Applied Technology
Electrical Circuits Resource

Exploring integrated learning experiences through the medium of electrical control

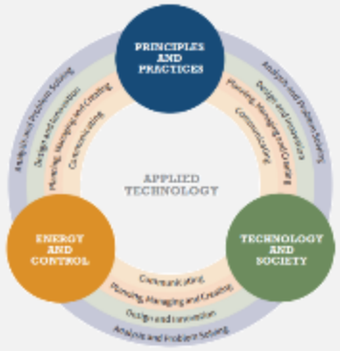
Using this resource

This PowerPoint has been designed as an interactive presentation which allows you to navigate to different slides as required. It is recommended that you engage with the resource in **presentation mode**. This will allow you to navigate through the resource by clicking on the links available on each slide.

Introduction

What is the purpose of this resource?

*Applied Technology uses an interdisciplinary approach which encourages the **integration of the three strands** in the teaching and learning of the subject. (Applied Technology Specification, page 9)*



In this context, this resource is designed to show how integrated learning experiences can be created with a primary focus on Electrical Control. This resource also considers how learning in Electrical Control can be incrementally developed over three years of Junior Cycle.

What is contained within this resource?

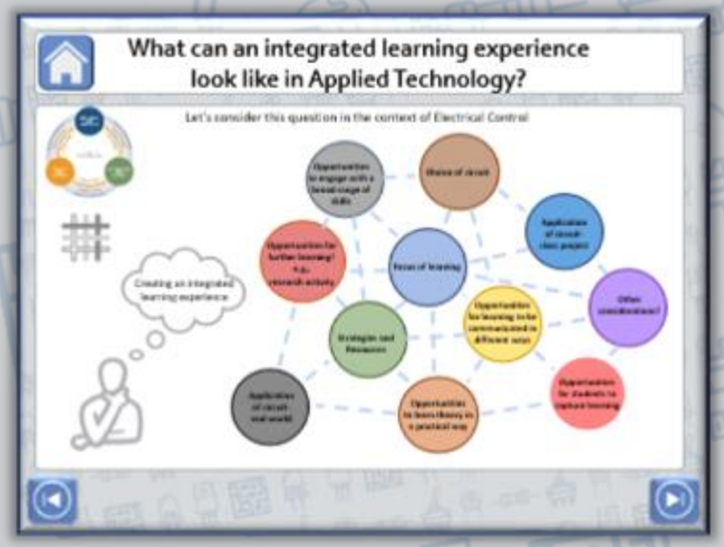
This resource explores factors to be considered when planning for integrated learning experiences to engage students. It sets out why planning using an integrated approach is important when students learn in Applied Technology. In this regard, the Applied Technology team have developed some useful prompt questions that you may find useful when planning integrated learning experiences for your students.

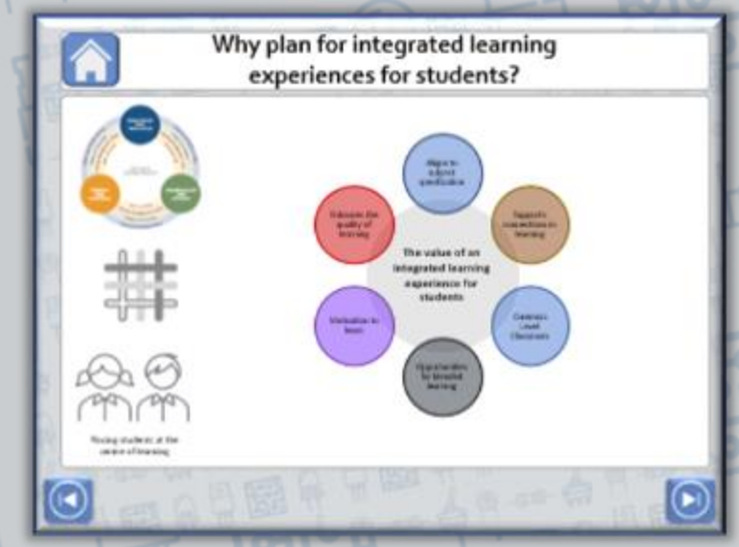
This resource also explores how learning opportunities can be integrated through the use of **four sample electrical circuits**. Through the use of the circuits, students will have opportunities to learn about fundamental concepts and principles in relation to electrical control. They will also have opportunities to connect learning with real world examples and to apply learning to new contexts. *It is not intended that these circuits are prescriptive in nature. Teachers may choose to use these circuits in class whilst having the freedom to adapt them and to consider alternative circuits to meet the needs of their students.*

How can this resource be used to support learning?

