



**Middle School**

**LEDnovation**

**Light Up with Technology: LED Circuit Application  
Teacher Lesson**



Created by Florida Advanced Technological Education Center, FLATE  
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NATURE OF EXPERIENCE	GRADE LEVELS
To understand and apply the theory behind basic electronics. Students are challenged to engineer and manufacture a light-emitting diode (LED) using a simple circuit.	6-8
TARGETED SUBJECT AREA/S	MANUFACTURING LEVEL
Electronics, robotics, math, physics, advanced manufacturing	Innovation, Design, Fabrication, Testing
LEARNING OBJECTIVES – The Students Will....	TIME FRAME
<ul style="list-style-type: none"> <li>• Understand and apply concepts of electrical circuits, current electricity, battery, conductivity, switch, circuit symbols, LED light.</li> <li>• Be able to understand and apply engineering design process</li> <li>• Develop manufacturing skills: innovation, design, build, test</li> <li>• Help students to understand that technology is closely linked to creativity, which has resulted in innovation.</li> </ul>	3-4 class sessions (55 minutes each)
STANDARDS ADDRESSED	
<b>Standards for Technological literacy <a href="#">ITEEA-TIDE</a>:</b>	
01.0 - Characteristics of technology: usefulness and development of technology, human creativity and motivation 02.0 - Core concepts of technology: systems, resources, processes, controls. 03.0 - Relationships among technologies and the connections between technology and the other fields of study. 04.0 - Effects of technology on the environment: management of waste. 05.0 - Role of society in the development and use of technology: inventions and innovations 08.0 - Demonstrate an understanding of the attributes of design and criteria and constraints. 09.0 - Develop an understanding of research, development, innovation and experimentation in problem solving. 10.0 - Problem solving: troubleshooting, invention and innovation, experimentation 11.0 - Apply design process: identify criteria and constrains, model a solution to a problem, test and evaluate a product. 12.0 - Use and maintain technological products and systems: safely use tools, adjust, and repair, use computers. 19.0 - Develop an understanding of and be able to select and use manufacturing technologies	
<b>Florida Department of Education-Sunshine Standards <a href="#">NGSSS</a>:</b>	
MAFS.6.EE.1.2 - Evaluate expression in which letters stand for numbers MAFS.6.EE.1.3. - Properties of operations MAFS.7.EE.1.2. - Basic application of math skills and concepts MAFS.7.G.2.6. - Solve real-world and mathematical problems involving area, volume. MA.7.G.4. - Geometry and Measurement MA.7.A.5. - Number and Operations	



## PRE-REQUIREMENTS

Basic concepts of electrons, atoms, current, measurement and units.

## MATERIALS

### Materials & Tool Required per group:

Ruler or measurement tape, scissors, black, blue and red color pencils or markers, wire cutters/ needle-nose pliers, wire stripper, electrical wire/hookup wire (recommended 22 gauge, this can be solid or stranded wire but it is easier to work with solid wire), conductive thread (optional), electrical wire connectors i.e. electrical tape or insulating, wire-nuts-3 per project (min. 2#22 - Max. 3#16 gauge), paper clips, decorative color ribbon with metallic border-optional (minimum 2<sup>1/2</sup> in. width and minimum length 1.5 foot per project, color foam sheets (minimum 8 in. x 12 in. per project), color paper (8<sup>1/2</sup> in x 11 in), transparency film (optional), stickers and decorative items i.e. foam shapes.

### Materials & Tool Required per person:

Student worksheet, paper, pencil, 1 lithium battery (recommended CR2032-3V or coin/button cell battery), 1 battery holder (optional), 2 mini metallic alligators clips or 1 slide switch (optional-double pole double trout-DPDT).

## KEY TERMS

Design, light-emitting diode (LED), manufacturing, electrical circuit, cathode, anode, current electricity, battery, conductors, conductivity, switch, circuit symbols, manufacturing, innovation, design, test.

