



## Magic of Electrons (PLTW)

<b>Primary Career Cluster:</b>	Science, Technology, Engineering, and Mathematics (STEM)
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<b>Course Code:</b>	0889
<b>Prerequisite(s):</b>	None
<b>Credit:</b>	N/A
<b>Grade Level:</b>	8
<b>Graduation Requirement:</b>	N/A
<b>Coursework and Sequence:</b>	This is a course in the <i>Project Lead the Way (PLTW)</i> middle school sequence of coursework.
<b>Necessary Equipment:</b>	Visit <a href="http://www.pltw.org">www.pltw.org</a> for more information.
<b>Aligned Student Organization(s):</b>	Technology Student Association (TSA): <a href="http://www.tntsa.org">http://www.tntsa.org</a> Tracy Whitehead, (615) 532-2804, <a href="mailto:Tracy.Whitehead@tn.gov">Tracy.Whitehead@tn.gov</a>
<b>Coordinating Work-Based Learning:</b>	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit <a href="https://tn.gov/education/topic/work-based-learning">https://tn.gov/education/topic/work-based-learning</a>
<b>Available Student Industry Certifications:</b>	N/A
<b>Dual Credit or Dual Enrollment Opportunities:</b>	N/A
<b>Teacher Endorsement(s):</b>	001, 007, 013, 014, 015, 016, 017, 018, (042 and 043), (042 and 044), (042 and 045), (042 and 046), (042 and 047), (042 and 077), (042 and 078), (042 and 079), (043 and 044), (043 and 045), (043 and 046), (043 and 047), (043 and 077), (043 and 078), (043 and 079), (044 and 045), (044 and 046), (044 and 047), (044 and 077), (044 and 078), (044 and 079), (045 and 046), (045 and 047), (045 and 077), (045 and 078), (045 and 079), (046 and 047), (046 and 077), (046 and 078), (046 and 079), (047 and 077), (047 and 078), (047 and 079), (077 and 078), (077 and 079), (078 and 079), 070, 081, 105, 121, 122, 123, 124, 125, 126, 127, 128, 129, 144, 145, 147, 157, 210, 211, 212, 213, 214, 230, 231, 232, 233, 400, 401, 402, 407, 413, 414, 415, 416, 417, 418, 440, 460, 461, 470, 477, 480, 481, 482, 483
<b>Required Teacher Certifications/Training:</b>	Teachers who have never taught this course MUST attend the training provided by PLTW and receive PLTW certification. This course has an associated fee through the vendor.
<b>Teacher Resources:</b>	<a href="https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework">https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework</a>

## Course Description

This is a course in the series of *Project Lead the Way (PLTW)* curriculum. For more information, visit the PLTW website at <http://www.pltw.org/>.

## Program of Study Application

These courses build knowledge and skills related to the following career clusters:

- 1) Architecture & Construction
- 2) Information Technology (IT)
- 3) Manufacturing
- 4) Science, Technology, Engineering & Mathematics (STEM)
- 5) Transportation, Distribution, & Logistics

## Course Standards

The course standards outlined below are the copyrighted property of *Project Lead the Way*. Teachers must participate in *Project Lead the Way* training in order to be able to teach this course. This course is one in a series of PLTW middle school courses. The lesson numbers below reflect the recommended sequence.

### Lesson 6.1 What is Electricity? (16 days)

#### *Understandings*

- 1) Electron flow is created as electrons are transferred between atoms.
- 2) As engineers design electrical systems, they must understand a material's tendency toward being a conductor or insulator.
- 3) Current, voltage, and resistance are measurable quantities that are used to explain electron flow in an electrical system.
- 4) Magnets play an important role in creating electromotive force which is used to make and convert electricity.
- 5) Generators are used to convert mechanical energy into electrical energy, while motors convert electrical energy into mechanical energy.

#### *Knowledge and Skills*

It is expected that students will:

- Identify the roles of protons, neutrons, and electrons in an atom.
- Explain how charges interact to hold an atom together.
- Identify metals, metalloids, and non-metals on the periodic table.
- Explain the relationship between current, voltage, and resistance.
- Describe the properties of a magnet including polarity and defining characteristics.
- Explain the role of an electromagnet in the function of a DC motor and generator.
- Describe how electron transfer between atoms and the flow of electricity are related.
- Evaluate whether a material is a conductor, insulator, or semiconductor based upon its number of valence electrons and its position on the periodic table.
- Identify an element based on the atomic number given a periodic table.
- Identify metals, metalloids, and non-metals on the periodic table.
- Measure voltage and current using a multimeter.
- Demonstrate the characteristics and functions of an electromagnet.

- Identify the primary parts of a DC motor and demonstrate how it functions.
- Identify the primary parts of a generator and demonstrate how it functions.
- Compare and contrast the characteristics of a basic motor and generator.

## **Lesson 6.2 Electronics (17 days)**

### *Understandings*

- 1) An electrical circuit is a system made up of conductors and electrical components that form a complete path for electrical current.
- 2) Engineers use circuit diagrams to communicate components and functions of electrical circuits.
- 3) A variety of electronic components are incorporated into electrical circuits by engineers to achieve specific functions.
- 4) When building or diagnosing circuits, it is important to be able to measure voltage, current, and resistance.
- 5) Ohm's Law explains the mathematical relationship between voltage, current, and resistance.
- 6) The transistor is an important electronic device because it allows a small amount of current to control a larger amount of current.
- 7) Engineers, designers, and engineering technologists are needed in high demand for the development of future technology to meet societal needs and wants.

### *Knowledge and Skills*

It is expected that students will:

- Identify the characteristics of series, parallel, and combination electrical circuits.
- Identify standardized schematic symbols using a chart.
- Distinguish between the functions and operations of fixed resistors, variable resistors, and photo resistors.
- Construct series, parallel, and combination electrical circuits.
- Sketch circuit diagrams using standardized schematic symbols.
- Construct 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.
- Determine the value of a fixed resistor based upon the color codes on those resistors.
- Measure voltage, current, and resistance using a multimeter.
- Mathematically calculate voltage, current, and resistance using Ohm's law.
- Design a circuit that uses a transistor as a switch.

## **Lesson 6.3 Digital Electronics (12 days)**

### *Understandings*

- 1) The relationship between the binary number system, decimal number system, and ASCII characters make it possible for computers to communicate and process complex functions.
- 2) Computer processors are the key component of electronic devices and function based on logic.
- 3) Logic gates are depicted by their schematic symbol and truth table.
- 4) Digital wave forms that communicate binary digits are the means of communication within and among digital electronic devices.

- 5) Engineers decide upon inputs, outputs, and the logic necessary for an electronic device and communicate them using electronic circuit diagrams.
- 6) Engineers must decide on the necessary constraints and trade-offs in control systems.

### *Knowledge and Skills*

It is expected that students will:

- Identify the relationship between the binary number system and the decimal number system.
- Describe the functions of NOT, AND, OR, NAND, NOR, and XOR gates.
- Convert binary numbers to Base-10.
- Convert ASCII characters to binary.
- Interpret logic scenarios to determine outputs based upon possible conditions within those scenarios.
- Create truth tables for logic scenarios and match those gates to truth tables.
- Create a digital wave form and graph it for a binary sequence.
- Communicate using electronic circuit diagrams.
- Use transistors as switches to create circuits that function as AND and OR gates.
- Determine the logic, sensors, gates, outputs, and other components needed to emulate existing electronic devices that utilize logic.
- Design, construct, and test device solutions for emulating common electronic devices that utilize logic.