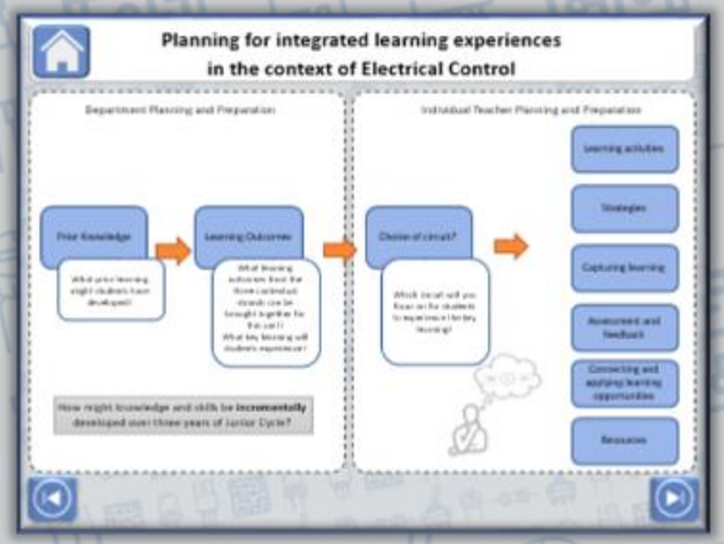
This resource can be used by a teacher in class as an interactive PowerPoint presentation. The embedded videos contained in this resource can support student learning using a ‘flipped-classroom’ strategy. It may also be used in other ways as teachers adapt this resource to meet the needs of their students.

Home


What can an integrated learning experience look like in Applied Technology?
Let's consider this question in the context of Electrical Control
Creating an integrated learning experience


Why plan for integrated learning experiences for students?
The value of an integrated learning experience for students


