

Students will learn about modern electronics by manufacturing a programmable microcontroller moodlight.

Atoms	<ul style="list-style-type: none"> The stuff the universe is made from. Atoms have positively charged protons at the centre, and.. ...negatively charged electrons particles that spin around the centre. The protons and electrons balance each other out so the atom is electrically neutral. 	
Electrons	Electrons are negatively charged. If electrons can break away from the atom they can flow as electric current .	
Conductor	Materials that allow current flow. Copper is used in wires because it is a good conductor.	
Insulators	Insulators do not conduct any current and can be used to protect us e.g. the PVC insulation covering on a wire	
Circuits	Current can only flow when there is a complete circuit (circular pathway) from and back to the power supply	
Voltage	The electro-motive force that pushes electrons around the circuit. Also used in voltage signals, e.g. high and low	
Current	The flow of negatively charged electrons	
Resistance	A resistance in the circuit will reduce the amount of current	

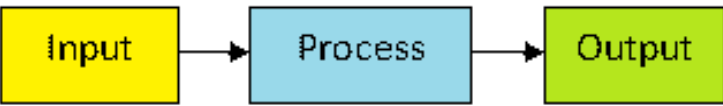
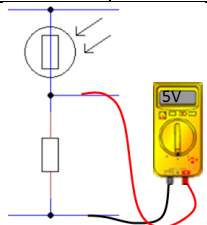

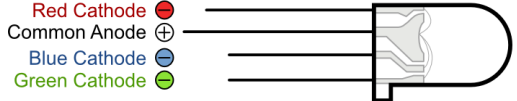















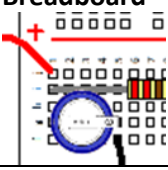
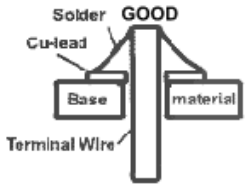
Identify the similarities between water flow in pipes and electric current flow in wires as follows:

Water circuit	...is similar to...	Electrical circuit
Pump	↔	Cell/battery
Pressure	↔	Voltage
Water	↔	Electrons
Pipe	↔	Wire
Flow rate	↔	Current
Blockage/obstruction/restriction	↔	Resistance





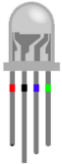
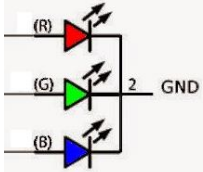



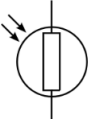

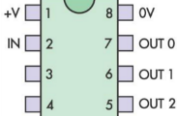
Be able to provide the following simple explanations of water flow and current flow in a circuit:

<p>A pump provides the pressure difference that pushes water around the circuit. The flow of water in the pipe is known as the flow rate. A blockage will cause a reduction in the flow rate.</p>	<p>A battery provides the voltage difference that pushes electrons around the circuit. The flow of electrons in the wire is known as the current. A resistance will cause a reduction in the current.</p>
<ul style="list-style-type: none"> In digital (switching) circuits, a high voltage is used as signal ON, 1, High, +V or True, In digital (switching) circuits, a low voltages indicate OFF, 0, Low, 0V or False. 	





