



Oide

Tacú leis an bhFoghlaim
Ghairmiúil i measc Ceannairí
Scoile agus Múinteoirí

Supporting the Professional
Learning of School Leaders
and Teachers

Electronics Workshop 1: An Introduction to Simple Circuits



Purpose of this Elective

To empower teachers with the confidence, theoretical and practical skills necessary for integrating electronics into their classrooms, including interacting with real-life components and building circuits



Key Messages

Through collaboration, teachers from STEM subjects can learn from each other, as they acquire skills applicable across subject areas.

The importance of translating theoretical knowledge into practical skills by physically building circuits.



In this session, we will...

Reflect upon, share and discuss our current practice in the area of electricity/electronics/circuitry with our colleagues

Collaboratively develop our ability to translate theoretical knowledge into practical skills by physically building circuits



Personal Reflection Moment



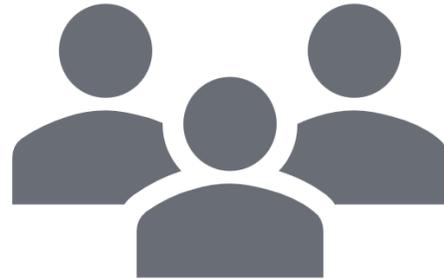
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Consider your current practice in relation to how students engage with electricity/electronics/circuitry

What challenges do students typically experience?
How do you support student learning as they encounter these challenges?



Group Feedback & Discussion



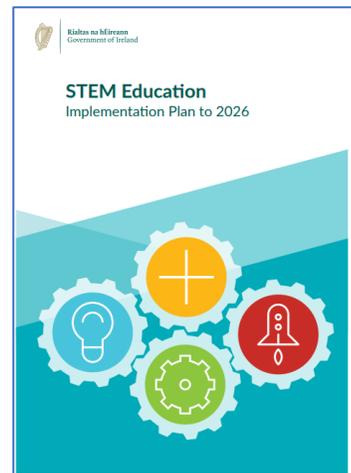
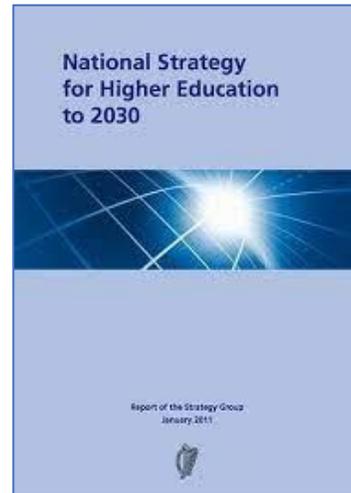
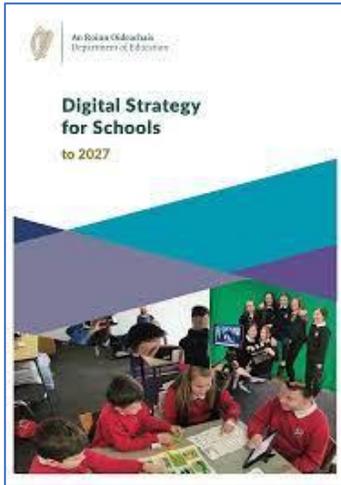
Share some of your experiences:

What challenges do students typically experience?

How do you support student learning as they encounter these challenges?



Policy and Educational Strategies

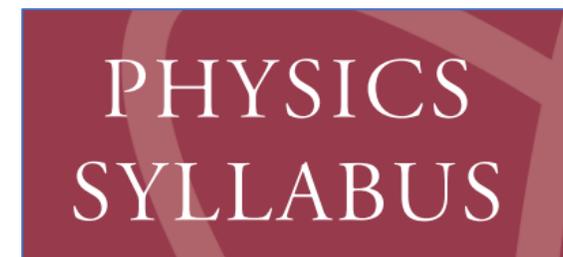


SUSTAINABLE DEVELOPMENT GOALS



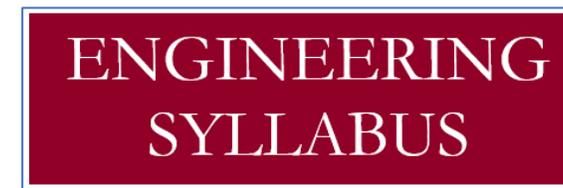


Cross-Curricular



*Where in **your** subject might you see this workshop being useful?*

Can you think of LOs in your subject area that are relevant?





Workshop Overview

Part 1

Using a Multimeter to Investigate I, V and R

Part 2

Develop Further Understanding by Simulating and Building Simple Circuits

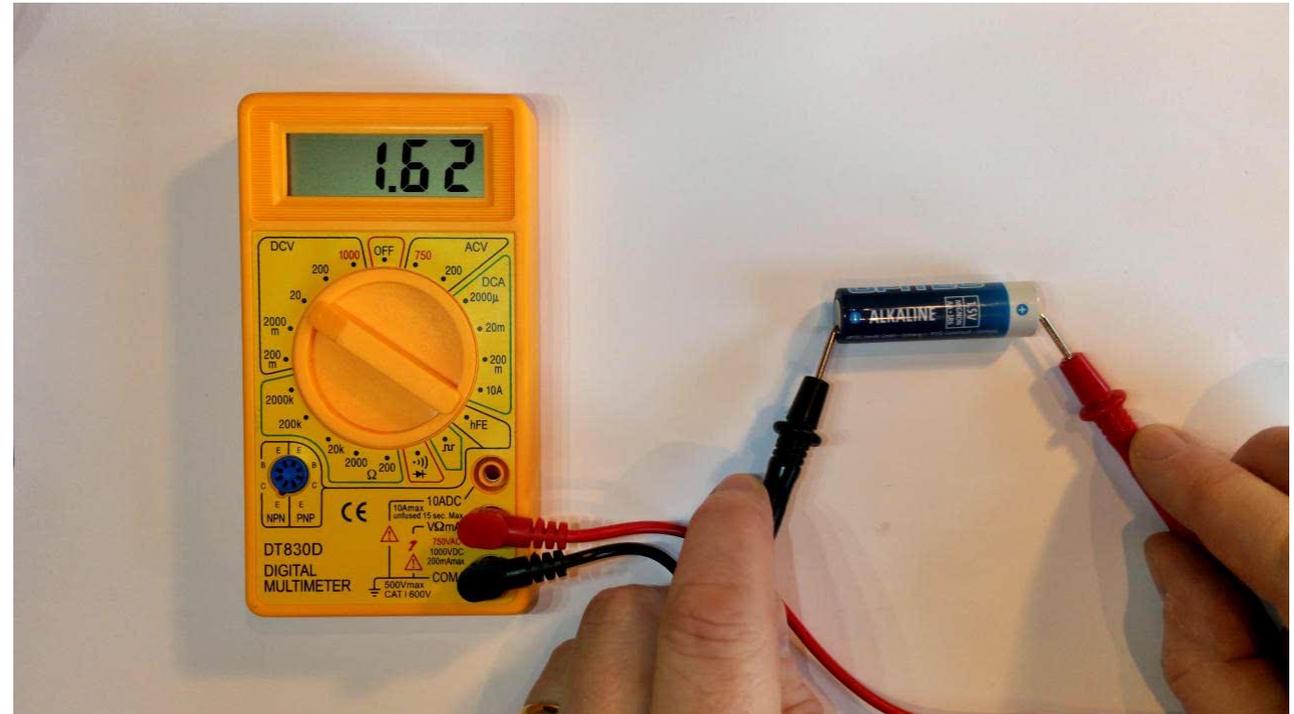


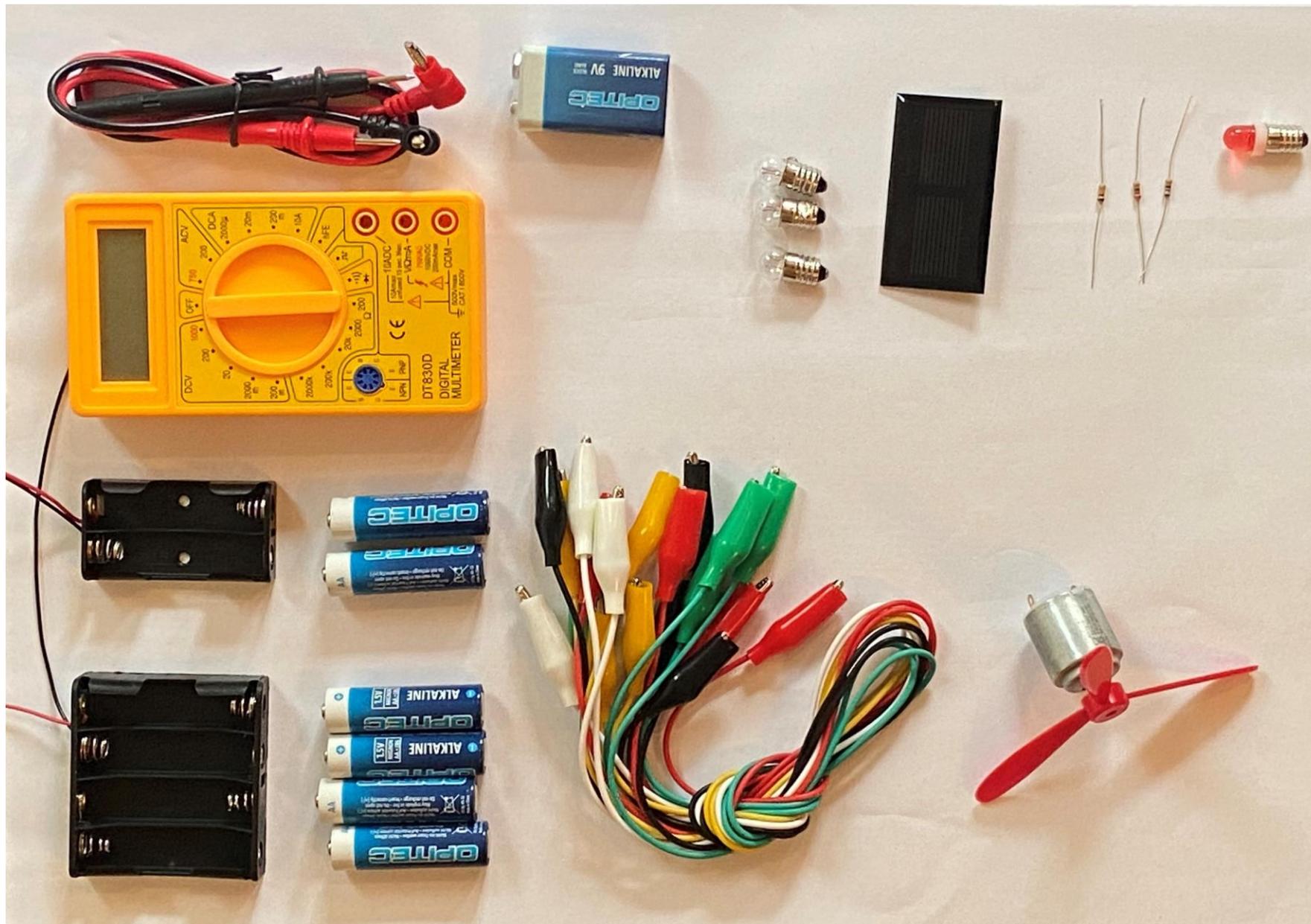
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Part 1: Using a Multimeter to Investigate I, V and R