Planning for integrated learning experiences in the context of Electrical Control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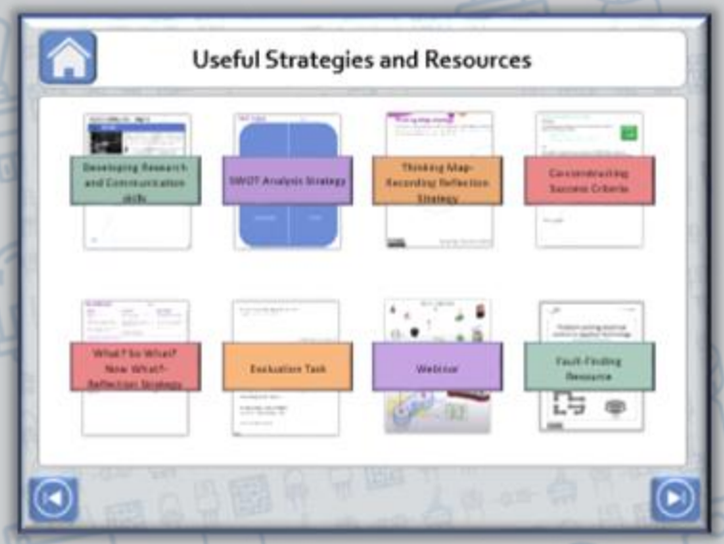
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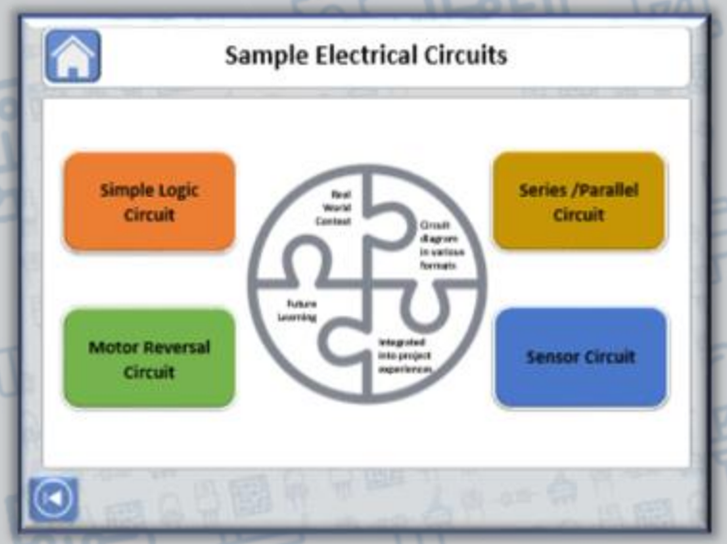
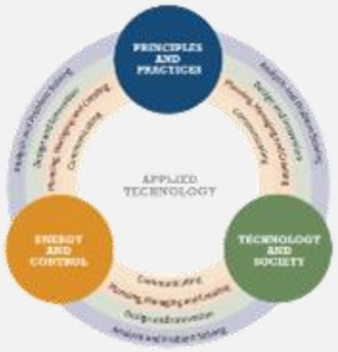
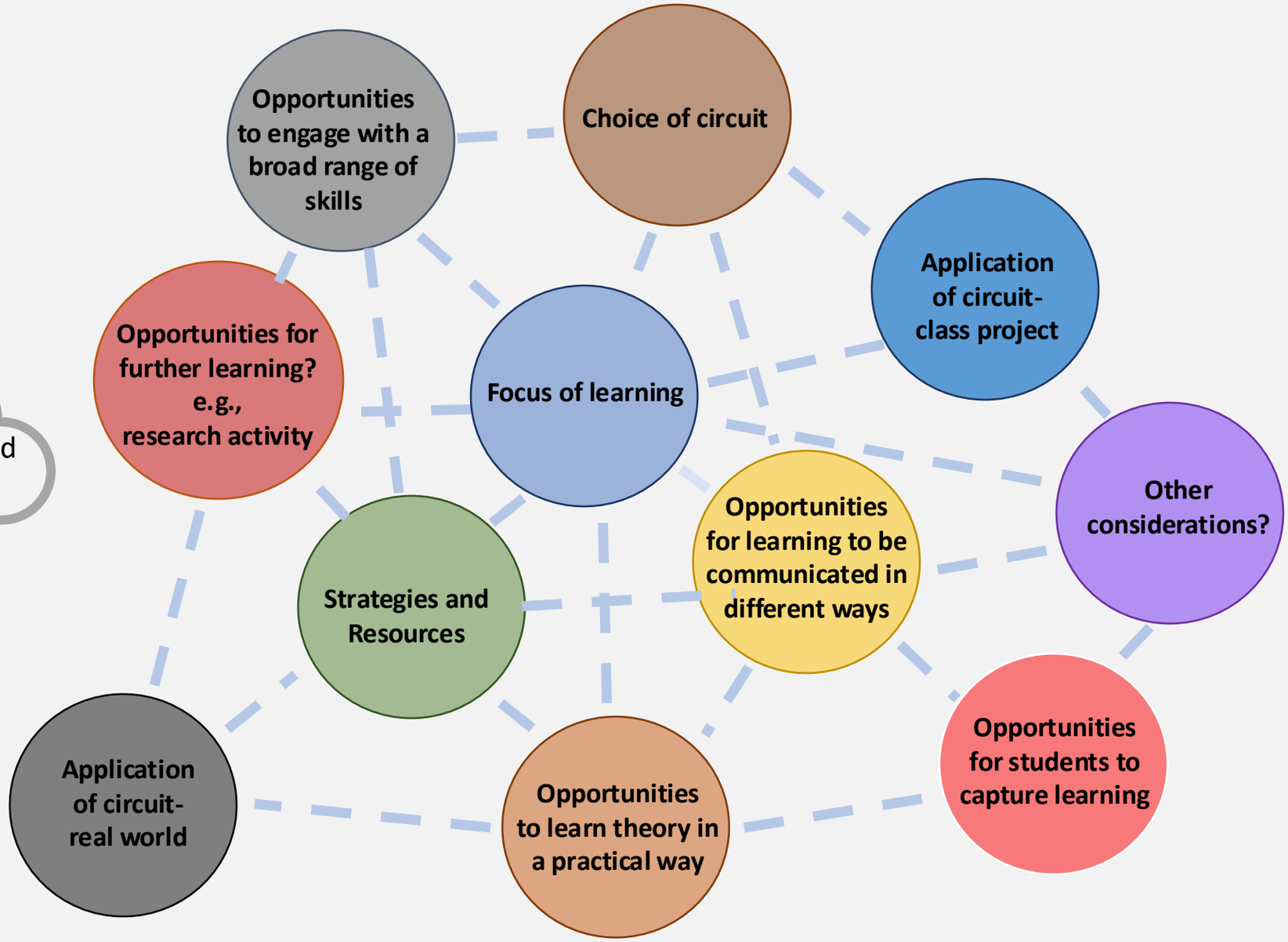