Teacher Activities	Notes
Get familiar with the activity and review reference material for theory and vocabulary before class	Review student worksheet, teacher's reference sheet, company fact sheet, presentation /video.
Gather Materials	See suggested materials listed in student worksheet.
<b>Lesson Activity Instructions</b> <b>A – Brain Storm Pre-Activity - Introducing/refreshing electric circuit's concepts.</b> <ul style="list-style-type: none"><li>• Brain storm about electrical circuits and its components. Start encouraging students to describe any objects in the classroom that use electricity. See if the students can identify the electrical component of the object that they are using as example.</li><li>• Continue introducing concepts of electrical circuits ie;<ol style="list-style-type: none"><li>1. What is an electron? A negative charged particle. One of the components of an atom.</li><li>2. What is electricity? Electricity is the movement of electrons that are present in atoms.</li><li>3. What is electric current? The flow of electrons.</li><li>4. What is a conductive material provide examples? Material/device that transport the flow of electrons/electric current. Examples: electrical wire.</li><li>5. What is a battery? Battery is a source of electrical energy that supplies electrons</li><li>6. What is an electrical circuit? The path that electrons follow is called electrical circuit. Electrons move easily along a path of conductive material, much like the movement of water through a pipe or hose.</li><li>7. Which are the three main components of an electric circuit? (1) A source of electrical energy that supplies electrons, such as a battery; (2) An object that makes use of the electricity, such as a light bulb; and (3) A conductor that connects everything together, usually metal wire or electrical wire.</li></ol></li></ul>	Make sure students understand which are the main components of a circuit.



<ul style="list-style-type: none"> <li>Review/explain concepts and key terms with students: ie; American wire gauge (AWG) is a measurement of diameter of a wire, electrical tape or insulating tape is used to insulate electrical wires and other material that conduct electricity.</li> <li>Review important standardized symbols (in power point presentation and student worksheet page 2).</li> <li>Introduce tools and applications. Make sure students use the proper tool(s) for the right job.</li> <li>Current/voltmeter (optional): introduce this measurement device to students and make sure they understand how to use it. To verify if the battery is charged make sure battery output in volts.</li> </ul> <p><b>Safety First</b> Make sure students understand the importance of safety. Provide as many safety tips you consider necessary.</p>	<p>Provide any resources necessary (print lesson reference sheet, use presentation “<b>Light Up with Technology</b>” and any additional educational resource you consider necessary.</p>
<p><b>Part A – Study the circuit diagram</b> Divide the class into groups (recommended 2 maximum 4 students per group). Ask students to study the circuit diagram provided and request them to decide if the diagram is correct and to answer the questions regarding the diagram.</p> <p><b>Part B – Build LED Circuit ( 2 components)</b> Ask students to draw the same circuit diagram shown in part A using a regular size piece of paper and ask them to label each circuit component including the positive and negative terminals. Request to use the red marker to draw an arrow showing the direction the electrons will flow in your circuit. Once they have clear identification of the meaning of each electric circuit symbol, request students to build the LED circuit following the instructions provided in the student’s worksheet. Make sure students test the circuit and check for loose ends.</p> <p><b>Build the LED Circuit + ON/OFF Switch (3 components)</b> Before students move on to the circuit construction part of this new design, ask them to answer the questions. Then have them follow the instructions provided in student worksheet page 4 Alligator clips will help to close the circuit and will work as an ON/OFF switch. Make sure students visualize and understand the concepts previously explained.</p> <p><b>Build your LED Circuit</b> Students are ready to complete the assignment; test different types of LEDs to determine the best LED to use with medical equipment used to help people in the hospital. Remember you do not want the lighting on the equipment to be too bright at night when the patient is trying to sleep.</p>	<p>Provide student worksheet make sure students have all the required material necessary to build a LED circuit (see material list student worksheet page 1). Instructions provided in student worksheet page 3.</p> <p>Remember to teach students how to use the wire cutters and wire stripper.</p> <p>Each group should have at least two different color LEDs.</p>
<p><b>C – Report</b> Have groups compare data and discuss results following the technical report guideline. Provide good guidelines about writing technical reports.</p>	
<p><b>D – Conclusion and Recommendations</b> Have groups to present conclusion, lessons learned and recommendations.</p>	
<p><b>Assessment</b> Assess the level of understanding of the topics covered throughout the lesson.</p>	<p>Use teacher grading rubric template</p>

