Lesson: **Electrical Engineering: Ohm’s Law**

Grade Level: 6-8 – Time Required: 35 minutes – Lesson Dependency: None – Subject Areas:

* Computer Science

**Summary**

Ohm’s Law is one of the most important and basic laws in electrical engineering. It explains its importance and how it is used to influence our daily lives. In this lesson the students will learn about Ohm’s Law and the relationship between voltage, current, resistance, and power. There is an activity and virtual simulation where the students must create their own circuits while learning about series and parallel circuits. 

**Engineering Connection**

Ohm’s Law is one of the most important and basic laws in electrical engineering. The formula for Ohm’s Law is I = V/R or Electric Current = Voltage/ Resistance. Voltage is the pressure of electricity that tries to push the energy through the wire. Current is the flow of electrons that are flowing through a wire or circuit. Resistance is the force that is going against the currents flow in a circuit. Electrical Engineers use this formula to control the flow of the current in a circuit.

**Learning Objectives**

Upon completing the lesson, the students should be able to:

● Understand what Ohm’s Law is and explain the importance of Ohm’s Law

● Know the history behind certain Electrical SI units and the people who contributed towards them

● Explain how Power relates to Ohm’s Law

● Comprehend what a Series and Parallel Circuit is and determine their overall differences

● Learn about the various circuit symbols and schematics

● Measure current and voltage

**Educational Standards**

* [CTE-TECED.68.ELCTEC.04.01](https://www.cpalms.org/Public/PreviewStandard/Preview/14476) - Use a digital or analog volt-ohm meter (VOM) to obtain accurate measurements.
* [CTE-TECED.68.ELCTEC.02.05](https://www.cpalms.org/Public/PreviewStandard/Preview/14468) - Mathematically calculate voltage, current, and resistance using Ohm’s law.
* [MAFS.912.A-CED.1.4](https://www.cpalms.org/Public/PreviewStandard/Preview/5557) - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law V = IR to highlight resistance R.
* [SC.912.P.10.15](https://www.cpalms.org/Public/PreviewStandard/Preview/1700) - Investigate and explain the relationships among current, voltage, resistance, and power.
* [CTE-TECED.68.ELCTEC.02.02](https://www.cpalms.org/Public/PreviewStandard/Preview/14465) - Sketch circuit diagrams using standardized schematic symbols.
* [CTE-TECED.68.ELCTEC.02.01](https://www.cpalms.org/Public/PreviewStandard/Preview/14464) - Identify the characteristics of series, parallel, and combination electrical circuits.

**Materials List**

* [Circuit Data Sheet](https://drive.google.com/file/d/1Y3tc-SZuQYUi2ZBCT41mp_h1mZ6SaIq3/view?usp=sharing)
* Computer/Laptop
* 1 Sheet of Paper
* Pencil
* Calculator

**Worksheets and Attachments**

* [Ohm’s Law Presentation -](https://docs.google.com/presentation/d/1-vnisDavqTbn-iRLF_OuXc_svsi4QBWJI-DSIXSSIqM/edit#slide=id.g8d5d0e59bb_0_227) (Slides 1-18)
* [Circuit Data Sheet (doc)](https://drive.google.com/file/d/1Y3tc-SZuQYUi2ZBCT41mp_h1mZ6SaIq3/view?usp=sharing)
* [Circuit Construction Kit Simulation](https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html)

**Pre-Req Knowledge**

Students should have basic math skills that include multiplication and division especially since most of the topic of Ohm’s Law revolves around solving the equation. They should have a brief understanding of what certain electrical concepts are such as voltage, resistance, and current.

**Lesson Background and Concepts for Teachers**

 The text and lessons follow the attached Google Slides Presentation. It starts off on slide 1 to 18. Each will breakdown the main objective of each slide and the key points/ideas behind them that could lead into a discussion. The presentation may be changed to adhere to certain examples or teaching methods to suit the needs of the class.