Sample Electrical Circuits
Simple Logic Circuit
Series /Parallel Circuit
Motor Reversal Circuit
Sensor Circuit
Real World Context
Circuit diagram in various formats
Integrated into project experiences
Future Learning

What can an integrated learning experience look like in Applied Technology?

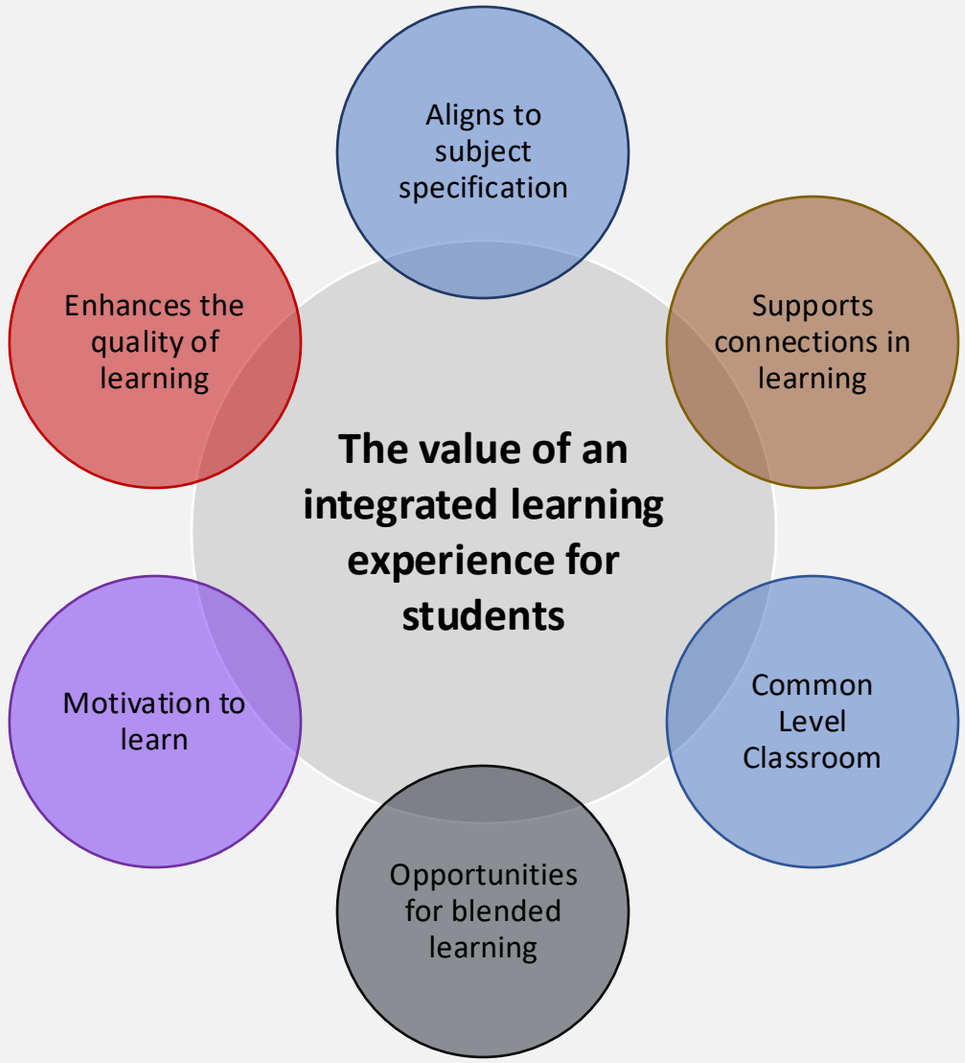
Let's consider this question in the context of Electrical Control