EACH KIT CONTAINING

6 X AA BATTERIES

1 X 9 VOLT BATTERIES

1 X 2 AA BATTERY HOLDER

1 X 4AA BATTERY HOLDER

3 X MES BULB CLEAR 6V

1 X SET OF CROC LEADS

1 X 8MM RED LED BULB

1 X 3 BLADE PROPELLOR

1 X ROUND PROPELLER

1 X MEDIUM TORQUE MOTOR

1 X 220 OHM RESISTOR

1 X 1000 OHM RESISTOR

1 X 10K RESISTOR

1 X DIGITAL MULTI METRE

1 X SOLAR CELL 124203

1 X STORAGE BOX

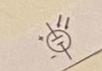


Multimeter
(Voltmeter, Ammeter,
Ohmmeter)



A tool for measuring voltage,
current and resistance

Solar Cell



Converts sunlight directly
into electricity

Resistor



Limits the flow of electric
current in a circuit

Battery holders and
batteries



Converts stored chemical
energy into electrical energy

Crocodile clips



Used to temporarily connect
wires to components

Motor



Converts electrical energy
into mechanical energy

MES bulb



Produces light by passing
electricity through a thin
filament

LED bulb

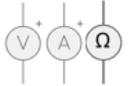


Energy efficient polarised
bulb





Activity 1: Matching Symbols and Components

Component	Name	Symbol	Description
	Multimeter (Voltmeter, Ammeter, Ohmmeter)		A tool for measuring voltage, current, resistance, conductivity
	Crocodile leads		Used to temporarily connect components together
	Battery holders and batteries		Converts stored chemical energy into electrical energy
	MES filament bulb		Produces light by passing current through a thin filament
	Resistor		Limits the flow of current in a circuit
	Motor		Converts electrical energy into mechanical energy
	Solar Cell		Converts light energy into electrical energy
	LED bulb		Energy efficient polarised bulb



What is a Multimeter?





Why is the Multimeter Integral to this session?

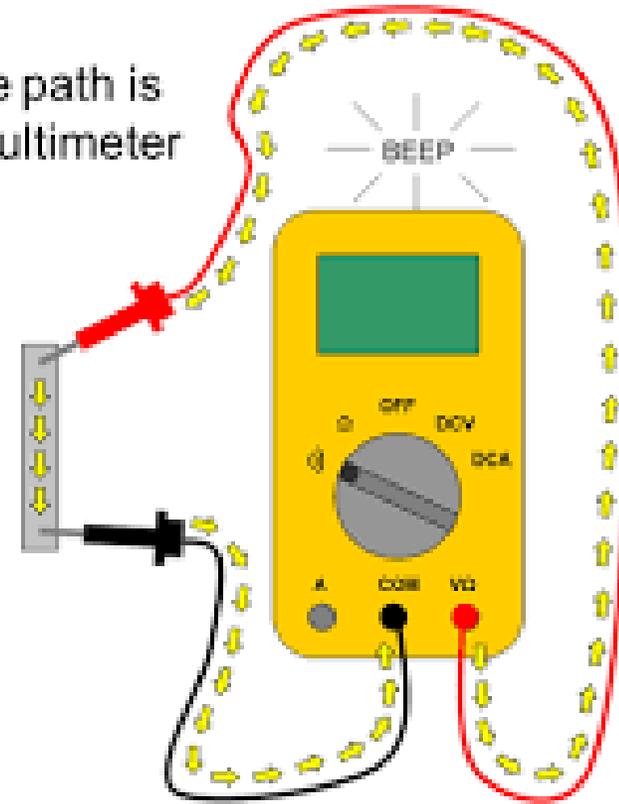




Activity 2: Testing Conductors and Insulators



If a conductive path is formed, the multimeter will beep.







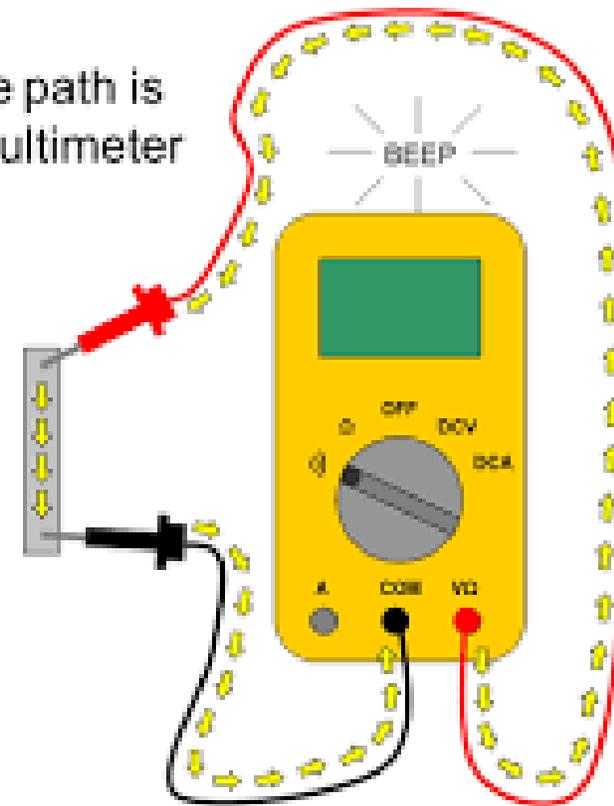
Summary

Conductors beep because...

...Electric charge (electrons) can flow (Current)

...Complete loop forming a complete circuit

If a conductive path is formed, the multimeter will beep.





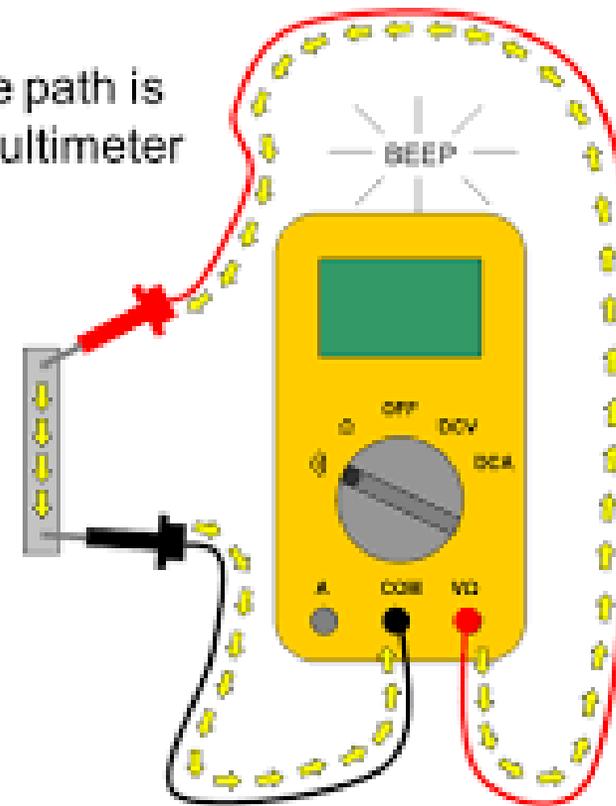
Summary

Insulators do not beep because...

...Electric charge (electrons) cannot flow
(No Current)

...An incomplete loop, resulting in an
incomplete circuit.

If a conductive path is formed, the multimeter will beep.





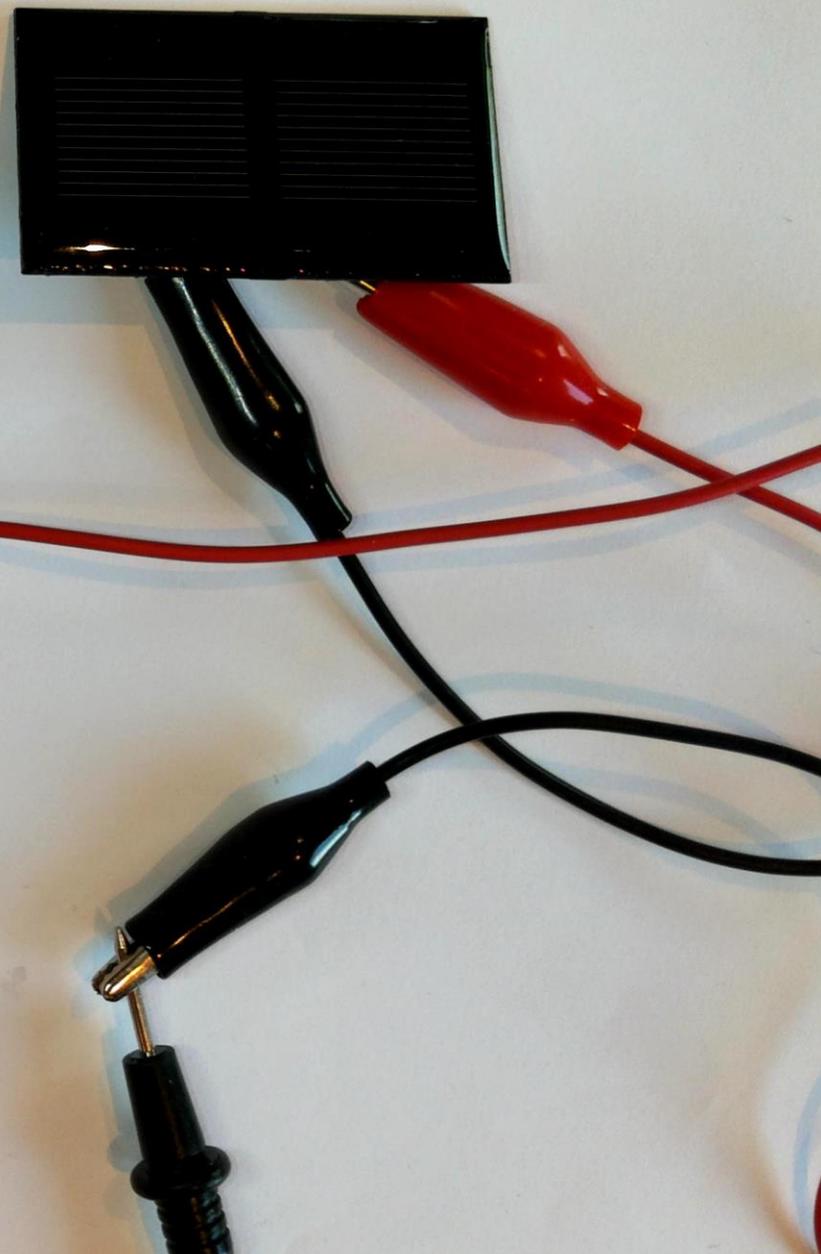
Activity 3: Measuring voltage

Explore voltage measurements using different sources such as:

- 1.5V Battery
- Partially discharged batteries
- 3V, 6V batteries
- Power supply unit
- Solar Panel
- Fan & Motor









Summary

- Voltage/Potential Difference/EMF
- Voltage is the measure of the electrical potential difference (energy used) between two points in a circuit
- Voltage is measured in Volts (V)





Summary

A multimeter measures voltage by detecting the electrical potential difference between two points in a circuit, displaying the value in volts

The voltmeter is connected in parallel





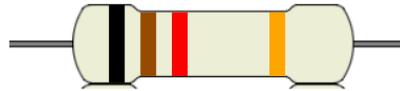
Activity 4: Measuring Resistance





Resistors and Colour Coding

100 Ω ±0.05% (W)



Number of Bands: 4 Band ▾

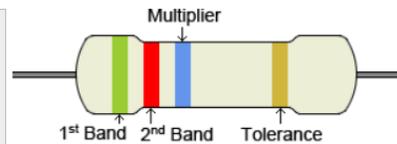
1st Band Color:
 black brown red orange yellow
 green blue violet grey white

2nd Band Color:
 black brown red orange yellow
 green blue violet grey white

Multiplier Color:
 black brown red orange yellow
 green blue violet grey white
 gold silver

Tolerance Color:
 brown red orange yellow green
 blue violet grey gold silver

Calculate ▶



Color	1 st , 2 nd Band Significant Figures	Multiplier	Tolerance
Black	0	× 1	
Brown	1	× 10	±1% (F)
Red	2	× 100	±2% (G)
Orange	3	× 1K	±0.05% (W)
Yellow	4	× 10K	±0.02% (P)
Green	5	× 100K	±0.5% (D)
Blue	6	× 1M	±0.25% (C)
Violet	7	× 10M	±0.1% (B)
Grey	8	× 100M	±0.01% (L)
White	9	× 1G	
Gold		× 0.1	±5% (J)
Silver		× 0.01	±10% (K)

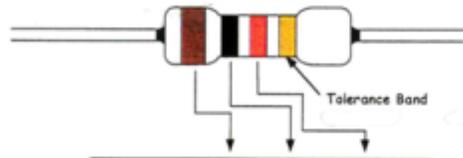


<https://www.calculator.net/resistor-calculator.html>



Activity 4: Measuring Resistance

Components:



Black	0	0	
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0000
Green	5	5	00000
Blue	6	6	000000
Violet	7	7	0000000
Grey	8	8	
White	9	9	

Task: Use a multimeter as an Ohmmeter to measure the resistance of a selection of resistors.

1. In the results table fill in the colours on the resistor and use the colour code to calculate its resistance
2. Attach red probe to V Ω mA and black probe to COM
3. Set dial on multimeter to 2000K Ω
4. Hold the ends of the resistor against the probes
5. Measure the resistance of the resistor and record your results.

Note: You may need to change the setting on the multimeter from 2000k, 200k, 20k, 20000, 200 until you get an accurate reading.

Observations

Results

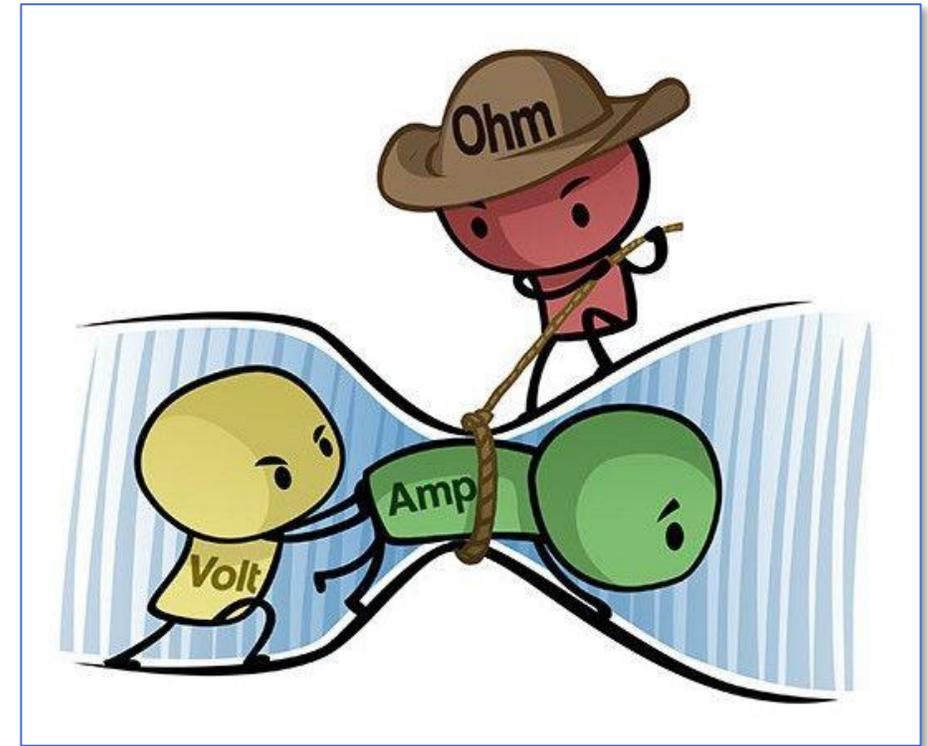
Resistor colours	Calculated Resistance (Ω)	Measured Resistance (Ω)
Yellow, violet, orange	47000 Ω	





Summary

- Resistance opposes the movement of electric charge (electrons) around a circuit
- It is the measure of how much a material opposes the flow of electric current through it
- Resistance is measured in Ohms Ω



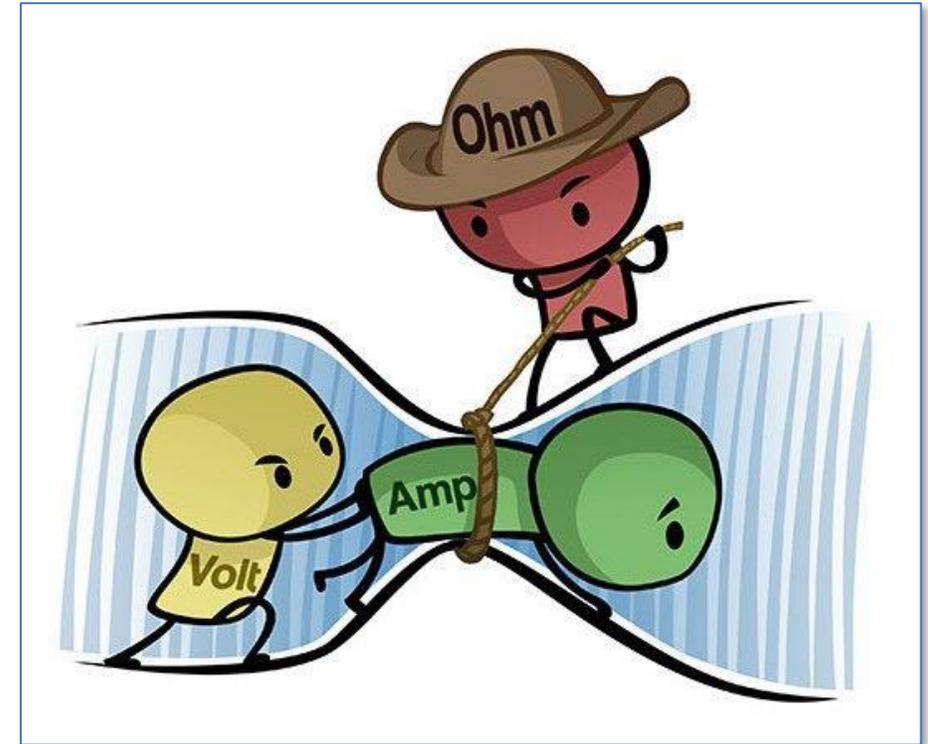
Source: <https://ohmify.com/courses/learn-electronics-1/>



Summary

A multimeter measures resistance by

- Sending a small current through the component
- Calculating the resistance based on the change in voltage across it.