**Procedure**

* **Slide 1-** Icebreaker
	+ Introduce yourself and try to get the students to do the same thing.
	+ Ask if any of them know what Electrical Engineering is.
* **Slide 2-** The Importance of Electrical Engineering
	+ Ohm’s law is vitally important to describing electric circuits because it relates the voltage to the current, with the resistance value moderating the relationship between the two. Because of this, you can use Ohm’s law to control the amount of current in a circuit, adding resistors to reduce the current flow and taking them away to increase the amount of current.
	+ In Europe, the electric outlets produce a higher voltage than in the United States. So if you were to plug something in to charge, the circuits would increase the current to the point where the resistance isn’t strong enough leading to the circuit to burn out.
	+ That is why it is important to understand Ohm’s Law because something as simple as plugging something into an outlet could end up burning out the device.
* **Slide 3-** Explain the history of Georg Ohm
	+ It was named after a guy of the same name Georg Ohm who was a German physicist and mathematician.
	+ Through the use of Ohm’s Law, it was able to heavily impact the way we currently use our electricity today.
* **Slide 4-** Explain the history of Alessandro Volta
	+ An Italian physicist who created the electric battery which was the first source of a continuous current.
	+ In his lifetime he has made various scientific achievements such as being the first person to isolate methane.
	+ As a result of his achievements in science, the unit of electric potential was named the Volt.
* **Slide 5-** Explain the history of André-Marie Ampère
	+ He was a French physicist who founded electromagnetism.
	+ While also being the forerunner that first introduced the concept of the electron.
	+ As a result of his achievements, the unit for measuring electric current was named the Ampere
* **Slide 6- Ohm’s Law**
	+ This formula is very simple to learn as it can easily be described using the triangle.
	+ The formula is Electric Current = Voltage / Resistance
	+ Ohm’s Law states that current, or amperage (I), in a circuit is equal to the voltage (V) in the circuit divided by the resistance (R) of the circuit.
* **Slide 7- Voltage**
	+ The unit volt is named after the Italian physicist Alessandro Volta who invented what is considered the first chemical battery.
	+ To understand voltage, current, and ohm we can use the analogy of a water tank. The water being the charge, pressure is voltage, and flow is current.
	+ Voltage is the pressure of electricity that attempts to push that energy out through the circuit
* **Slide 8- Current**
	+ Current is the flow at which electricity is being moved through a wire.
	+ Electrical current is a measure of the amount of electrical charge transferred per unit of time.
	+ Current is the rate of flow in a circuit that is measured in amperes.
	+ The conventional symbol for current is I, which originates from the French phrase intensité de courant, meaning current intensity.
* **Slide 9- Resistance**
	+ Resistance can be described as a bottleneck or a smaller pipe that limits the amount of energy that is going through a circuit.
	+ Resistance is the force that is going against the currents flow in a circuit.
	+ Resistance is measured in Ohms that is also used as the omega symbol "Ω".
	+ The circuit with the higher resistance will allow less charge to flow, meaning the circuit with higher resistance has less current flowing through it.
* **Slide 10- Power**
	+ Power is the rate at which energy flows through a circuit.
	+ The formula is Power = Current \* Voltage
	+ The water analogy still works as it is a combination of current and voltage.
		- When either the voltage or current increases then it will result in more power.
	+ When too much power goes through a resistor that creates heat that depending on how much power is being exerted could lead to the resistor burning out.
* **Slide 11- Ohm’s Law Quiz**
	+ Take a few minutes to solve 3 equations
		- For guidance the students are allowed to use the triangle
* **Slide 12- Electrical Circuits**
	+ Circuit is any unbroken loop of electrical components that forms a continuous conducting path.
	+ An open circuit is one where the continuity has been broken by an interruption in the path for current to flow.
	+ A closed circuit is one that is complete, with good continuity throughout.
	+ The properties of an electrical circuit include voltage, current, and resistance.
* **Slide 13- Two types of circuits**
	+ **Series circuit**
		- Current stays the same
		- The voltage taken by each resistance is equal to the source voltage
	+ **Parallel circuit**
		- The voltage is always the same
		- The total current is the sum of the current flowing through each component
* **Slide 14- Series Connection**
	+ In a series circuit the current flow of a circuit is always the same.
		- The components are connected in an unbroken single loop which current can flow through
* **Slide 15- Parallel Connection**
	+ In a parallel circuit the components are split into multiple paths for current to flow through
	+ There are many paths for current flow, but only one voltage across all components.
	+ What makes parallel circuits unique is that all of their components are connected.
* **Slide 16-** Circuit Schematics
	+ Wires connect to components so that the current is able to pass through the circuit.
	+ Cell is what gives the circuit electrical energy; the larger line on the left is positive.
	+ Battery is more than one cell that provides electrical energy.
	+ Light Bulb a transducer that converts electrical energy into light.
	+ Resistor is what is used to restrict the flow of electricity.
	+ A switch controls whether the circuit stays opened or closed
		- When a switch is open that means the flow of the current has been broken by an interruption.
		- While a closed circuit is where the flow is complete with the current going throughout the circuit.
* **Slide 17- Voltmeter**
	+ Voltmeter: A device that is used for measuring electric potential in volts between two points in a circuit
	+ In the circuit simulation to measure voltage we use a Voltmeter
		- Place the red probe on the current that is coming out of the resistance
		- Place the black probe on the current that is going in
* **Slide 18- Circuit Construction Kit Simulation**
	+ Create both a series parallel circuit using the simulation program
	+ Use the Circuit Data sheet to fill in your answers
	+ Analyze the constructed circuits using both the ammeter and the voltmeter.
	+ To change the light bulb or battery value click on it
	+ Provide a link to allow the students complete the worksheet
	+ This should take 10-15 minutes to complete
* **Slide 19- Break Slide**
	+ The students will now take a break from everything that was taught
		- The lesson ends here, if you want this could be expanded on with a discussion

**Lesson Closure**

Lesson Closure starts when the Circuit Construction Kit Simulation ends. Slide 19 can be a transition into a closing where students are asked what is at least 1 thing that they learned or liked about the lesson. Now that the students understand a bit more about Ohm’s Law they will be prepared if they want to pursue a career in Electrical Engineering.

