2023 U07 iSTEM 2 - Intro to Electrical Engineering

Content Area: **CTE**
Course(s): **iSTEM**
Time Period: **March**
Length: **12 - 14 weeks**
Status: **Published**

Unit Overview:

The goal of this unit is to introduce some of the fundamentals of Electrical Engineering in the most simple, effective and fast way. This unit begins with a introduction to the basic vocabulary and terminology of parallel and series circuits, and then introduces students to the Tinker CAD program for a simulation of the assembly of different types of electrical circuits. Students will assemble Arduino circuits and battery circuits that will operate different circuit elements in the online program and learn their characteristics and typical applications. The class will then advance to the physical assembly of DC circuits such as Arduino bread boards, and batteries operating elements using the online program as a tool to check the physical prototype that they design and assemble. Advancement from DC electricity to AC electricity will bring in to play the students understanding of how electricity travels from the source to their home, how the electrical wiring in a house works, and finally students will learn how to wire their own light bulb to switch. Student will take the principles learned from DC and AC electricity, and apply them to the Carnival Game design challenge. Throughout the electrical engineering unit, students will be assigned exploratory assignments that will allow them to gain a larger understanding of the type of work electrical engineers do, the career opportunities available to Electrical Engineers, and the skills needed to become an Electrical Engineer.

Essential Questions:

- Why are some materials good at conducting electricity and some are not?
- How do electricians measure electricity values?
- How are motors and generators the same? Different?
- How are series and parallel electrical circuits similar? Different?
- What elements are needed when creating circuits?
- How does power flow through a circuit? How can you assemble a circuit to operate a light / switch?
- Why is the mathematical relationship expressed through Ohm’s Law so important for designing and evaluating electrical circuits?
- How does electric travel from the sources using power lines to the the outlets in your house?
- What tools and materials are needed when wiring to a outlet and light switch?

Enduring Understandings:

- Define current, voltage, and resistance
- Measure voltage, current, and resistance using a multimeter
- Build a DC motor to identify the primary parts and demonstrate how it functions.
- Compare the characteristics of a basic motor and generator.
- Build series, parallel, and combination electrical circuits.

- Create circuit diagrams using standardized schematic symbols.

- Build and test physical electrical circuits based upon circuit diagrams.

- Integrate DC sources, lamps, switches, diodes, light emitting diodes, resistors, and capacitors into electrical circuits to achieve specific functions.

- Mathematically calculate voltage, current, and resistance using Ohm's law.

- Investigate safe practices involving electricity
- Describe materials used in electric wiring
- Explain the procedure for installing switches, making common splices, and doing other electrical wiring tasks.

Lesson Titles:

- Presentation of Information: Electrical Power, DC vs AC Electric

- Tinker CAD introduction

- Mini - Project: Create your own Circuits

- Mini - Project: Arduino Board Operation

- Mini - Project: At Home Electrical Wiring

- Connecting elements of a circuit

- Calculating Voltage, Current, and Resistance

- Design Challenge #9: Carnival Game

- Project Presentations

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

- Direct Instruction: Daily Overviews (Promethean Board, Chromebooks, White Board)
- Direct Instruction: Presentations - Presentations of Information (google slides)
- Instruction: Step by Step Videos / Example: Creating Circuits, At Home Electrical Wiring

- Independent Work: Voltage, Current, and Resistance Calculations, AC vs DC Electric Assignments, Arduino Board Practice Assignments
- Indirect Instruction: Reflective Discussion, Evaluation of Data and Technical Writing - ENB Write Ups, Self Evaluations, Presentation of Projects
- Experiential: Project - Carnival Game
- Experiential:- Mini - Project: Create your own Circuits
- Experiential: Mini - Project: Arduino Board Operation
- Experiential: Mini - Project: At Home Electrical Wiring
- Cooperative: Partner classwork, short projects, projects and ENB entries

Summative Assessment:

- Mini - Project: Arduino Board Operation
- Mini - Project: At Home Electrical Wiring
- Mini - Project: Create Your Own Circuits
- Project: Carnival Game Packet and Presentation
- Quiz: Arduino Board Operation ENB
- Quiz: At Home Electrical Wiring ENB
- Quiz: Calculating V, I, and R (Ohm's Law) Quiz

Formative Assessment:

- Anticipatory Set - Overview of items for the day, future activities of the unit, and/or review of previous information from the unit
- Classroom / Student Observation - check in on student work during in-class activities / projects
- Closure of Projects - students provide results of their projects, self-evaluate projects for possible improvements that could be made, and evaluate instruction that could be improved
- Closure of Units - students complete a design project that pertains to the unit at hand as well as prior units
- Conferences between the instructor and student at various points in the semester.
- ENB (engineering notebooks) - reviewed periodically during the school year
- In-class activities where students informally present their results.
- Presentation Sample Slides - Students participate in classroom discussion on topic that is being introduced and reviewed
- Q & A session - Student led question and answer session at the start of class for project information as needed
- Question and answer sessions, formal, planned and informal, spontaneous.
- Warm-Up - review information from current topic or previous topics, preview time for current activity, and/or opportunity for clarity on the previous day's work

Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

Alternative Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Standards/Indicators/Student Learning Objectives (SLOs):

9-12.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.
9-12.HS-ETS1-1.1	Asking Questions and Defining Problems
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-ETS1-4.5.1	Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
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-ETS1-1.ETS1.A	Defining and Delimiting Engineering Problems
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.

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.6	Model integrity, ethical leadership and effective management.
WRK.K-12.P.7	Plan education and career paths aligned to personal goals.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

	Key Ideas and Details
	Integration of Knowledge and Ideas
	Comprehension and Collaboration
	Presentation of Knowledge and Ideas
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-ETS1-3	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.

Technology Materials and Standards

- SmartBoard Presentations
- Chromebooks, Google Drive, Google Applications
- MS Office Software as needed
- Smartphones
- Construction Hand Tools and Safety Equipment
- Tinker CAD Program

TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
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.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
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.

Computer Science and Design Thinking Standards

CS.K-12.1.a	Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.
CS.K-12.1.c	Employ self- and peer-advocacy to address bias in interactions, product design, and development methods.
CS.K-12.2.b	Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness.
CS.K-12.2.c	Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.
CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
CS.K-12.4.b	Evaluate existing technological functionalities and incorporate them into new designs.
CS.K-12.4.d	Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.
CS.K-12.7.a	Select, organize, and interpret large data sets from multiple sources to support a claim.
CS.K-12.7.b	Describe, justify, and document computational and/or design processes and solutions using appropriate terminology consistent with the intended audience and purpose.

Equity Considerations

Climate Change

Topics: Activities to help students understand Climate Change

Materials Used: https://www.weareteachers.com/climate-change-activities/

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Asian American Pacific Islander Mandate

Topic: Activities that emphasize the impact of Asian American and Pacific Islanders on STEM

Materials Used: https://www.idtech.com/blog/aapi-heritage-month-stem-activities

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Modifications

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be

considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments

- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

Resources & Materials:

- Project Lead the Way, Introduction to Engineering Design Information
- Walker, Exploring Drafting, II: Goodhart-Wilcox, 1996
- Gradwell & Wekch. Technology, Engineering Our World, IL: Goodhart-Wilcox, 2012
- Tinker CAD Program