activity will have you relationships that exist between the length and diameter of a wire and the resistance of the wire.
- Lab Activity: Building Circuits on a Breadboard : Discover some of the properties about series and parallel circuits.
- Lab Activity: Capacitor Lab. This lab activity is designed to teach you the basic properties of capacitors.
- Lab Activity: Ohm's Law Complete. Discover the relationships between voltage, current, power and resistance through a combination of real resistors and the simulation program.
- Lab Activity: Ohm's Law Virtual. Discover the relationships between voltage, current, power and resistance using the simulation program only.
- Lab Activity: Series and Parallel Circuits: Discover some of the properties about series and parallel circuits.
- Mini Lab Quiz: Identifying Circuit Types: A series of pictures that you have to classify as series, parallel, not connected or short circuited.
- Notes about electrical resistance
- Notes on Capacitor Basics
- Notes on Current and Voltage
- Notes on Electric Fields
- Notes on Electrostatics and Electrostatic Force
- Notes on Series and Parallel Circuits
- Ownwork: Electric Field Problems. These problems will give you a bit of practice with the formulas for the electric field strength.
- Ownwork: Electrical Power Problems. A few problems dealing with electrical energy and power.
- Ownwork: Electrostatics Problems. These problems will give you a chance to practice using the Coulomb Equation for charged objects.
- Ownwork: Ohm's Law Problems. A series of problems dealing with current, voltage and resistance and how they are related to each other.
- Ownwork: Resistance Problems. Problems involving electrical resistance of wires.
- Practice for Electrostatics Quiz

- Practice for the Quiz on Series and Parallel Circuits.
- Review for Quiz on Electricity Basics

Modifications

- Tutoring During Delsea 1

ELL Modifications:

- Focus on domain specific vocabulary and key words
- Offer sources for specific topics in primary language (Youtube web resources)
- Repeat, reword and clarify
- Digital Translators
- Use real objects when possible

IEP & 504 Modifications:

- Formula sheets and example problems to use on assessments
- Modeling and showing various examples
- Scaffolding notes
- Students will be able to use calculators and/or other math tools

G&T Modifications:

- Extra labs to do outside the classroom
- Provide links to extension videos or other media
- Increase the level of problems and challenge problems

At Risk Modifications

- Utilize Delsea One to complete assignments, try supplemental material or to modify classroom behaviors
- Reach out to parents

Formative Assessment:

- Quiz 6.1 Electrostatics
- Quiz 6.2 Capacitors and Power
- Quiz 6.3 Resistance and Ohm's Law

- Quiz 6.4 Series and Parallel Circuits

Summative Assessment:

- Lab Assessment: Electricity and Circuits
- Unit 6 Exam: Electricity and Circuits

Alternative Assessments:

Performance tasks
Project-based assignments
Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments:

Skills-based assessment
Reading response
Writing prompt
Lab practical

Resources & Materials:

- Cell Phone Apps for Video Editing
- Chromebooks
- https://sites.google.com/site/delseaphysics1/Home
- Lab Pro Modules and appropriate sensors
- Meter Sticks/metric rules
- Timing Devices

Technology:

- Chromebook
- Class Website
- Ed Puzzle
- Google Classroom
- Google Suite
- Graphical Analysis Program
- Lab Pro Modules and Sensors
- Other
- Promethean Board

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.4	Explain and identify interdependent systems and their functions.
TECH.8.2.12.C.CS3	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.CS1	Computational thinking and computer programming as tools used in design and engineering.