**Associated Activities**

**Circuit Construction Kit Simulation** - Students will construct a series and parallel circuit using the “Circuit Construction Kit Simulation” to learn about how different circuits operate.

**Pop Quiz** - Using the skills they just learned, students must calculate 3 equations about Ohm’s Law. For guidance they may use triangles to complete the calculation.

**Vocabulary**

* **Ammeter -** *A measuring device that is used to measure the current in a circuit*
* **Current -** *The rate of flow in a circuit which is measured in amps*
* **Parallel Circuit -** *A circuit with more than one path with all components being connected*
* **Resistance -** *The opposition to the flow of the current in an electrical circuit measured in ohms*
* **Power -** *The rate at which a current flows times the voltage of the current that is usually measured in watts*
* **Series Circuit -** *A circuit where there is only one path for the current to flow through*
* **Voltage -** *The rate at which the current flows times the resistance of the circuit which is measured in volts*
* **Voltmeter -** *A device that is used for measuring electric potential in volts between two points in a circuit*
* **Watt -** *Electric power that is used to measure Power*

**Homework**

Students will need to complete questions that relate to Ohm’s Law and circuits. These questions can be calculated by using the Ohm’s Law.

**Lesson Extension**

One way to extend the lesson is with an activity that the students could take part in. For example by adding more plugs to a power strip does it reduce its power? Students should be paired in groups for this activity as together they could come up with their own conclusion on how it would affect Ohm’s Law.

Another way to extend the lesson would be by giving them Ohm calculations. This could be by finding a sample circuit of a series or parallel and the student has to figure out what either the current, voltage, or current is.

**References**

* **CPALMS Standards (Source of educational standards)**
	+ <https://www.cpalms.org/Public/search/Standard>
* **TeachEngineering Ohm's Law I (Based on the lesson structure)**
	+ <https://www.teachengineering.org/activities/view/ohm1_act_joy>
* **Circuit Construction Kit: DC**
	+ Copyright © 2002-2019 University of Colorado Boulder
* **Ohm's Law: What Is it & Why Is It Important?**
	+ <https://sciencing.com/ohms-law-what-is-it-why-is-it-important-13721185.html>
* **Encyclopedia Britannica (Information)**
	+ <https://www.britannica.com/>

**Contributors**

Kyle Kamiya, Alex Garrido, Victoria Velazquez, Justin Barroso, Abiel Vasallo, Reuben Latorre, and Jorge Diaz.

**Supporting Program**

SYIP 2020 Summer Internship Program partnered with Hialeah Gardens Senior High School.

**Acknowledgments**

I would like to acknowledge the author(s) of Lesson: Ohm's Law. I based the structure of my lesson on the article. I would also like to acknowledge Hialeah Gardens Senior High School for allowing me to write this lesson and conduct the research on it.

**Lesson: Electrical Engineering: Computer Science**

Grade Level: 8-9) – Time Required: 40 minutes – Lesson Dependency: None – Subject Areas:

* Physics
* Algebra
* Science and Technology

**Summary**

Computer Science has become a popular branch of engineering in the last few years as computers have become more integrated into our society. To the point where they are able to perform certain tasks. To solve these tasks a computer program is written which are instructions set in place to solve a problem. This leads to algorithms which are an analysis of the rules set in place to solve calculations and operations step by step. Although to simplify an algorithm we would use a flowchart that explains the program method in a graphical process. In this lesson the students will learn about how to create a flowchart and what the various symbols represent. There will be a worksheet provided that will test their knowledge on flowcharts and regarding whether or not they have paid attention.

**Engineering Connection**

Computer Science has become a popular branch of engineering in the last few years as computers have become more integrated into our society. To make certain jobs easier computer scientists and engineers create and execute algorithms that include sequencing, selection, and iteration. Sequencing is the execution of statements one at a time in the algorithm. Selection is the use of IF, THEN, or ELSE statements to allow the computer to make a logical decision based on the information provided to it. Finally, iteration is the use of repetition or a loop in an algorithm until it reaches a certain condition. As it provides an outline on how to write code in a detailed sequence of operations for a specific issue.