Components

<p>A System is where a set of interconnecting parts work together to fulfil a purpose. In systems, we think of input, process and output.</p>																					
Input	The input is the part of the system where something enters into the system from the outside world.																				
Process	The process part of the system is where things are done . It is also the word used for what is done.																				
Output	The output part of the system is where the product (the result of the process) is sent out .																				
Input - Light Sensing Circuit		<ul style="list-style-type: none"> • Know that the circuit on the left is the input (light sensing) circuit • Know that an increase in light level causes a decrease in resistance in an LDR. • Know that a decrease in the resistance in the LDR will cause an increase in voltage at the mid-point of our light sensing circuit (between the LDR and the fixed resistor). 																			
Microcontrollers (process)		<ul style="list-style-type: none"> • A microcontroller is a tiny computer built onto an integrated circuit. • The correct name for a silicon chip is an integrated circuit (IC). • Know that integrated circuits have input pins, output pins, and power pins. • Pin 1 is indicated with a notch and a dot • A program is a sequence of instructions, written to perform a specified task on a computer. • A microcontroller can be programmed from a PC. 																			
Output - RGB LED (Red Green Blue Light Emitting Diode)																					
<ul style="list-style-type: none"> • Know that pin 1 of an LED and can be identified by the 'flat' on the side of the LED's outer casing. • Know that the longer lead of an RGB LED is the cathode (negative leg) 																					
Flowcharts	<ul style="list-style-type: none"> • Know the commands start, decision, output on, output off, wait, end • A microcontroller program can be created using flowchart techniques • Know that a microcontroller can be reprogrammed to fix errors (bugs) or improve its function and performance (upgrade). 	<table border="1"> <thead> <tr> <th>Symbol</th> <th>Name</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td></td> <td>Start/end</td> <td>An oval represents a start or end point.</td> </tr> <tr> <td></td> <td>Arrows</td> <td>A line is a connector that shows relationships between the representative shapes.</td> </tr> <tr> <td></td> <td>Input/Output</td> <td>A parallelogram represents input or output.</td> </tr> <tr> <td></td> <td>Process</td> <td>A rectangle represents a process.</td> </tr> <tr> <td></td> <td>Decision</td> <td>A diamond indicates a decision.</td> </tr> </tbody> </table>		Symbol	Name	Function		Start/end	An oval represents a start or end point.		Arrows	A line is a connector that shows relationships between the representative shapes.		Input/Output	A parallelogram represents input or output.		Process	A rectangle represents a process.		Decision	A diamond indicates a decision.
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Breadboard		<ul style="list-style-type: none"> • Used for testing circuits to make sure they will work properly. • Components can be easily moved, connected and reconnected. • Components legs are not cut/ damaged so saves money. • No chemicals are required so is safe and good for the environment. • Uses real components so can check performance e.g. times, volume, brightness etc. 																			
Printed Circuit Boards (PCB)	<ul style="list-style-type: none"> • A PCB is a printed circuit board and is built on a Glass Reinforced Plastic board. This is a thermoset plastic, so doesn't melt during soldering. • Pads are circular patches of copper with a hole in for the component legs to fit through ready for soldering. • The pads are connected with copper tracks which act as the wires in the circuit. • The design of a PCB layout, showing tracks and pads, is known as artwork. <p>When artwork is printed onto transparent paper, this is known as a mask.</p>																				
PCB Manufacture	<p>Artwork -> Expose -> Develop -> Etch -> Drill -> Solder</p> <ul style="list-style-type: none"> • The copper layer is etched to for pads and tracks • The pads are drilled with a PCB drill where components are to be fitted • Solder joints electrically connect components to the pads should appear pointed and shiny to avoid dry joints (non-conducting) 																				

Circuit Symbols

Component Name	Appearance	Symbol
Battery (a gang of more than one cell)		
Resistor		
RGB LED		
Toggle Switch		
LDR		
PICAXE 08M2+ Microcontroller with chip socket		

Safety Points

Breadboarding Safety Points	<ul style="list-style-type: none"> <input type="checkbox"/> ALWAYS wear your SAFETY GLASSES <input type="checkbox"/> DISCONNECT circuits when troubleshooting <input type="checkbox"/> Always DOUBLE CHECK POLARITY when connecting components into a circuit, especially with electrolytic capacitors which will explode if connected incorrectly!
Soldering Safety Points	<ul style="list-style-type: none"> <input type="checkbox"/> KEEP soldering irons in their protective STAND when not in use <input type="checkbox"/> DO NOT TOUCH the tip end of a soldering iron to check for heat – it will burn you very quickly <input type="checkbox"/> DO NOT touch your face or put solder or any other equipment or materials in your mouth (lead is poisonous – wash your hands after use)
PCB Safety	<ul style="list-style-type: none"> <input type="checkbox"/> When manufacturing a PCB using the photoetch technique, wear the appropriate PPE of goggles, plastic gloves and plastic apron <input type="checkbox"/> When drilling, always wear safety glasses and tie hair back <input type="checkbox"/> The dust from PCB drilling contains glass and is an irritant so should not be touched or blown around
Irritant Chemicals	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"></div> <ul style="list-style-type: none"> <input type="checkbox"/> Irritant - avoid contact <input type="checkbox"/> Wear PPE (personal protective equipment) <input type="checkbox"/> Do not eat or touch face in the workshop </div>
Personal Protective Equipment	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Goggles</p>  </div> <div style="text-align: center;"> <p>Plastic gloves</p>  </div> <div style="text-align: center;"> <p>Plastic Apron</p>  </div> </div>