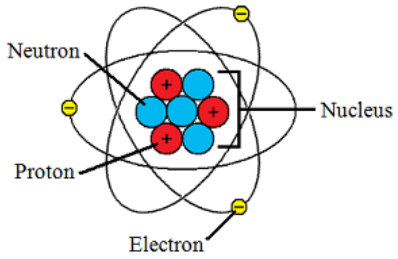
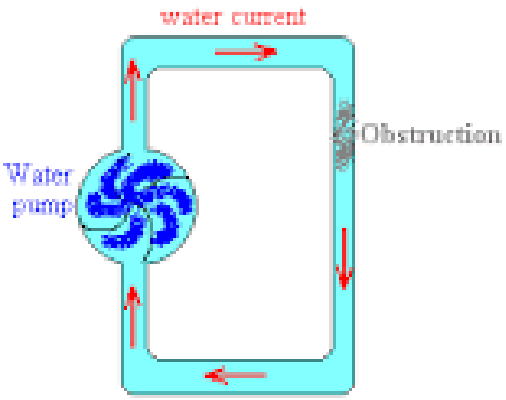
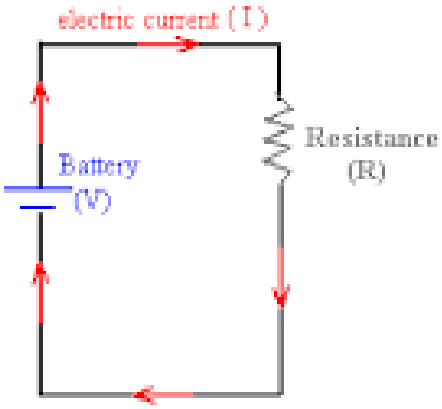
Year 7 Electronics – Knowledge Map **Name _____ Group _____**

Students will learn about current flow and energy storage through manufacturing a rechargeable torch.

Atoms	• 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	
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

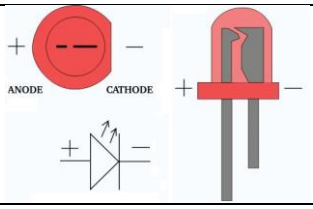
Be able to provide the following simple explanations of water flow and current flow in a circuit:

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**.	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**.

Components

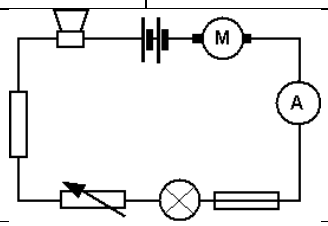
LED stands for Light Emitting Diode

- Know that the negative leg 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 a new LED is the positive lead.

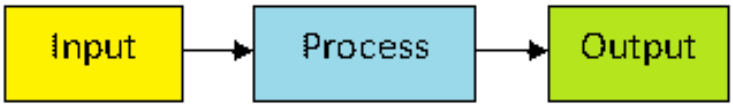


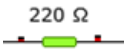
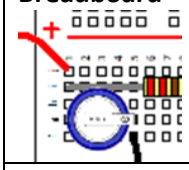
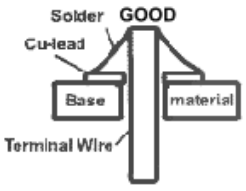
- **Capacitors** store electrical energy. They have two 'plates'. When connected to a power supply such as a battery, one plate fills up with negative charge (electrons). The opposite plate fills up with positive charge. This is known as **charging** the capacitor.
- When the capacitor is removed from the power supply, the charge is stored.
- The capacitor can then be used a bit like a battery, but unlike a battery, it will only last for a small amount of time. As the capacitor energy is used, it is emptied of charge. This is known as **discharging**.

Circuit diagrams show how each component is connected. In a circuit diagram, wires can cross if necessary, but this is to be avoided. If wires join in a circuit diagram this is known as a junction and shown with a dot at the point the wires connect. Know that components connected in **series** are connected in a 'chain' pattern, one after the other, like this (see right)

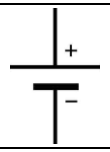


A **System** is where a set of interconnecting parts work together to fulfil a purpose. In systems, we think of input, process and output.



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**.
Circuit Simulation 	• Doesn't require any physical components, so **money isn't wasted** on expensive parts. • You can **save** and **edit** an idea, which makes it easier and cheaper to modify your design as you go along. • Simulation is **safe** - if a component explodes, it cannot hurt you – it's not real!
Breadboard 	• 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)	• 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 tracks **cannot cross** on a PCB or they will **short circuit**. • The design of a PCB layout, showing tracks and pads, is known as **artwork**. When artwork is printed onto transparent paper, this is known as a **mask**.
PCB Manufacture	**Artwork -> Expose -> Develop -> Etch -> Drill -> Solder** • 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
Cell		
DC Power Supply		
Filament lamp		
Toggle Switch		
Polarised capacitor		
Push to Make Switch		
Light Emitting Diode (LED)		

Safety Points

Breadboarding Safety Points	❑ ALWAYS wear your SAFETY GLASSES ❑ DISCONNECT circuits when troubleshooting ❑ Always **DOUBLE CHECK** POLARITY when connecting components into a circuit, especially with electrolytic capacitors **which will explode** if connected incorrectly!
Soldering Safety Points	❑ KEEP soldering irons in their protective STAND when not in use ❑ DO NOT TOUCH the tip end of a soldering iron to check for heat – it will burn you very quickly ❑ 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	❑ When manufacturing a PCB using the photoetch technique, wear the appropriate PPE of **goggles**, **plastic gloves** and **plastic apron** ❑ When drilling, always wear **safety glasses** and tie **hair** back ❑ The dust from PCB drilling contains glass and is an **irritant** so should not be touched or blown around
Irritant Chemicals	 ❑ Irritant - avoid contact ❑ Wear PPE (**personal protective equipment**) ❑ Do not eat or touch face in the workshop
Personal Protective Equipment	**Goggles**  **Plastic gloves**  **Plastic Apron**