**Learning Objectives**

Upon completing the lesson, the students should be able to:

* Answer what is Computer Science and why it is important
* Understand what an algorithm is and how it is used in our everyday life.
* Tell the difference between an algorithm and program while also explaining how they relate to one another.
* Know what a Flowchart is and how it relates to an algorithm
* Explain the flowchart symbols
* Grasp the complexity that goes into algorithm flowcharts

**Educational Standards**

* [CTE-IT.68.PROG.04.08](https://www.cpalms.org/Public/PreviewStandard/Preview/13834) - Create a model flowchart for a computer program.
* [LAFS.68.RST.3.7](https://www.cpalms.org/Public/PreviewStandard/Preview/6168) - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
* [MAFS.K12.MP.4.1](https://www.cpalms.org/Public/PreviewStandard/Preview/6331) - Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
* [SC.K2.CS-CS.2.5](https://www.cpalms.org/Public/PreviewStandard/Preview/8668) - Create a simple algorithm, individually and collaboratively, without using computers to complete the task (e.g., making a sandwich, getting ready for school).
* [SC.912.CS-CS.2.7](https://www.cpalms.org/Public/PreviewStandard/Preview/8866) - Explain how sequence, selection, iteration, and recursion are building blocks of algorithms.
* [SC.912.CS-CP.2.6](https://www.cpalms.org/Public/PreviewStandard/Preview/8904) - Describe a variety of commonly used programming languages.

**Materials List**

* [Flowchart Data Sheet](https://drive.google.com/file/d/17MHr_6QAyDQwuxybavGXJK2aAV-Yh9km/view?usp=sharing)
* Pencil
* Laptop
* 1 Sheet of Paper

**Worksheets and Attachments**

* [Computer Science Presentation](https://docs.google.com/presentation/d/1m_AXLcxKYMe4pmBTVMqH5gHbzhrSSCGaCR9-w1oPUi0/edit?usp=sharing) (Slides 1-17)
* [Rubik Cube solved by robot](https://www.youtube.com/watch?v=by1yz7Toick) (Video) – Stop the video at 0:48 mark.
* [Flowchart Data Sheet (doc)](https://drive.google.com/file/d/17MHr_6QAyDQwuxybavGXJK2aAV-Yh9km/view?usp=sharing)

**Pre-Req Knowledge**

This lesson revolves around the basics of flowcharts so when creating a diagram, it may be similar to the design process. Students should have background knowledge of what is the design process specifically the analysis, design, and iterative steps in order to fully understand how to use a flowchart. When creating the flowchart, the students should have prior experience with certain projects that will have led them to think methodical and sequentially.

**Lesson Background and Concepts for Teachers**

The text and lessons follow the attached Google Slides Presentation. It begins on slide 1 to 17 . Each will breakdown the main objective of each slide and the key points/ideas behind them that could lead into a discussion. The presentation may be changed to adhere to certain examples or teaching methods to suit the needs of the class.