Source: <https://ohmify.com/courses/learn-electronics-1/>

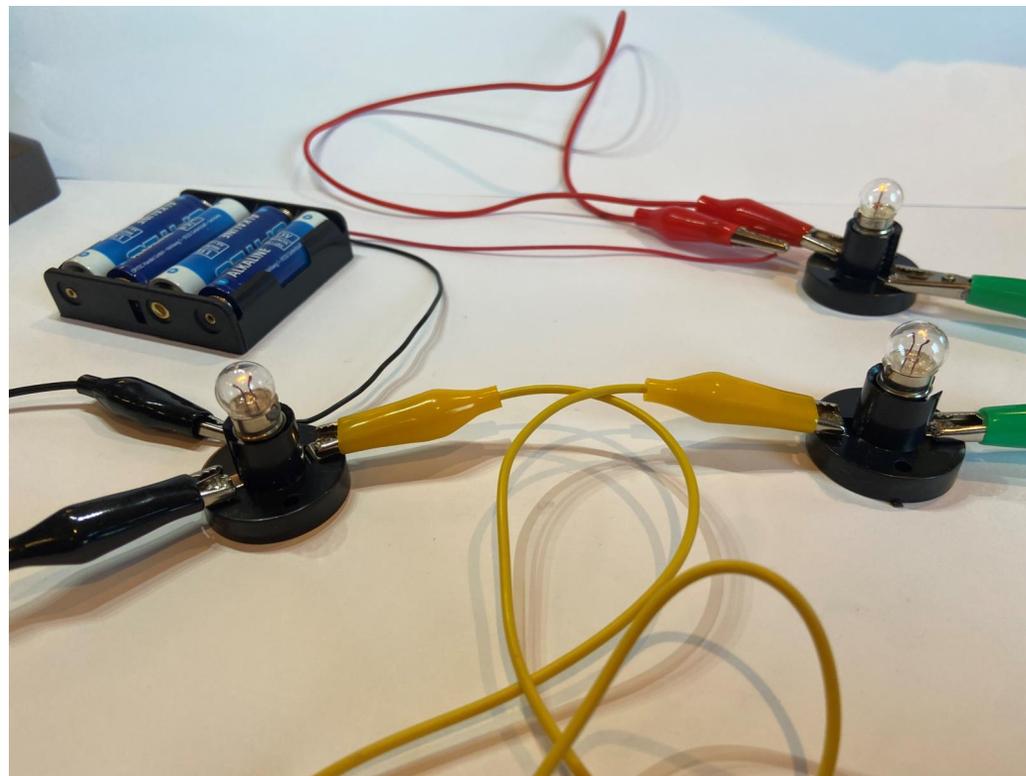


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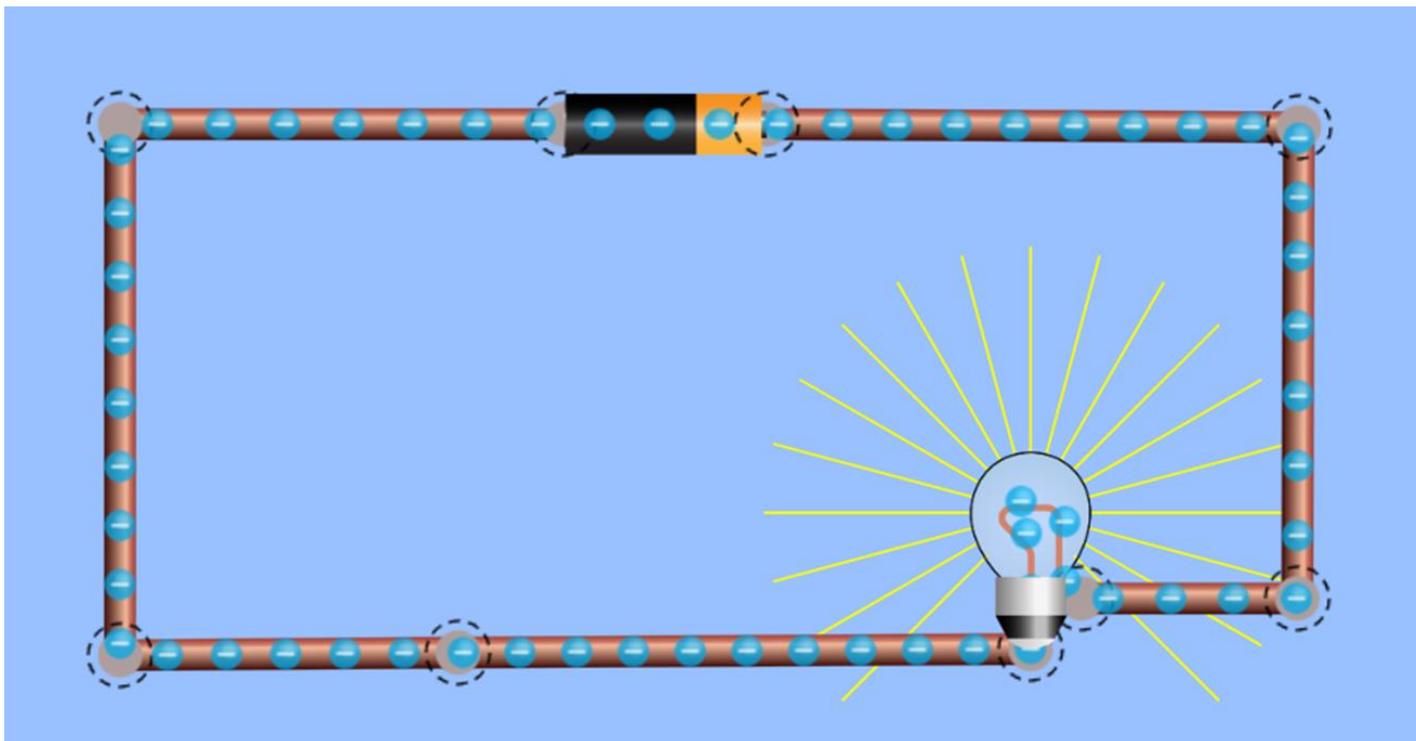
Part 2: Further developing understanding by simulating and building circuits





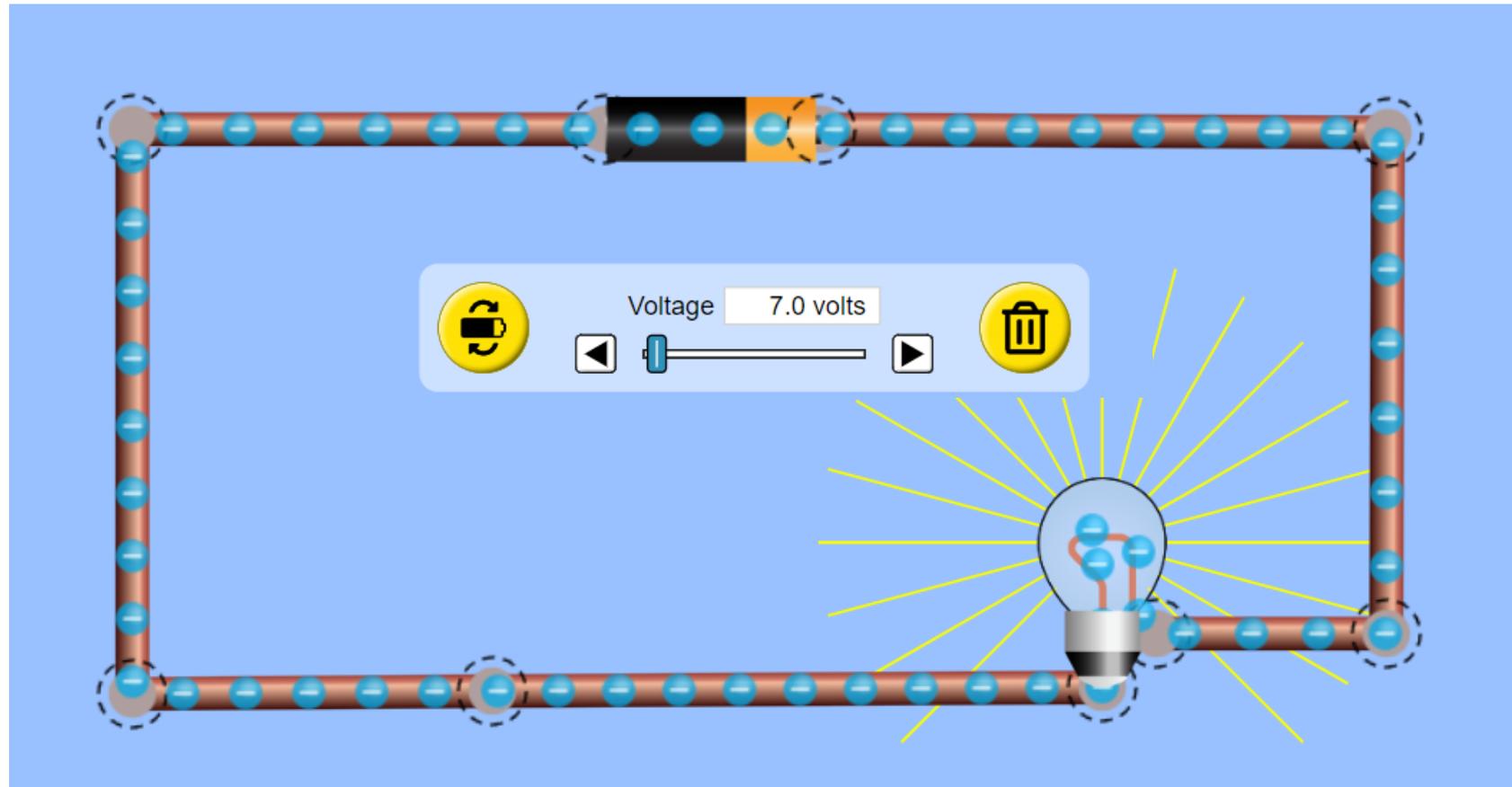
PHET Circuit Construction

<http://tinyurl.com/OideSimpleCircuits>





Explore voltage

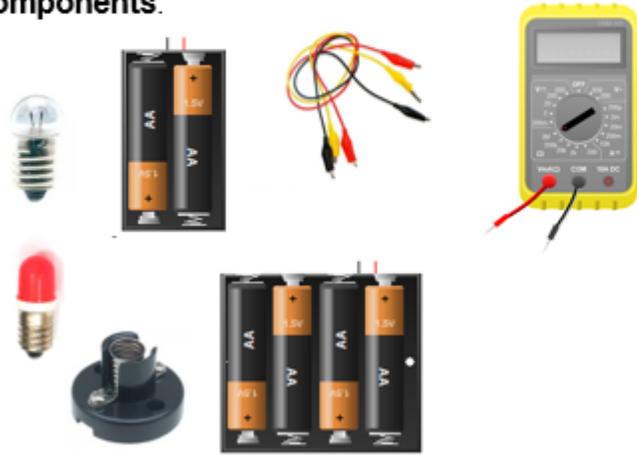


- Show Current
 - Electrons 
 - Conventional 
- Labels
- Values



Activity 5: Build a simple circuit

Components:



Task: Build a simple circuit using a battery pack and a MES filament bulb

1. Attach a crocodile lead from the battery pack to one of the MES bulb holder connections
2. Attach another crocodile lead from the other MES bulb holder connection back to the battery pack
3. Measure the voltage across the battery pack and the MES filament bulb
4. Measure the current in the circuit
5. Repeat the steps using different power sources and the LED bulb
6. Record your observations and draw a circuit diagram for one of the circuits

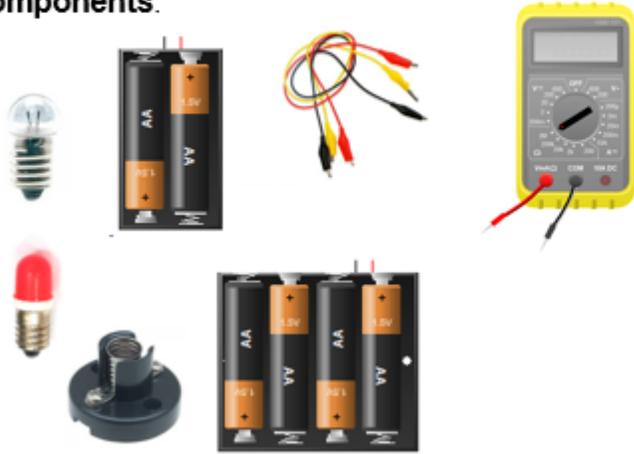
Observations

Circuit diagram including voltmeter and ammeter



Activity 5: Build a simple circuit

Components:



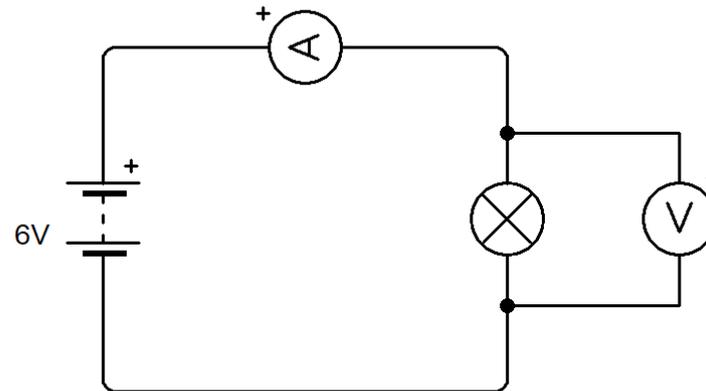
Task: Build a simple circuit using a battery pack and a MES filament bulb

1. Attach a crocodile lead from the battery pack to one of the MES bulb holder connections
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Observations

