

Unit 5: Electrical Engineering and Speakers

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 2**
Length: **25**
Status: **Published**

Summary

Introduction:

Students will explore the patents for the first speakers in the 20th century and make a speaker using a coil, permanent magnet and cone. Students will have a design objective to make a louder speaker and will apply the properties of wire, Ohm's law, Kirchoff's law, and properties of waves to accomplish their goal.

Revision Date: July 2020

SCI.HS.PS1.A	Structure and Properties of Matter
SCI.HS-PS4	Waves and Their Applications in Technologies for Information Transfer
SCI.HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
SCI.HS.PS4.B	Electromagnetic Radiation
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS.ETS1.B	Developing Possible Solutions 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.
CS.9-12.ED	Engineering Design
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
SCI.HS	Waves and Electromagnetic Radiation
SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
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	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
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.A	The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live.
TECH.8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
TECH.8.2.12.A.CS1	The characteristics and scope of technology.
TECH.8.2.12.A.CS2	The core concepts of technology.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
TECH.8.2.12.C.4	Explain and identify interdependent systems and their functions.
TECH.8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.

TECH.8.2.12.C.CS1	The attributes of design.
TECH.8.2.12.C.CS2	The application of engineering design.
TECH.8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
TECH.8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
TECH.8.2.12.D.CS1	Apply the design process.
TECH.8.2.12.D.CS2	Use and maintain technological products and systems.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CT	Critical Thinking and Problem-solving
	Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.

Essential Questions/Enduring Understandings

Essential Questions:

How do electrical engineers solve problems?

How does science affect speaker design?

Enduring Understandings:

The design loop ends with a new beginning: redesign and reimplementation.

Electrical engineers use a range of science and math based strategies to improve a design.

Patents are used to protect intellectual property.

Electrical engineers make technical drawings to communicate solutions.

Objectives

Students will know:

Safety practices when using electrical components.

how science is applied to acoustic design of a device like a speaker

how to apply research skills to a design problem.

historical background information regarding speaker design.

What an actual patent looks like.

how to use mathematical equations relating waves, frequency, and period.

key terms and vocabulary: sones, decibels, rms (root mean square or quadratic mean), wave length, frequency, amplitude, phase, period, sinusoidal wave, electro-magnetic waves, Ohm's law, Kirchoff's law, power, current, resistance, gauge, units of measure and conversions (metric/imperial).

Students will be skilled at:

Practicing safety in the electronics lab.

Safely using a soldering iron.

Prototyping a speaker.

Documenting work in a design log.

Critically making choices about improving a design.

Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Lectures and quiz on safety and using electronics in the unit.

Lecture and quiz on safely using a soldering iron.

Lectures and lessons will be provided to develop understanding of the properties of waves.

Lectures and lessons will be provided to develop understanding of Ohm's law, Kirchoff's law.

Lectures and lessons will be provided to develop understanding of the properties of wire, including resistance, current, and gauge.

Problem based learning: In groups of 2 students, students will perform research on patents on speakers (Kellogg and Rice). Students will complete worksheets related to the properties of materials and Laws. Students will view on-line tutorials and demonstrations of how to make a rudimentary speaker. Students will make a rudimentary speaker and test it. Students will apply principles discussed in class and make improvements. Work will be documented in design logs and with phones. Students will make a presentation

that shows application of the design loop to make a louder speaker.

Design logs will be maintained throughout the design problem sequence to document the process.

Summative assessments will be conducted throughout to evaluate skills acquisition.

Complete unit test and writing prompt.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Complete writing prompt.

Assessment

Formative assessments

will be conducted throughout the process using class discussion, student writing and practice quizzes

Assess students previous design logs and provide feedback

exit tickets

participation in class discussions on properties of wire, including resistance, current, and gauge, properties of waves , etc

Summative assessment:

use the design loop and develop solutions to a design problem like the design of a speaker enclosure. The design process and solution will be graded using project specific rubrics.

demonstrate the ability to methodically document solutions to the problem.

demonstrate the ability to perform calculations related to waves in their projects and on worksheets, quizzes or tests.

complete written tests and quizzes

complete writing prompts: explain what scientific principle was applied to make the speaker louder. (i.e. heavier gauge wire, wave analysis, multiple wires) Explain how coils in parallel affect impedance requirements.

answer the essential questions.

Alternate Assessment:

document various steps of speaker design and assembly using video, audio and pictures

Benchmark assessment: Final exam

Materials

Copper magnet wire of various gauges: 28, 30, 36, 38, 50.

Multimeter

Tape, paper

Permanent magnets

Receiver (music source with amplifier)

On-line tutorials

Email and e-board

Websites

CAD and other software programs may be used to document the systems.

SmartBoard use for presentation and interactive lessons

Integrated Accommodation and Modifications...

[Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education and those with 504s](#)