**Procedure**

* **Slide 1-** Computer Science
	+ Introduction to what is Computer Science
		- Ask a question to see what the students know about this topic
* **Slide 2 -** Explain what Computer Science is
	+ Well, Computer Science is the study of the ideas, ways of thinking, languages, and the software needed to solve problems by using computers.
	+ Unlike electrical engineers, computer scientists focus mainly on software issues and systems that can include design, theories, and development.
	+ Most people in this profession will have to learn various programming languages, maintain databases, and use operating systems.
* **Slide 3 -** Popularity of Computer Science
	+ In recent years Computer Science has become one of the most popular branches of engineering.
	+ This is due to the newfound appeal of computers as they have slowly become more integrated into our society and daily lives.
	+ There are various reasons as to why Computer Science is considered important.
		- The main reason being that we use computing in almost everything that we do.
		- As it allows us to tackle complex and challenging problems. Along with the increase in computers that led to numerous computing jobs and opportunities.
* **Slide 4 -** Coding
	+ Ask if they know what coding or programming is.
	+ Essentially they are the same thing as it is the process of creating instructions for your computer so that it may be able to complete certain tasks.
	+ In other words it is how humans are able to communicate with computers.
	+ These instructions are written by a computer programmer in a programming language.
* **Slide 5 -** Uses of Coding
	+ When you think about it because of programs we are able to use most of the devices that we use today.
	+ From phones and apps to websites and whole supercomputers, coding is the basic instruction of every piece of technology we use.
	+ Even billboards and things as overlooked as pop-up ads use coding.
* **Slide 6 -** What is the difference
	+ Computer Science is the study of the ideas, ways of thinking, languages, and software needed to solve problems with computers.
	+ Programming is the process of creating instructions for your computer so that it may be able to complete the task.
	+ Basically, Computer Programming is the process of designing and creating programs to solve a specific task while Computer Science is the overall study of that process.
	+ While Computer Science is solving a problem using computers, coding and programming is the implementation of the solutions.
* **Slide 7-** Algorithms
	+ Even though knowing how to program is vital to the study of computer science it is still only one part of a bigger puzzle.
	+ So what is a programming algorithm? It is a set of rules that need to be followed by calculations in order to solve the issue.
	+ Computer scientists create and analyze algorithms to solve problems and evaluate the softwares performance.
	+ You can compare an algorithm to a food recipe as they list their ingredients and the steps that need to be taken.
	+ The algorithm has to be converted into a programming language so that it is capable of operating. That program is a sequential set of directions that needs to comply with the rules of the language in order to complete the task.
* **Slide 8 -** Rubik Cube
	+ Algorithms are the step by step instructions needed in order to solve a specific problem.
	+ One example of an algorithm is with a Rubik's Cube. Does anyone know how to solve one?
	+ We’re now going to play a video of the fastest time a Rubik's Cube was ever solved
* **Slide 9 -** Algorithms and Rubik’s Cubes
	+ So to solve a rubik's cube there are certain algorithms a person could use as each rotation is a move. By putting the movies together it becomes an algorithm with the purpose of solving the cube!
	+ With six sides representing nine blocks of a single color—orange, yellow, green, red, white, and blue—a Rubik’s is said to hold 43 quintillion potential configurations.
	+ As not even the original creator, Erno Rubik, knew how to solve it!
* **Slide 10 -** Algorithms and Flowcharts
	+ There are two tools used in explaining the process of a program: the algorithm and a flowchart.
	+ The main difference being that a flowchart is the graphical version of an algorithm.
	+ Flowcharts are simple to understand as it follows a sequential flow.
* **Slide 11 -** Introduction to a Flowchart
	+ A flowchart is a figure that represents an algorithm or a process.
	+ It is a step-by-step method of how to solve a problem.
	+ One of the reasons why people use flowcharts is because it simplifies complex problems into simple steps that can be programmed into a computer later.
		- Since it shows data flow they are used to explain the process behind a program as it shows the way the code is organized.
* **Slide 12 -** Flowchart symbols and Terminator
	+ So in a flowchart there are these symbols each that represent a different function.
		- The first shape is called a Terminator, but not like the robot from the movie.
			* This represents the start and end function in a flowchart. As you can see it has an oval shape.
			* Start is always required in a flowchart, but some flowcharts may not have an end.
* **Slide 13** - Input/Output Operation
	+ An Input/Output Operation with the shape being a parallelogram.
		- It indicates an input or output operation while also representing any type of data in a flowchart.
* **Slide 14** - Processes
	+ A process is a rectangle that involves the action part of the flowchart.
		- Some of these examples include Add 1, Turn the light on, or Rotate the knob.
* **Slide 15** - Decisions
	+ Decisions are shaped like rhombuses and are indicated as a decision point between different paths in the chart.
		- As the outcome is either a yes, no, and could include an or.
* **Slide 16** - Arrows
	+ Arrows show the flow of the chart as they are drawn from the output of one block to the input of another.
		- There can only be one arrow that represents an output. On the other hand various arrows could represent inputs.
* **Slide 17 -** Flowchart Worksheet
	+ Tell the students they are going to take a quick review to see how much they have learned
	+ Provide a link to allow the students complete the worksheet
	+ Draw the flowchart symbol that matches with the command
	+ Use the Flowchart Data sheet to answer the following questions
	+ This should take them 5-10 minutes to complete
* **Slide 18- Break Slide**
	+ The students will now take a break from everything that was taught
		- The lesson ends here, if you want this could be expanded on with a discussion

**Lesson Closure**

Lesson Closure starts when the Flowchart Worksheet ends. Slide 18 can be a transition into a closing where students are asked what is at least 1 thing that they learned or liked about the lesson. Now that the students understand a bit more about algorithms they will be prepared if they want to pursue a career in Computer Science.

**Vocabulary/Definitions**

* **Algorithm** *- A process or set of instructions to be followed in calculations or other problem-solving operations.*
* **Flowchart** *- A diagram that represents an algorithm or a process*
* **Iteration** *- Uses repetition or a complete loop until it reaches a certain condition*
* ***Programming*** *- The process of creating instructions for your computer so that it may be able to complete the task.*
* **Selection** *- The use of IF, THEN, or ELSE statements to inform a computer how to make choices depending on the information provided.*
* **Sequencing** *- The execution of statements one at a time that follows the order of one after the other.*

**Homework**

Students will be asked to label some of the following flowchart symbols that are used in the diagram. Afterwards they would need to fill out a table drawing the symbol, name, and function.