Why plan for integrated learning experiences for students?

Placing students at the centre of learning



Planning for integrated learning experiences in the context of Electrical Control

Please consider the following prompts when choosing an appropriate circuit for student learning.

Prior Learning:
What knowledge, understanding, skills and values have your students developed so far?

Learning Outcomes:
What learning outcomes could students engage with through this circuit?
How does your chosen circuit address the key learning identified? E.g., specific components, electrical concepts.
What opportunities are there to engage your students in learning across the three strands and the four elements?

Learner Activities:
How could your students experience the learning? Soldering a circuit, using circuit simulation, applied as part of a unit of learning?
Through your circuit, what opportunities do your students have to demonstrate learning in a creative way?
What opportunities have students to make connections in learning to real-word contexts?
What opportunities have students to engage in more challenging tasks? E.g., conduct a research activity

Strategies/Methodologies:
How can your students learn electrical concepts and principles? through a practical experience, groupwork, research activity.
How can this resource be used as part of a 'Flipped Classroom' strategy towards learning? E.g., using this resource, is there a homework activity that students could engage with prior to the start of the next class?
How will you know that students are learning? How will you support students as they learn?

Resources:
Do I have access to the electrical components needed to complete the circuit?
Where can I commercially source electrical components?
Who can I collaborate with colleagues when planning for learning in electrical control?

Feedback to move learning forward:
How will a student receive feedback in relation to what they are learning? Teacher/student, peer to peer
How can students record the feedback they receive in a sustainable way?
How can students be encouraged to act on feedback that they receive in class?

Planning for integrated learning experiences in the context of Electrical Control

Department Planning and Preparation

Prior Knowledge

What prior learning might students have developed?

Learning Outcomes

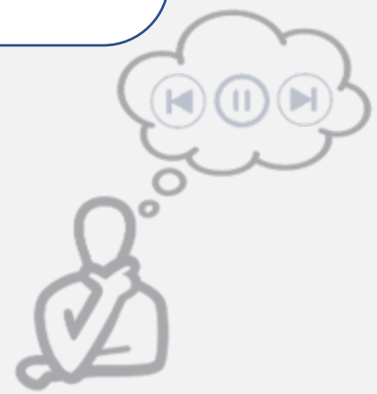
What learning outcomes from the three contextual strands can be brought together for this unit?
What key learning will students experience?

How might knowledge and skills be **incrementally** developed over three years of Junior Cycle?

Individual Teacher Planning and Preparation

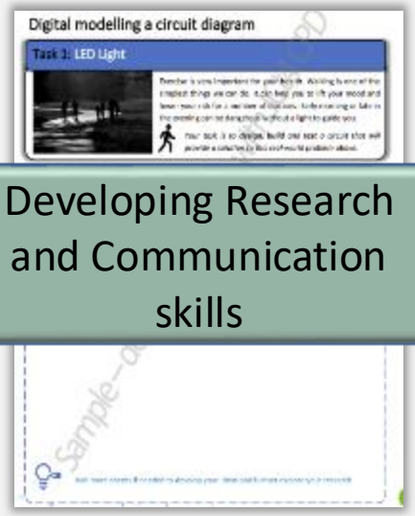
Choice of circuit?

Which circuit will you focus on for students to experience the key learning?



