

Students will learn about modern electronics by manufacturing an electronic steady hand game

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:

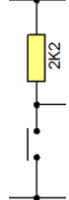
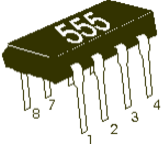

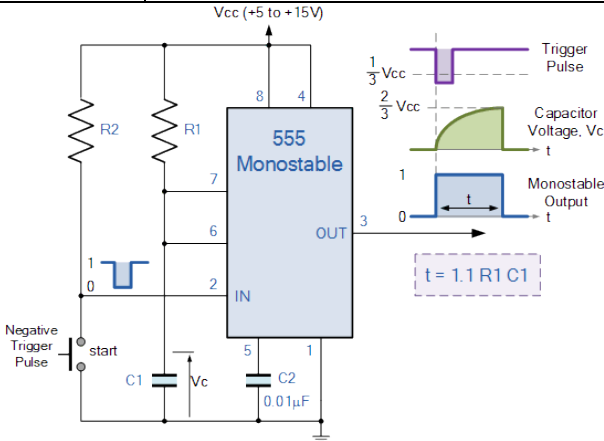
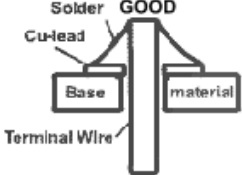


Water circuit	...is similar to...	Electrical circuit
Pump	↔	Cell/battery
Pressure	↔	Voltage
Water	↔	Electrons
Pipe	↔	Wire
Flow rate	↔	Current
Blockage/obstruction/restriction	↔	Resistance

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






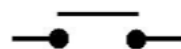








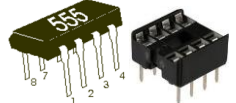
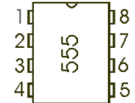
<p>A pump provides the pressure difference that pushes water around the circuit. The flow of water in the pipe is known as the flow rate. A blockage will cause a reduction in the flow rate.</p>	<p>A battery provides the voltage difference that pushes electrons around the circuit. The flow of electrons 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 .	

<p>Input Circuit</p>		<ul style="list-style-type: none"> • Know that the circuit on the left is the input circuit • The resistor is a pull-up resistor, so the output is usually HIGH • Pushing the switch pulls the voltage LOW
<p>555 (process)</p> 	<ul style="list-style-type: none"> • 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 • The 555 can be configured for different timing operations, commonly monostable (timer) or astable (pulses) 	
<p>Outputs – Buzzer and LED</p> <ul style="list-style-type: none"> • Know that a buzzer will create a sound when a direct (continuous) voltage is applied to it. • Know that the LED requires a resistor in series to protect it from too much current 		
<p>Monostable</p> <ul style="list-style-type: none"> • A monostable has one stable state • The monostable is started by pulsing the trigger pin with the input circuit • Once triggered, the output pin 3 will go to HIGH voltage • After a set time, the output will drop back to its stable state (LOW) 		
<p>Time constant</p>	<ul style="list-style-type: none"> • The time is set by how long capacitor C1 takes to fill. This is increased by reducing the current flow into it (increase resistance R1) or making the capacitor bigger so it takes longer to fill (increase C1). • The formula $T = 1.1 \times R1 \times C1$ can be used to calculate the time duration of the pulse 	
<p>Printed Circuit Boards (PCB)</p>	<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>	
<p>PCB manufacture</p>	<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) 	
<p>Heat shrink tubing</p>	<ul style="list-style-type: none"> • This tubing can be used to insulate bare wires • After sliding on the tubing, heat from the side of a soldering iron can be used to shrink the tubing securely into place 	
<p>PCB pillar</p>	<ul style="list-style-type: none"> • Used to support printed circuit boards. Can be detached for maintenance and repair 	

Circuit Symbols

Component Name	Appearance	Symbol
Battery (a gang of more than one cell)		
Toggle Switch		
Push to Make Switch (PTM)		
Resistor		
Electrolytic Capacitor		
LED		
Buzzer		
555 timer with chip socket		

Safety Points

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;">  <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>