**Lesson Extension**

One way to extend the lesson is with an activity where they have to create a flowchart. Provide them with a scenario about doing an action then tell them to create a flowchart based on that. For instance, opening a door includes many steps such as the steps taken, the knob turning, or getting out of your seat. That depends on how the student creates it.

**References**

* **CPALMS Standards (Source of educational standards)**
	+ <https://www.cpalms.org/Public/search/Standard>
* **TeachEngineering Program Analysis Using App Inventor (Based on the lesson structure)**
	+ <https://www.teachengineering.org/lessons/view/uno_appinventor_lesson01>
* **WHAT IS A FLOWCHART? (Information)**
	+ <https://asq.org/quality-resources/flowchart>
* **Encyclopedia Britannica (Information)**
	+ <https://www.britannica.com/>
* **Fastest robot to solve a Rubik's Cube**
	+ Copyright of Guinness World Records on Youtube

**Contributors**

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**Supporting Program**

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**Acknowledgments**

I would like to acknowledge the author(s) of Lesson: Computer Science Algorithms. I based the structure of my lesson on the article. I would also like to acknowledge Hialeah Gardens Senior High School for allowing me to write this lesson and conduct the research on it.

**Lesson: Electrical Engineering: Computer Engineering**

Grade Level: 8-9) – Time Required: 40 minutes – Lesson Dependency: None – Subject Areas:

* Computer Science

**Summary**

Computer Engineering is the combination of both Computer Science and Electrical Engineering. As it is a part of our daily lives nearly everyday. We will discuss the four basic functions of a computer and how computers have changed as years have gone by. This also includes hardware and software. Elaborating on certain pieces of hardware and software that students may have not known about such as the CPU and data. Binary is what computers use to represent information. It only has two digits, 1 and 0. In this lesson the students will learn about what is binary and its overall importance in computer engineering. There will be a worksheet provided to test the students on their knowledge on Binary and regarding whether or not they have paid attention.

**Engineering Connection**

We interact with computers and all their components nearly everyday. The Computer Engineering branch is the combination of both Computer Science and Electrical Engineering. They focus on the software and hardware sides of computing. Although they not only focus on how a computer system works, but also how it incorporates into the real world. As we can send emails through smartphones, take money out of ATMS, and interact with one another through a webcam.

**Learning Objectives**

Upon completing the lesson, the students should be able to:

* Describe why computers are important
* Explain how computers work
* Describe the four basic computer functions
* Explain the difference between computer hardware and computer software
* Understand the history of computers
* Know what binary is and how it relates to computers

**Educational Standards**

* [CTE-IT.68.PROG.02.03](https://www.cpalms.org/Public/PreviewStandard/Preview/13811) - Understand the binary representation of data and programs in computers.
* [CTE-IT.68.PROG.08.02](https://www.cpalms.org/Public/PreviewStandard/Preview/13875) - Explain the binary representation of data and programs in computers.
* [SC.912.CS-CS.4.3](https://www.cpalms.org/Public/PreviewStandard/Preview/8878) - Differentiate between multiple levels of hardware and software (such as CPU hardware, operating system, translation, and interpretation) that support program execution.
* [CTE-IT.68.PROG.02.02](https://www.cpalms.org/Public/PreviewStandard/Preview/13810) - Describe how hardware and software make up computer architecture.
* [SC.35.CS-CS.4.3](https://www.cpalms.org/Public/PreviewStandard/Preview/8728) - Compare and contrast hardware and software.
* [CTE-GEN.68.GENRL.19.01](https://www.cpalms.org/Public/PreviewStandard/Preview/13081) - Define computer related terms (computer, data input, output, hardware, software, language, processing, memory, program, terminal, peripheral devices, keyboard characters, virtual reality, three-dimensional devices).
* [CTE-IT.68.GENRL.02.01](https://www.cpalms.org/Public/PreviewStandard/Preview/13699) - Describe what defines a computer and ways a computer can be used.

**Materials List**

* [Binary Data Sheet](https://drive.google.com/file/d/1pFX0dIbzmbob6ArpzJqZyzqYuWOePoyj/view?usp=sharing)
* Computer/Laptop
* Pencil

**Worksheets and Attachments**

* [Computer Engineering Presentation -](https://docs.google.com/presentation/d/1vMAAwT2RD8GLbSx5m3DA6q20nUYas0HH88aSovuWk6M/edit?usp=sharing) (Slides 1-18)
* [The First Computer Video](https://www.youtube.com/watch?v=k4oGI_dNaPc&feature=youtu.be)
* [Binary Data Sheet](https://drive.google.com/file/d/1pFX0dIbzmbob6ArpzJqZyzqYuWOePoyj/view?usp=sharing)

**Pre-Req Knowledge**

This lesson revolves around computers and how they function so the students should have a basic understanding of what a computer is and how it works. As well as the adding skills to solve a binary addition equation.