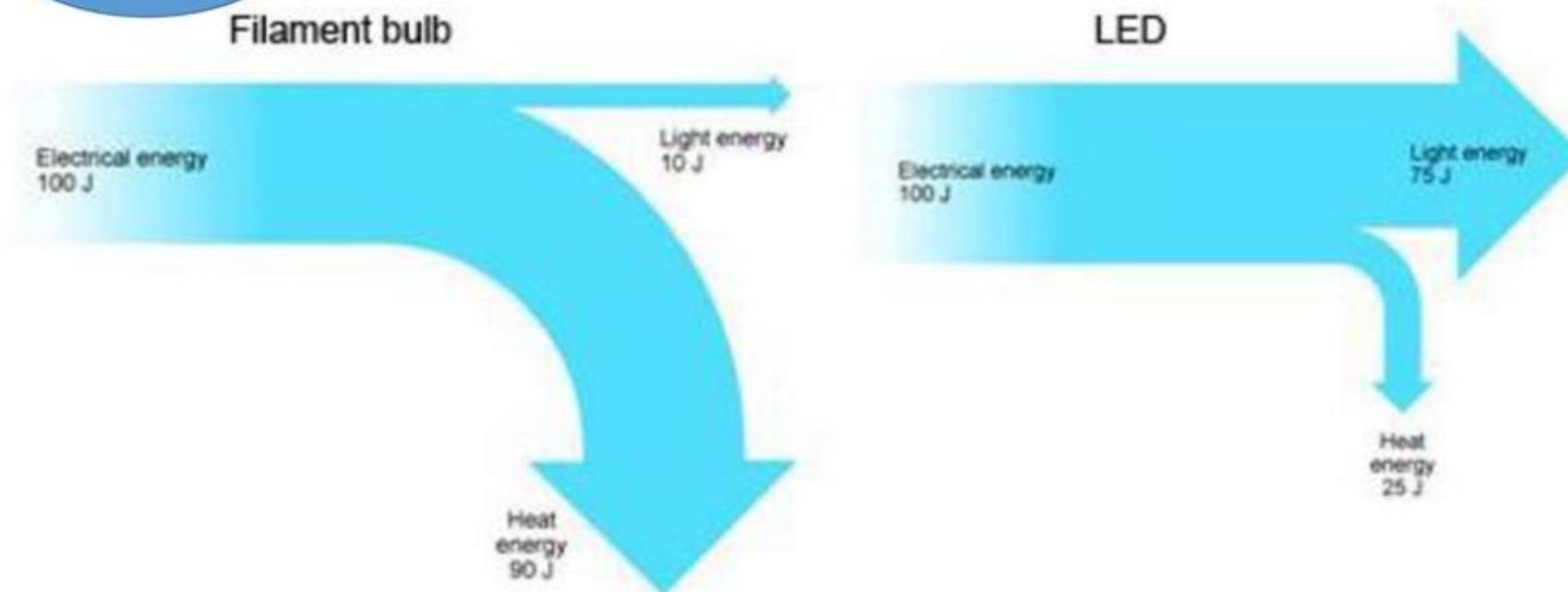
Circuit diagram including voltmeter and ammeter

