Unit 2: Circuitry

Content Area: **Engineering**
Course(s): **STEM**
Time Period: **Week 16**
Length: **15 Days**
Status: **Published**

Unit Overview

In this unit, students will learn the basic principles of what makes circuits function. Students will begin by learning the differences between common types of circuits (simple, series, and parallel). Students will experiment with each type, discovering practical applications for each. Students will then apply this knowledge of circuitry to create models to solve real world problems. Students will build upon their knowledge from Unit 1 by coming up with a plan of approach to solve each problem.

Standards

	Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
	Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
CCSS.ELA-Literacy.WHST.6-8.2.c	Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
CCSS.ELA-Literacy.WHST.6-8.4	Produce clear and coherent writing in which the development, organization, and style are

	appropriate to task, purpose, and audience.
SCI.MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
SCI.MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
SCI.MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Essential Questions

1) What real world applications can you think of that apply the idea of circuitry?

2) Compare and contrast the advantages/disadvantages of series/parallel circuits.

3) Why is it a good idea to always begin a project by coming up with a problem solving plan first?

Application of Knowledge: Students will know that...

- A battery is a type of energy source.
- A conductor is a material capable of transmitting an electrical current.
- A parallel circuit is a closed circuit in which the current divides into two or more paths before recombining to complete the circuit.
- A series circuit has a single path for electricity to flow.
- A switch is a device used to open and close circuits.
- An electrical circuit is a complete path through which electrons flow from an energy source, through a conducting wire and appliance, and back to the energy source.
- An insulator is a material capable of preventing the transfer of electrical energy.

Application of Skills: Students will be able to...

- Compare and contrast the differences between a series circuit and a parallel circuit.
- Create a model that demonstrates the use of a parallel circuit.
- Create a simple circuit in which a single light bulb is able to be lit.
- Solve real world problems involving the creation of a simple/series circuit.

Assessments

- Journal logs: Will be used for students to share anything that worked out well during the design process or anything unexpected they encountered.
- Lighthouse Project (self scoring rubric): students will be asked to grade themselves and their

classmates on their custom lighthouses.
- Steady Hand Game: students will be assessed as to whether or not they were able to successfully create a parallel circuit to power both a light bulb and an electric buzzer.
- Information from this unit will be included on a locally developed, end of course benchmark assessment that may take the form of a test, performance based project, or other summative assessment.

Suggested Activities

- Lighthouse Project: for this project students will be asked to design a lighthouse out of a minimal list of supplies in which they will use a simple circuit to power a light bulb on the top. Students will research various New Jersey lighthouses and must incorporate at least 1 distinct characteristic from a lighthouse into their own custom lighthouse.
- Steady Hand Game: for this activity, students will construct their own steady hand game (like those seen at carnivals and in the game "Operation"). Students must work with their teammate to construct a game that is challenging yet winnable. Students must correctly design a parallel circuit that will not only light a light bulb if they lose, but also ring an electric buzzer.
- Electric Fan: students will be given a set of materials and asked to design a hand held electric fan to keep you cool during those hot summer months.

Activities to Differentiate Instruction

Differentiation for special education:

- General modifications may include:
    - Modifications & accommodations as listed in the student's IEP
    - Assign a peer to help keep student on task
    - Modified or reduced assignments
    - Reduce length of assignment for different mode of delivery
    - Increase one-to-one time
    - Prioritize tasks
    - Think in concrete terms and provide hands-on-tasks
    - Position student near helping peer or have quick access to teacher
    - Anticipate where needs will be

- Content specific modifications may include:
    - Break a project up into small attainable goals that can be met each period.
    - Small handout of the definitions associated with this unit.

Differentiation for ELL's:

- General modifications may include:
    - Strategy groups

- Teacher conferences
- Modification plan
- Collaboration with ELL Teacher

- Content specific vocabulary important for ELL students to understand include: electricity, circuit, battery, conductor, switch, insulator, parallel circuit, series circuit.

Differentiation to extend learning for gifted students may include:

- Have students design their own game similar to "Operation" that can be created using multiple parallel circuits.
- Have students think of ways so their lighthouse can be turned on when the room gets dark.

Integrated/Cross-Disciplinary Instruction

ELA: Practice formulating complete and grammatically correct responses for the given journal entries.

Science: Students will see first hand how circuits are used and the differences between series and parallel circuits.

Engineering: Successfully create a custom lighthouse modeled after characteristics of New Jersey lighthouses.

Resources

www.learn2.stem101.org

STEM Labs for Middle Grades

Youtube videos: self directed videos that can help students along in the design process

21st Century Skills

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP6	Demonstrate creativity and innovation.

CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.