**Lesson Background and Concepts for Teachers**

 The text and lessons follow the attached Google Slides Presentation. It starts off on slide 1 to 18. Each will breakdown the main objective of each slide and the key points/ideas behind them that could lead into a discussion. The presentation may be changed to adhere to certain examples or teaching methods to suit the needs of the class.

**Procedure**

* **Slide 1- Computer Engineering**
	+ Icebreaker
	+ Introduce yourself and try to get the students to do the same thing.
	+ Ask if any of them know what Computer Engineering is.
* **Slide 2- Explain what Computer Engineering is**
	+ Computer Engineering is the branch that combines both computer science and electrical engineering
	+ This includes aspects from software to hardware.
	+ Computer Engineering is included in most of our daily lives as we have computers in our pockets, cars, tvs, etc.
	+ Ask the students how long they’re on their phones daily
* **Slide 3- What a Computer is**
	+ A computer is an electronic device that is able to store and process data into information.
	+ What actually makes a computer a computer is when the electronic device is able to input, store, process, and output data.
	+ A computer is designed to manipulate data
	+ Explain the importance of a computer in our lives.
		- Computers are everywhere and most people use them. They can be seen in our cars, living rooms, fridges, stores, and work. Computers are so important that we have to use them for work in order to complete our task. This includes the text that is just being read.
		- We use computers to communicate and to complete tasks. The ability to communicate allows us to keep in touch with friends and family, but also find things we need.
* **Slide 4- Input**
	+ This is what the user of the computer tells the computer to do
	+ To simplify input is the transfer of information onto a computer system.
	+ This can be done through typing on a keyboard, using a mouse to move the pointer, taking a photo with your phone's camera, etc
	+ When you use your finger on an electronic device with touchscreen it senses your finger and takes that information as input
* **Slide 5- Storage**
	+ This is where the data from the input devices go to
		- Data is stored in memory
	+ The storage is usually in hard drives or other external storage devices
	+ Computers store the data so that it may be processed
* **Slide 6- Process**
	+ Processing is when the computer takes raw, unorganized data and turns it into information
	+ The data is transformed by using algorithms
	+ When data is turned into information it gets sent back to storage and continues being processed until it is output
	+ Computer processes input and produces output
	+ An analogy to this would be similar to taking dirty water and turning it into clean water. Without processing the dirty water it will just stay the same.
* **Slide 7- Output**
	+ When the data is processed it turns into an output
	+ The data is processed so that the information can be understood by people
	+ Output is what allows a computer to display information depending on what the computer was designed to do
		- An output can be from a monitor that displays text and pictures
		- Printers produce a hard copy
		- Speakers produce sound that can be heard throughout the room
* **Slide 8- The First Computer**
	+ We will now show a video about one of the very first computers
* **Slide 9- Modern Computers**
	+ Compared to now the technology used in computers has skyrocketed as computers are now an integral part of our lives
	+ Nowadays computers have been so applicably compacted that innovative utilizations of these amazing machines have been brought to the engineering community’s light almost weekly
	+ None of those people could have possibly imagined the vast uses of the easily portable computer and how this would have been the future.
* **Slide 10- Computer Hardware Engineering**
	+ Computer Hardware mainly focuses on the installing of external and internal physical components of the computer and possible eventual fixing
	+ Hardware is directed by the software to go about a task and follow the command
	+ Ask the students to name at least 5 pieces of hardware
* **Slide 11- Central Processing Units**
	+ The most important part of a computer system
		- It is known as the brain of the computer sending signals to control the other computer components
	+ The CPU is responsible for storing and processing information
	+ It inputs data is processed by the CPU
	+ The CPU outputs data using devices such as a monitor or speaker or just saves it in storage
* **Slide 12- Memory Units**
	+ There are two types of memory RAM and ROM
	+ RAM (Random Access Memory) this memory can be accessed randomly
	+ This is the primary memory of a computer as it is mostly common in computers and other devices such as smartphones, printers, and tablets.
		- Stores data in MBs
		- Temporary Storage
		- Voltalite
		- Used during normal operations
		- Processing time is faster but uses too much power
	+ ROM (Read Only Memory)
	+ ROM is used for storing permanent data, however it can only be read. Along with the difficulty it is to modify it. It is able to hold its memory evern when turned off
	+ ROM is used in video game consoles as the cartridge that allows a system to run the game
	+ ROM starts and boots ups the PC
		- Stores data in GBs
		- Permanent storage
		- Non-volatile
		- It is used during the startup process
		- Processing time is fast but uses very little power
* **Slide 13- Computer Software Engineering**
	+ Computer Software Engineering mainly focuses on the installing of programs and operating softwares and the possible repair of those due to aging or malware
	+ It is mainly information processed by a computer system
	+ Ask the students to name at least 5 pieces of software
* **Slide 14- Applications**
	+ An application is a program or app that allows the user to complete certain tasks done by the user
		- Applications allow for specific functions
	+ We use computer applications constantly as it can be used to play a game on an app or to access this lesson.
	+ Web Browser - Software applications used for retrieving and launching a URL on the World Wide Web
	+ WWW- a collection of web pages and other resources which are connected across the internet
* **Slide 15- Data**
	+ Data is information that that needs to be processed or stored in a computer
	+ Computer Data is stored and processed as a string of ones and zeros.
	+ Data is processed to become more useful and to serve a purpose
		- Data that is processed must be required when available, accurate, and complete.
	+ The steps for processing data are input, process, and output
* **Slide 16- What is Binary**
	+ Binary is a form of software that is able to control the hardware of a computer
	+ Binary is a numerical system that is represented with 1 and 0 to store data and perform calculations using binary digits or bits.
	+ Computers use binary as the primary language to represent information using electricity.
	+ Most software information that is processed and stored uses binary
	+ The speed of a computer depends on the number of bits a computer can process at once.
	+ It is called binary is because it only uses two digits
	+ The reason why computers use binary
		- It is very simple as it is just two digits that can represent any number
		- The 1 and 0 make it quick to learn if the signal is on or off
	+ Bits and Bytes are all that a computer uses to store and transmit information.
	+ It doesn’t just represent numbers, but also text, sounds, and images
* **Slide 17- Counting in Binary**
	+ Computers use binary to represent computer data.
	+ In a circuit the signal is either ON or OFF/ 1 or 0
	+ Each 1 and 0 is a bit
	+ The bits have an exponential increase of 1,2,4,8,16,32,64,128 and so on
	+ When the bit is 1 that means it could be added
	+ When the bit is 0 that means the value is off so just ignore them
	+ By adding all of the bits with an On value it reveals the decimal equivalent
	+ Since a single bit can’t represent much they are typically grouped together in groups of eight
		- A group of 8 bits is called a byte which represents numbers from 0 to 255
	+ Binary just needs two digits to represent any number
* **Slide 18- Binary Worksheet**
	+ Tell the students they are going to take a quick review to see how much they have learned
	+ Provide a link to allow the students complete the worksheet
	+ Add binary numbers together and then convert it into decimal
	+ Use the Binary Data sheet to answer the following questions
	+ This should take them 5-10 minutes to complete
* **Slide 19- Break Slide**
	+ The students will now take a break from everything that was taught
		- The lesson ends here if you want this could be expanded on with a discussion