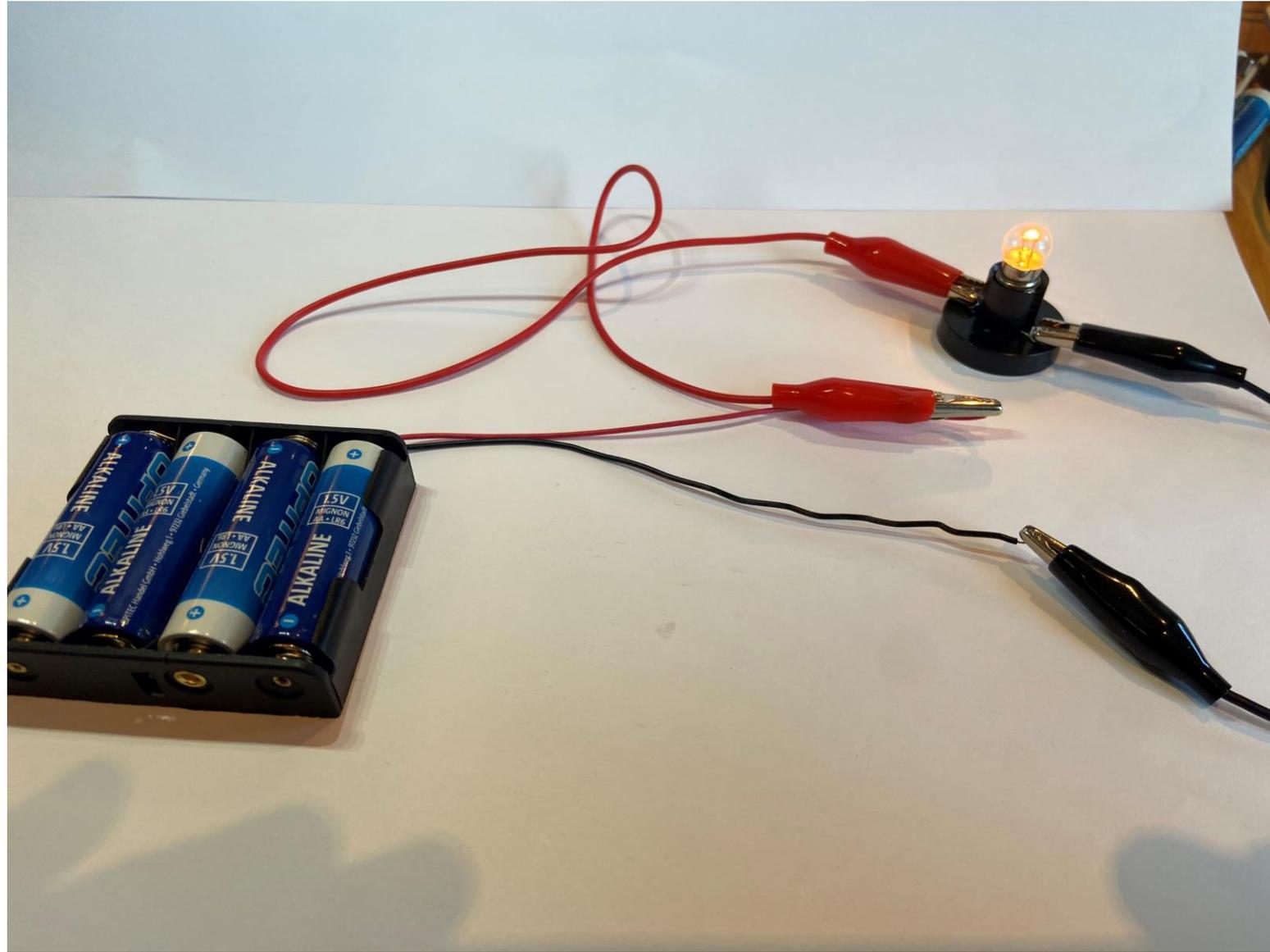




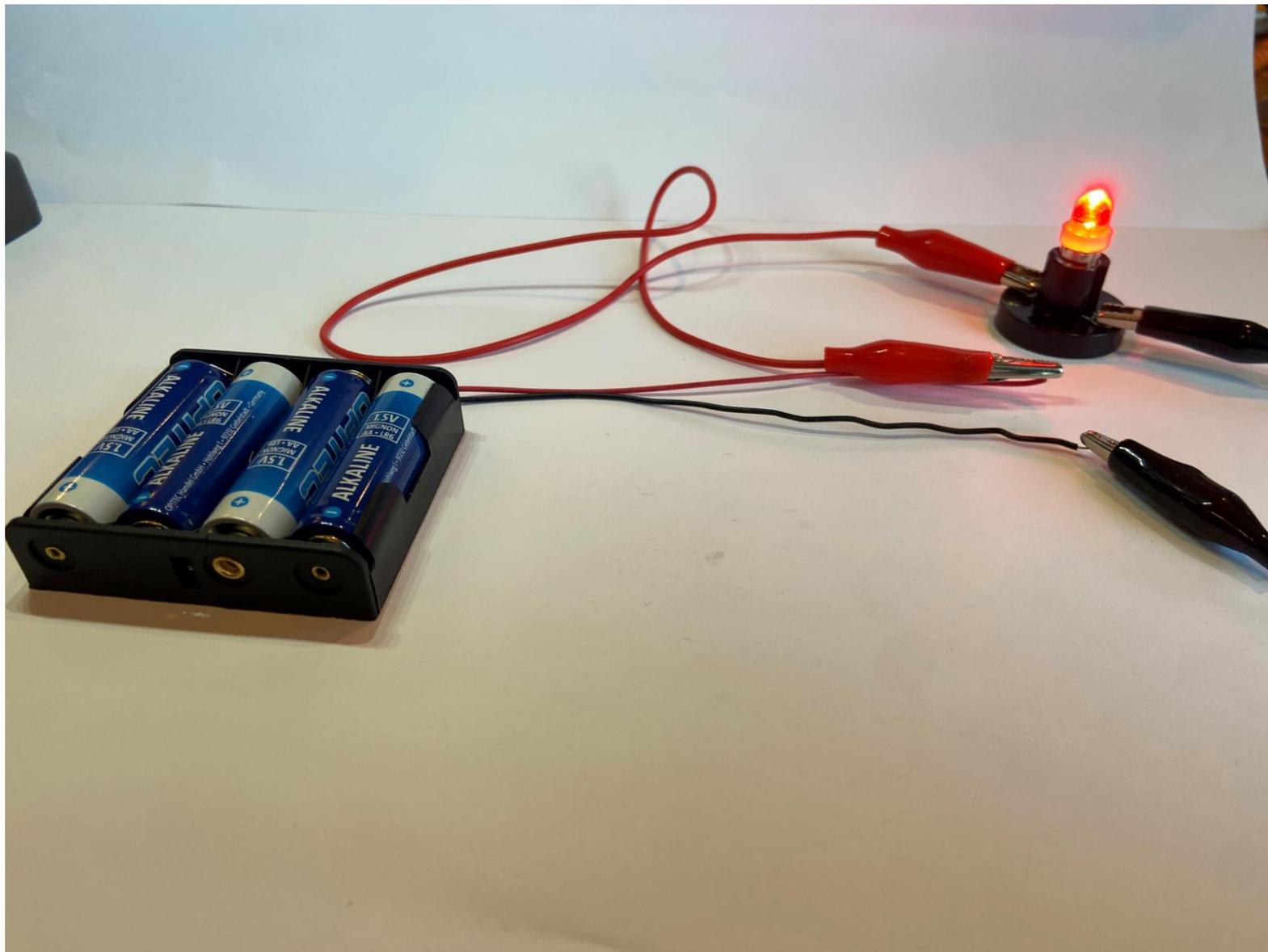
Sankey
Diagram

Wasted and Useful Energy





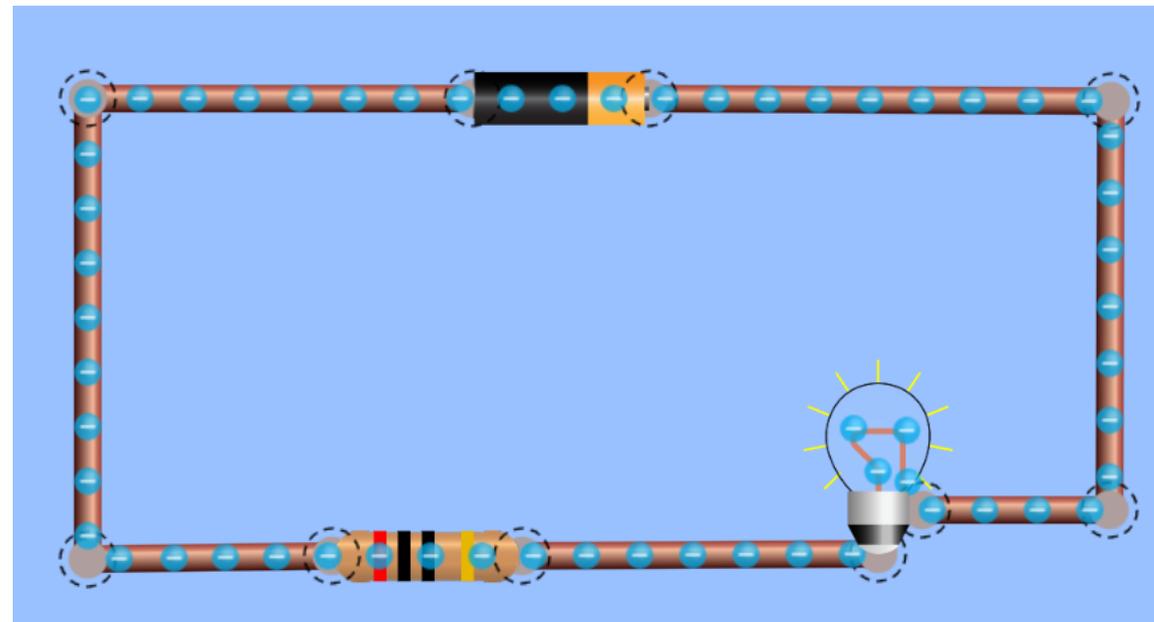
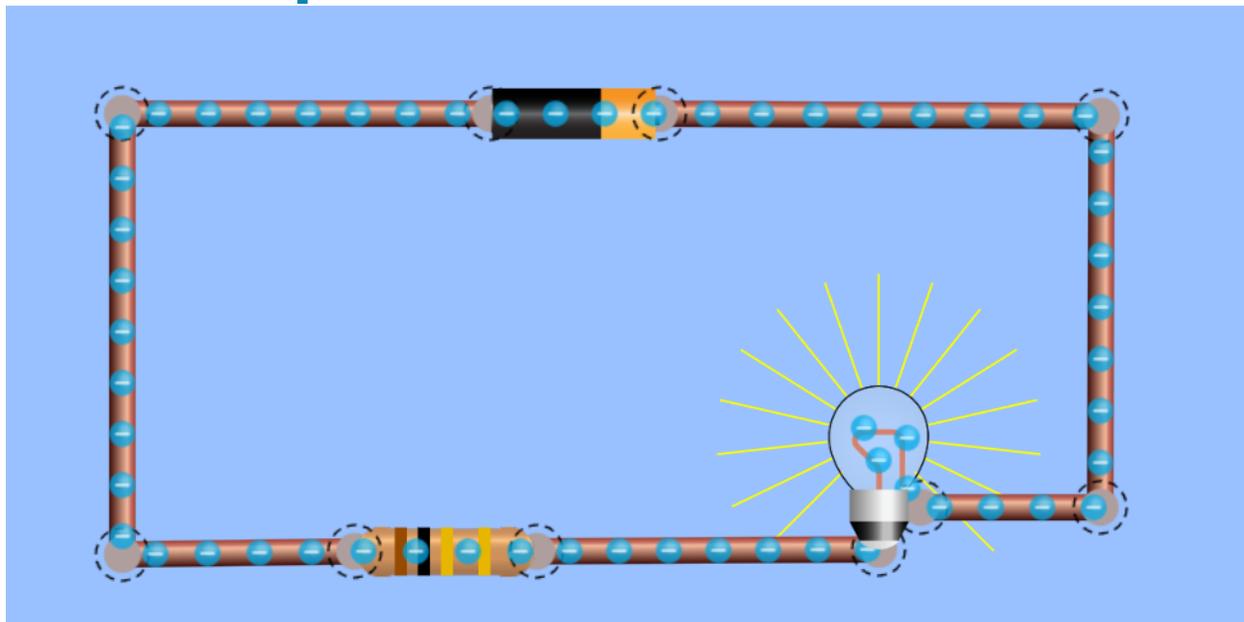
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Explore Resistance



Resistance

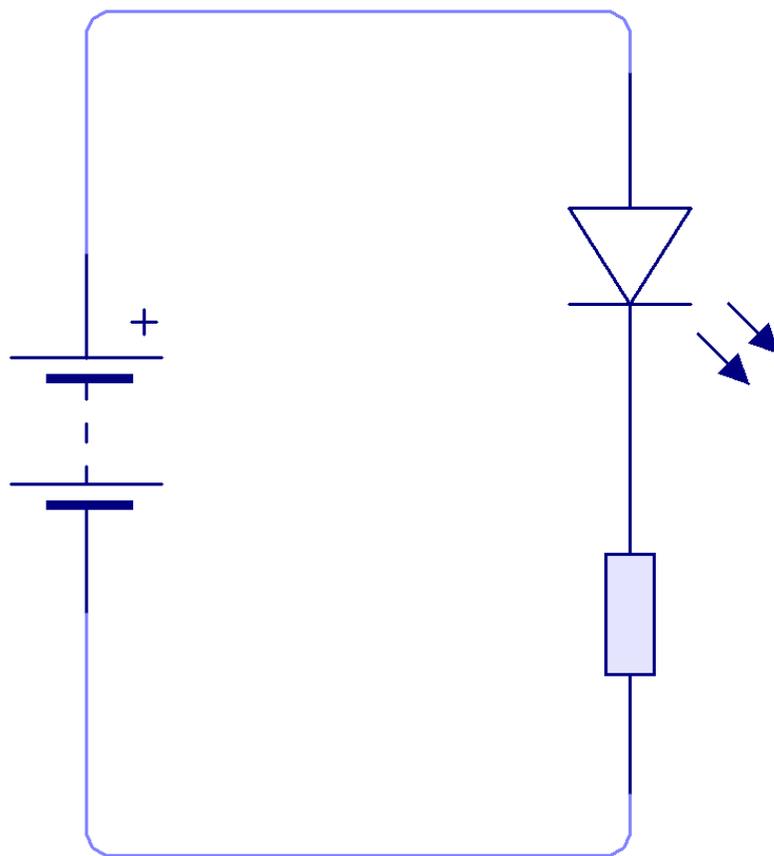
A slider control with a blue knob positioned at the left end. The slider is flanked by left and right arrow buttons. To the right of the slider is a yellow trash can icon.

Resistance

A slider control with a blue knob positioned at the right end. The slider is flanked by left and right arrow buttons. To the right of the slider is a yellow trash can icon.

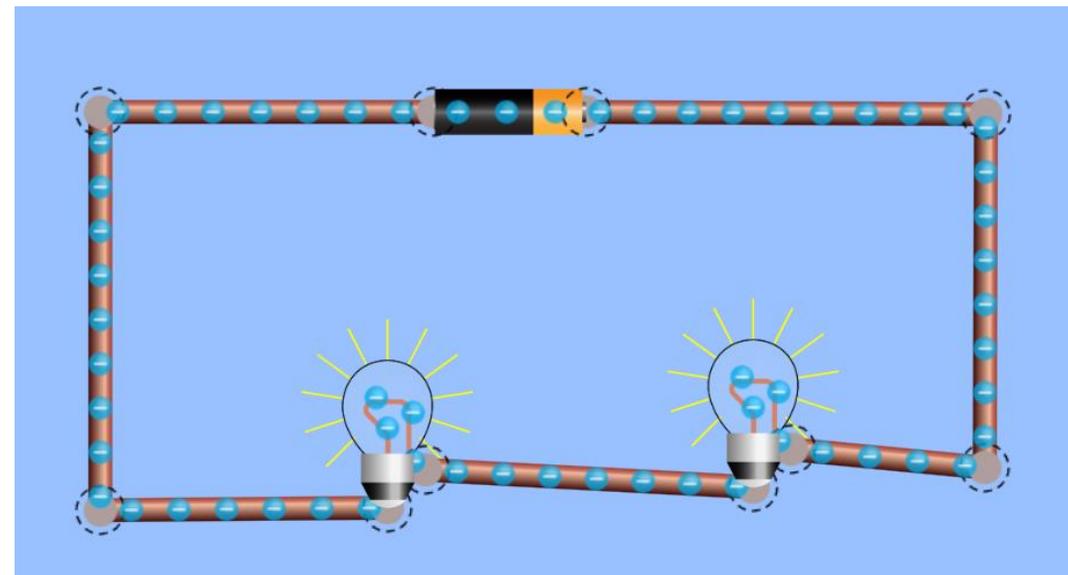
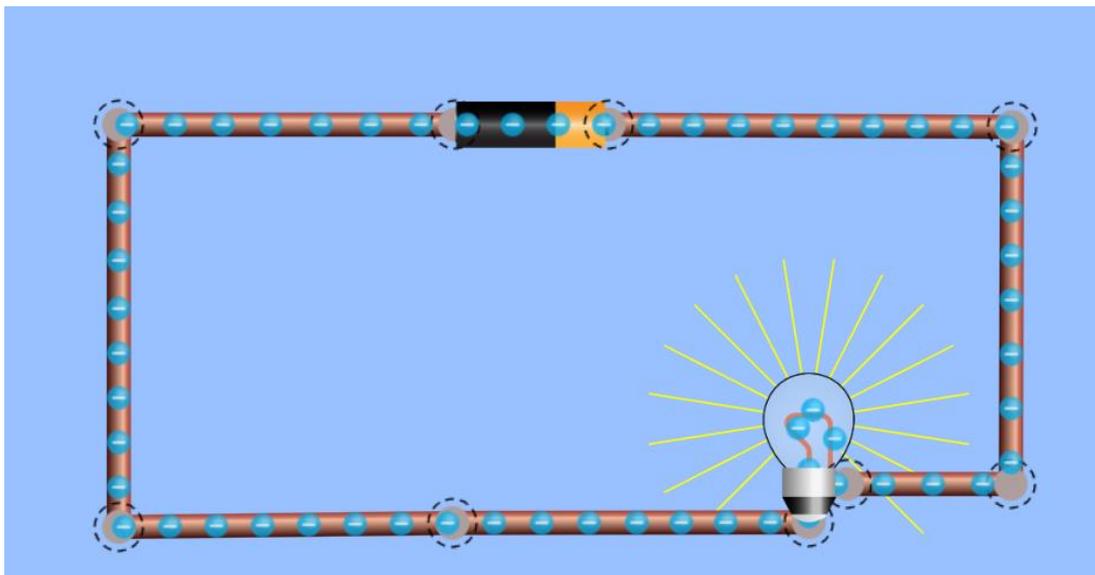


Reducing the intensity of the light





Activity 6: Series circuit





Activity 6: Build a series circuit with 3 MES bulbs

Components:



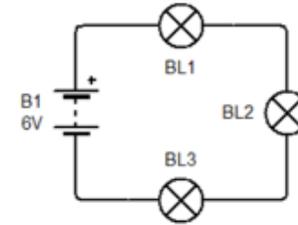
x3



x3



Task: Using the components build the circuit as shown in the circuit diagram.

