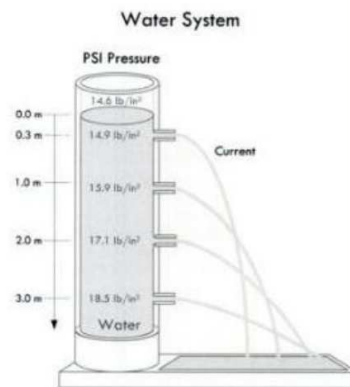
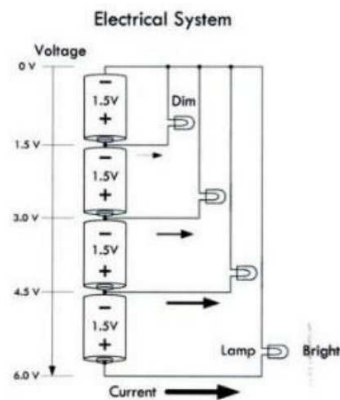
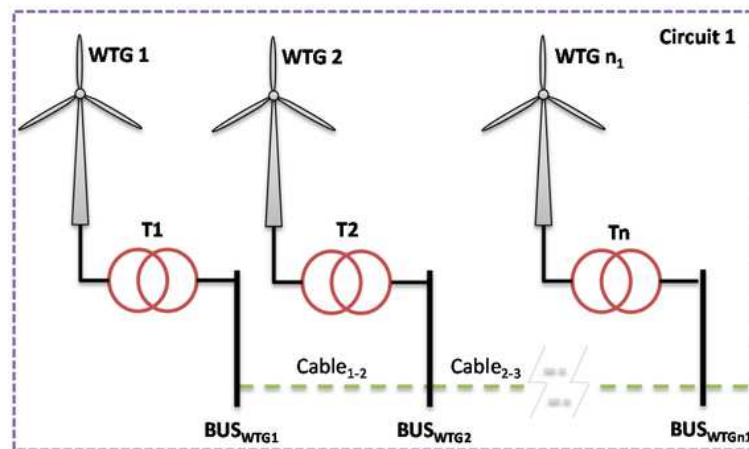


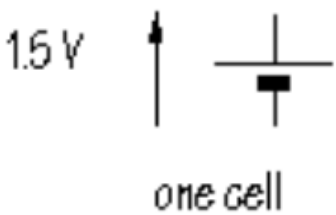
## Introduction to Electricity with Lego Mindstorms

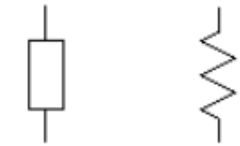
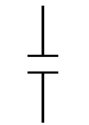
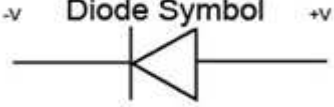
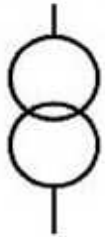


I Love Neutrinos 2015-2016






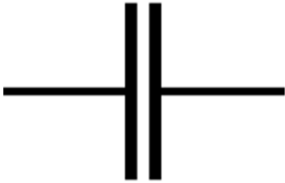
Juan Antonio Breña Moral

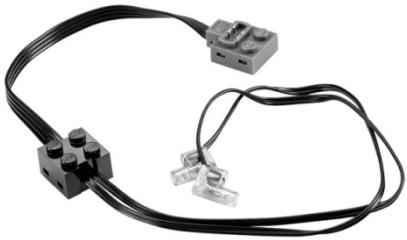

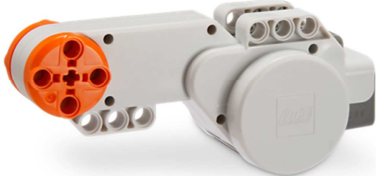
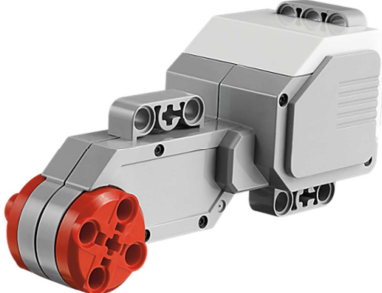




## Electrical concepts

Element	Symbol	Unit	Description
Charge	q	Coulomb (C)	<p>The fundamental electric quantity is charge.</p> <p>Atoms are composed of charge carrying particles: electrons and protons, and neutral particles, neutrons.</p> <p>The smallest amount of charge that exists is carried by an electron and a proton.</p>
Current	I	Ampere	<p>Current is rate of flow of negatively-charged particles, called electrons, through a predetermined cross-sectional area in a conductor.</p>
Voltage	V  	Volt	<p>Potential difference across two terminals in a circuit “across variable.”</p> <p>In order to move charge from point A to point B, work needs to be done.</p>
Wattage	W	Watt	<p>The watt (symbol: W) is a derived unit of power in the International System of Units (SI), named after the Scottish engineer James Watt (1736–1819). <b>The unit is defined as joule per second</b> and can be used to express the rate of energy conversion or transfer with respect to time.</p> <ul style="list-style-type: none"> <li>Watts = Volts x Amps</li> </ul>
Resistor	I	Ohms	<p>Flow of electric current through a conductor experiences a certain amount of resistance.</p>

	 Europe      USA, Japan		<p>This behavior of materials is often used to control/limit electric current flow in circuits.</p> <p>A resistor is a dissipative element. It converts electrical energy into heat energy.</p> <p>It is analogous to the viscous friction element of mechanical system.</p>
Capacitor	 Fixed capacitor		<p>A capacitor is an energy storage element which is analogous to the spring element of mechanical systems.</p> <p>It can store electrical pressure (voltage) for periods of time.</p>
Diode	 -v      Diode Symbol      +v		<p>The fundamental property of a diode is its tendency to conduct electric current in only one direction.</p>
Transformer			<p>A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.</p> <p>Commonly, transformers are used to increase or decrease the voltages of alternating current in electric power applications.</p>

## Electric elements with Lego

Element	Lego component	Electric circuit symbol
Battery		
Voltimeter		
Capacitor		

Lamp	 A LEGO lamp assembly consisting of a black cable with two connectors. One connector is a 3-pin plug, and the other is a 2-pin plug.	 A schematic symbol for a lamp, consisting of a circle with an 'X' inside, connected to two horizontal lines.
Motor	   Three different LEGO motor assemblies. The first is a small grey motor with an orange output. The second is a larger grey motor with a red output. The third is a rectangular grey motor with multiple ports.	 A schematic symbol for a motor, consisting of a circle with the letter 'M' inside, connected to two horizontal lines.
Generator	 A LEGO generator assembly consisting of a grey rectangular block with multiple ports and a black cable with a connector.	 A schematic symbol for a generator, consisting of a circle with a sine wave inside, connected to two horizontal lines.

Switch	