**Lesson Closure**

Lesson Closure starts when the Binary Data Sheet ends. Slide 19 can be a transition into a closing where students are asked what is at least 1 thing that they learned or liked about the lesson. Now that the students understand a bit more about Computers and Binary, they will be better prepared if they want to pursue a career in Electrical Engineering.

**Associated Activities**

**Binary Data Sheet** - Students will be given a worksheet in which they will be assigned binary equations where they must add binary numbers together. Students must calculate for the sum and then convert the binary into decimals.

**Name 5** - When the students first learn about hardware and software ask them to list 5 examples off the top of their heads. This is a quick activity that shouldn’t take a lot of time. The purpose of this activity is to interact with the students as well as to explain things they may have not known before.

**Vocabulary**

* **Application -** *A program or app that allows the user to complete certain tasks done by the user*
* **Binary –** *Binary is a numerical system that is represented with 1 and 0 to store data and perform calculations.*
* **Bits –** *A binary digit that is the basic unit of information used in computers.*
* **Computer –** *An electronic device used for storing and processing data, usually in binary form, at high speeds.*
* **CPU –** *Central Processing Unit: the part of the computer that allows for operations to be executed.*
* **Data –** *Information that is processed or stored in a computer.*
* **Information –** *Data that has been processed and organized so that it can be used*
* **Hardware –** *The physical part of the computer system*
* **Processing*****-*** *When the computer takes raw, unorganized data and turns it into information*
* **Software –** *The programs used to operate the computer*

**Homework**

After learning about binary, the students must fill out the binary numbers using cards as bits. To complete this activity the bits must be converted into decimal and binary numbers.

**Lesson Extension**

One way to extend the lesson is with a longer explanation on the history of computers. Provide examples on the different generations and how each generation was able to impact the way we use computers today.

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**Contributors**

Kyle Kamiya, Alex Garrido, Victoria Velazquez, Justin Barroso, Abiel Vasallo, Reuben Latorre, and Jorge Diaz.

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