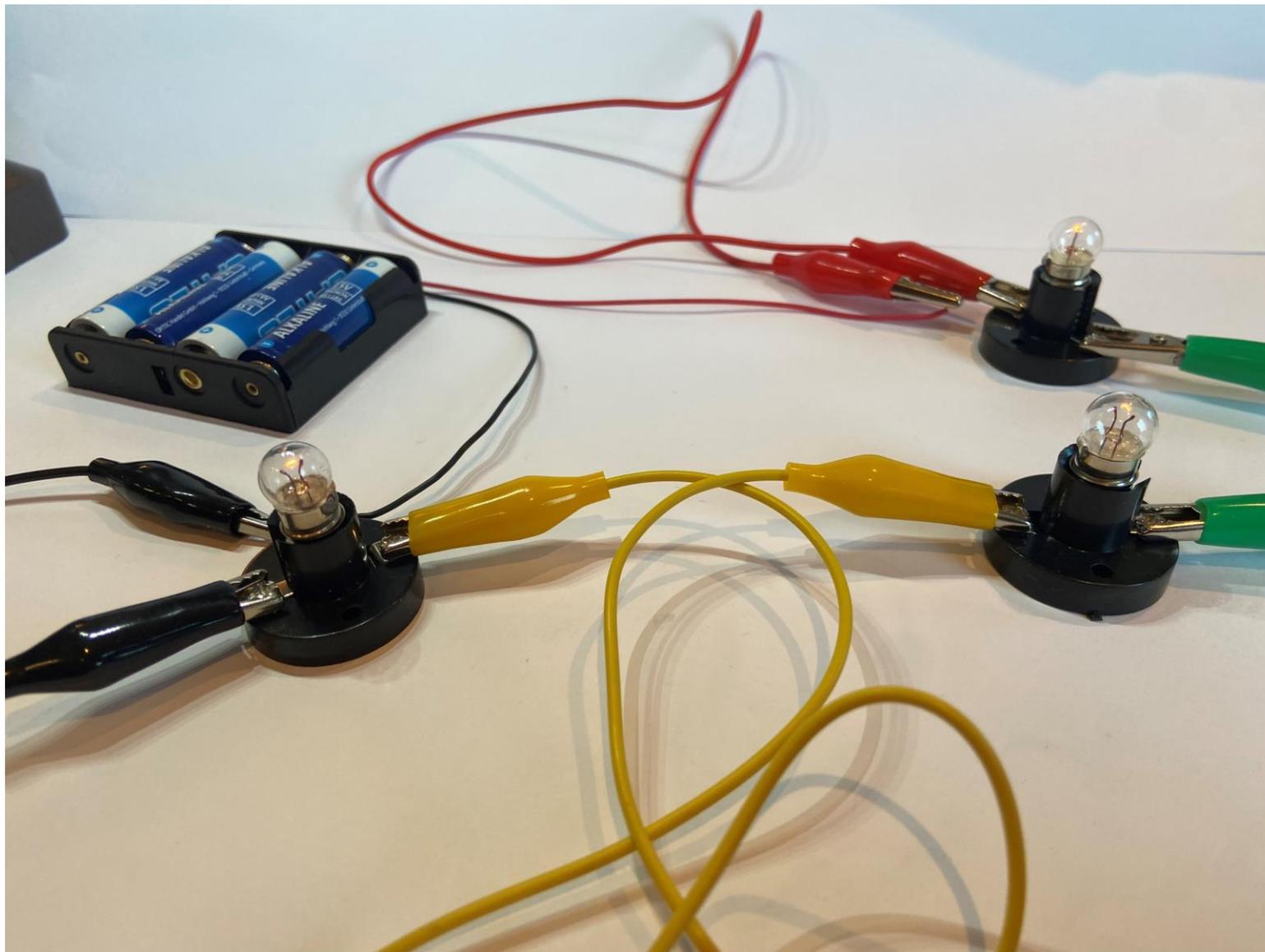


1. Use the multimeter to measure the voltage and resistance across the components
2. Measure the current at number of points in the circuit
3. Record your results in the table and note your observations

Observations

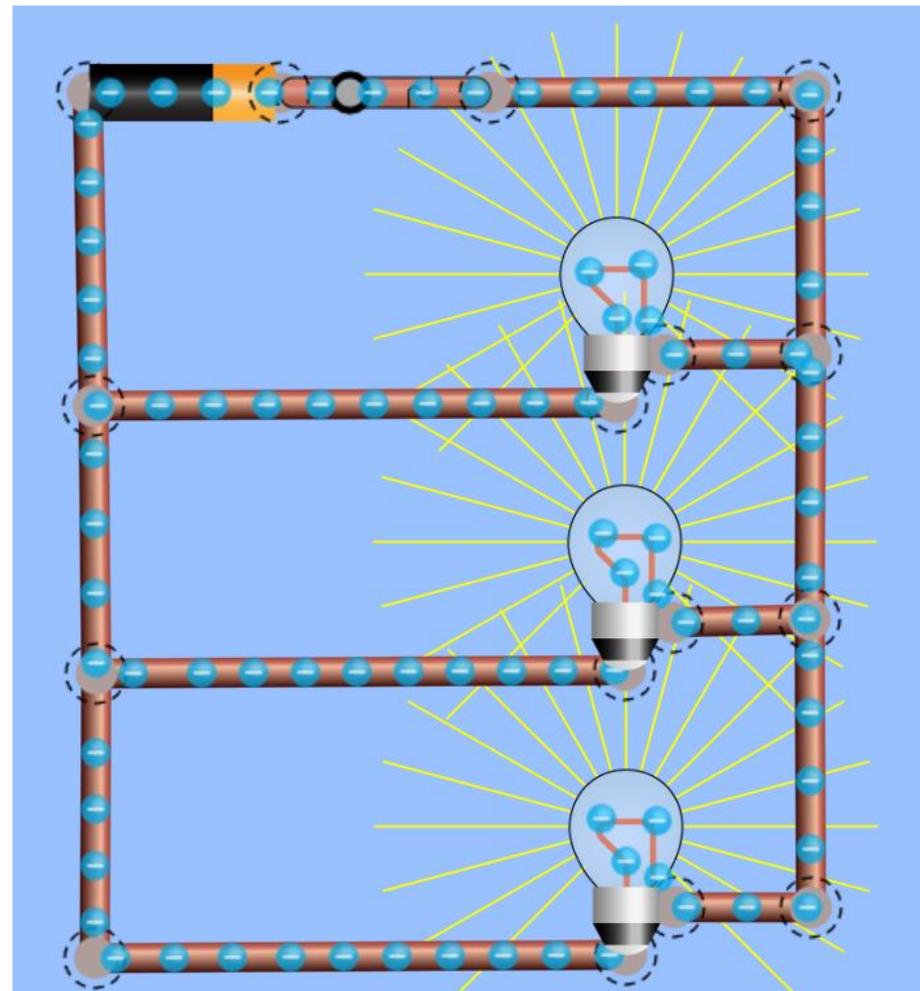
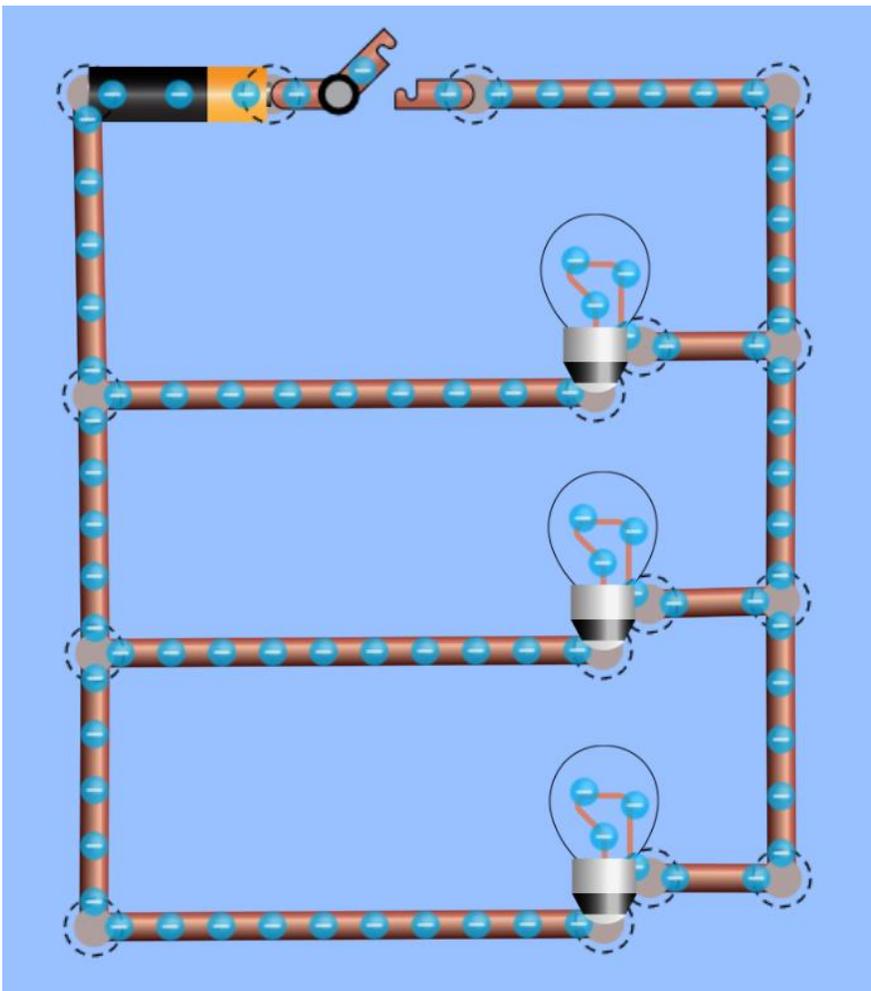
Results

Component	Measured Voltage (V)	Measured Current (I)	Measured Resistance (R)
Battery pack (B1)			
Bulb 1 (BL1)			
Bulb 2 (BL2)			
Bulb 3 (BL3)			
Bulb 1 + Bulb 2 + Bulb 3			





Activity 7: Parallel Circuit



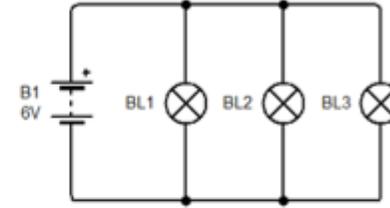


Activity 7: Build a parallel circuit with 3 MES bulbs

Components:



Task: Using the components build the circuit as shown in the circuit diagram.



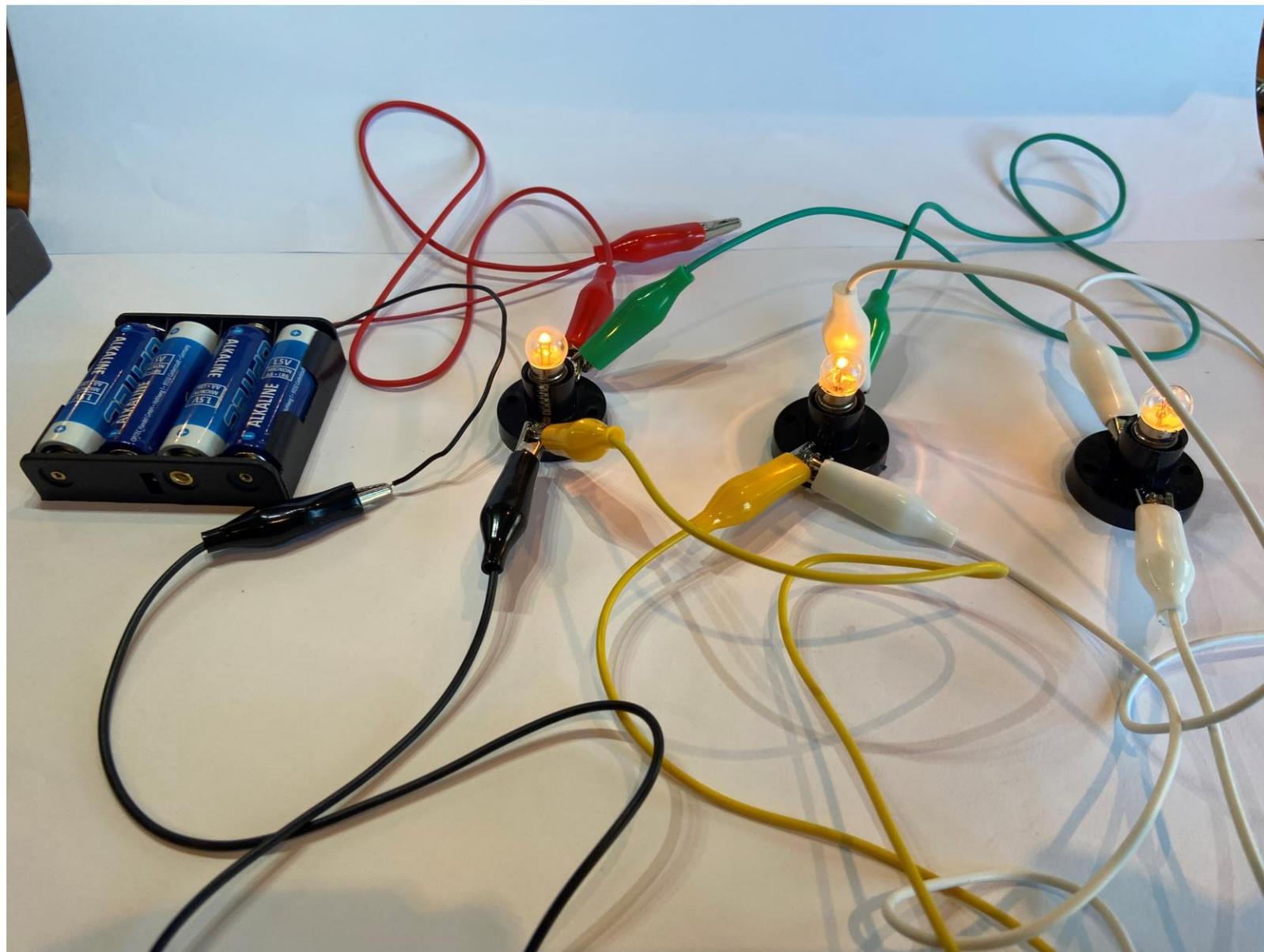
1. Use the multimeter to measure the voltage and resistance across the components
2. Measure the current at number of points in the circuit
3. Record your results in the table and note your observations
4. Compare results and observations to those from the series circuit

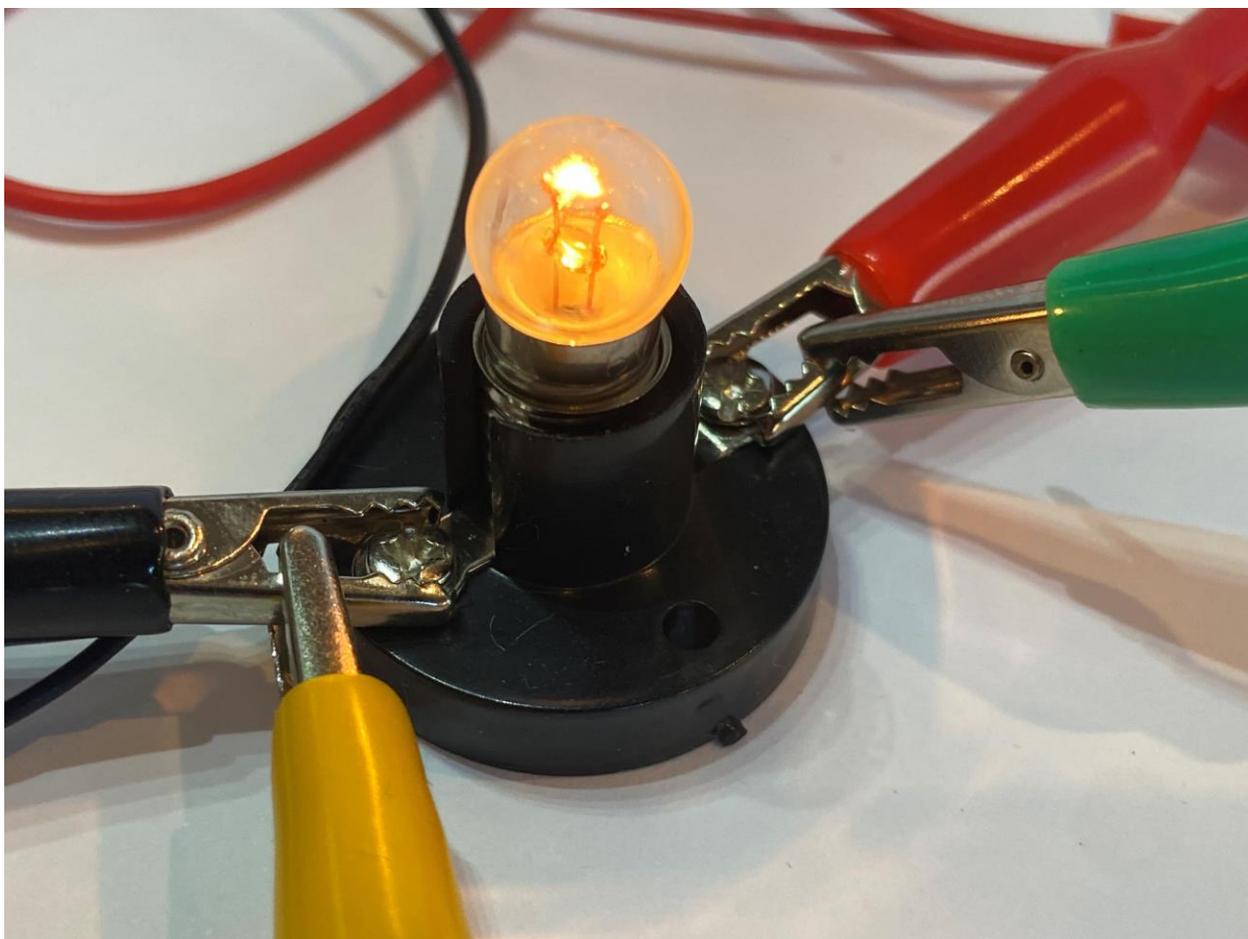
Observations

Blank area for recording observations.

Results

Component	Measured Voltage (V)	Measured Current (I)	Measured Resistance (R)
Battery pack (B1)			
Bulb 1 (BL1)			
Bulb 2 (BL2)			
Bulb 3 (BL3)			





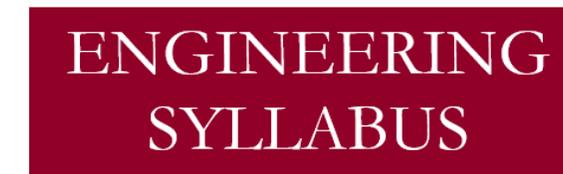
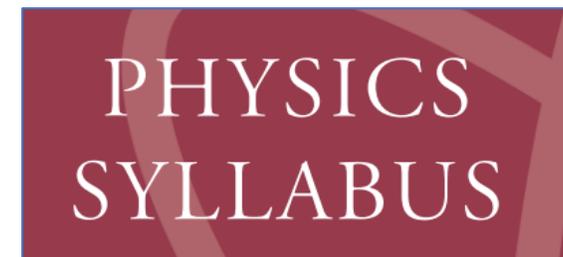


Examples of Effective Questions

Purpose of Question	Examples
To clarify their thinking (e.g. to check their understanding of polarity)	<i>What might happen if you swap the probes? Why do we sometimes get negative voltage?</i>
To extend and deepen students' thinking (e.g. checking the batteries and checking the predicted against the actual)	<i>What were your assumptions? How did you come up with your prediction?</i>
To prompt students to reflect on their conceptual understanding (e.g. asking student to reflect on their understanding of the concept of Voltage, Current, Resistance)	<i>Can you explain this concept in your own words?</i>
To ask students to illustrate a concept with an example (e.g. ask them to draw the schematic of a physical circuit, ask them to give real-life example i.e. wind turbine or solar energy)	<i>Can the idea be shown through a diagram? How does this relate to real- life?</i>

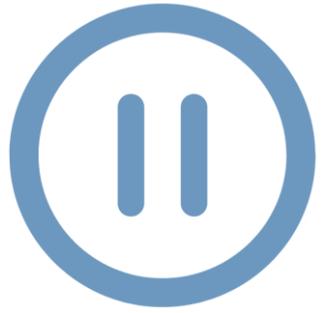


Reflection: Cross-Curricular



*Where in **your** subject might you see this workshop being useful?*

Can you think of LOs in your subject area that are relevant?



Personal Reflection Moment



How could you work with other subject departments in your school to bring this learning to life in the classroom?



Key Messages

Through collaboration, teachers from STEM subjects can learn from each other, as they acquire skills applicable across subject areas.

The importance of translating theoretical knowledge into practical skills by physically building circuits.



In this session, we...

Reflected upon, shared and discussed our current practice in the area of electricity/electronics/circuitry with our colleagues

Developed our ability to translate theoretical knowledge into practical skills by physically building circuits



Using a Multimeter

[Overview of a Multimeter](#)



<http://tinyurl.com/Apr24Multimeter>

[Connecting the probes/leads](#)



<http://tinyurl.com/Apr24Probes>