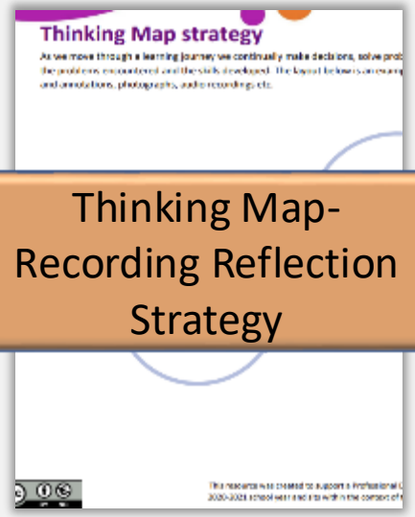
- Learning activities
- Strategies
- Capturing learning
- Assessment and feedback
- Connecting and applying learning opportunities
- Resources

Useful Strategies and Resources

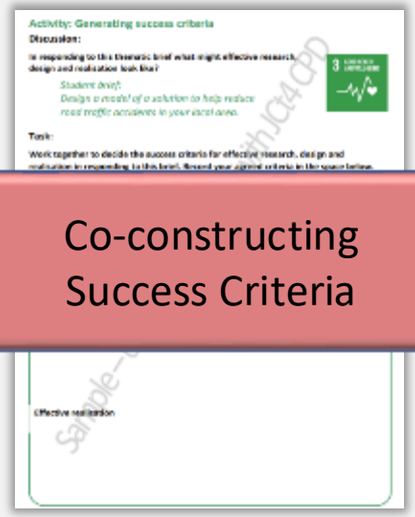


Developing Research and Communication skills

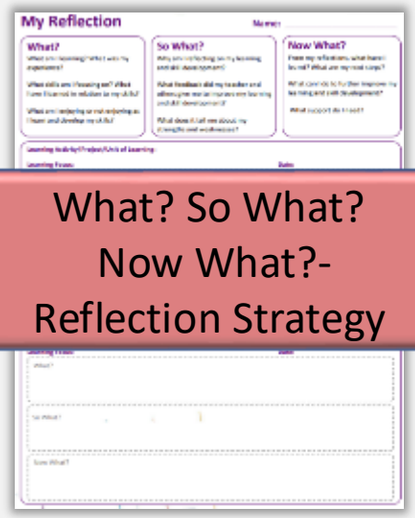
SWOT Analysis Strategy



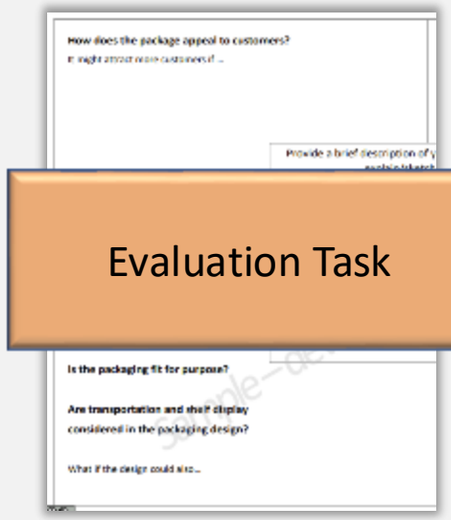
Thinking Map- Recording Reflection Strategy



Co-constructing Success Criteria

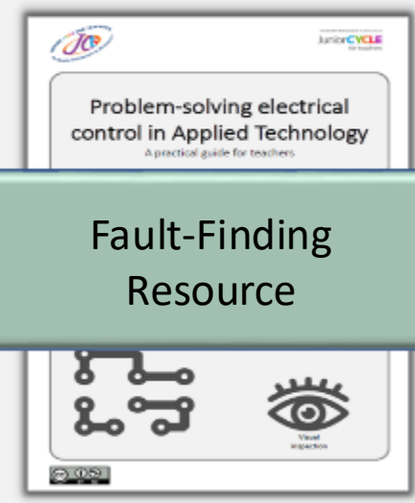


What? So What? Now What?- Reflection Strategy



Evaluation Task

Webinar

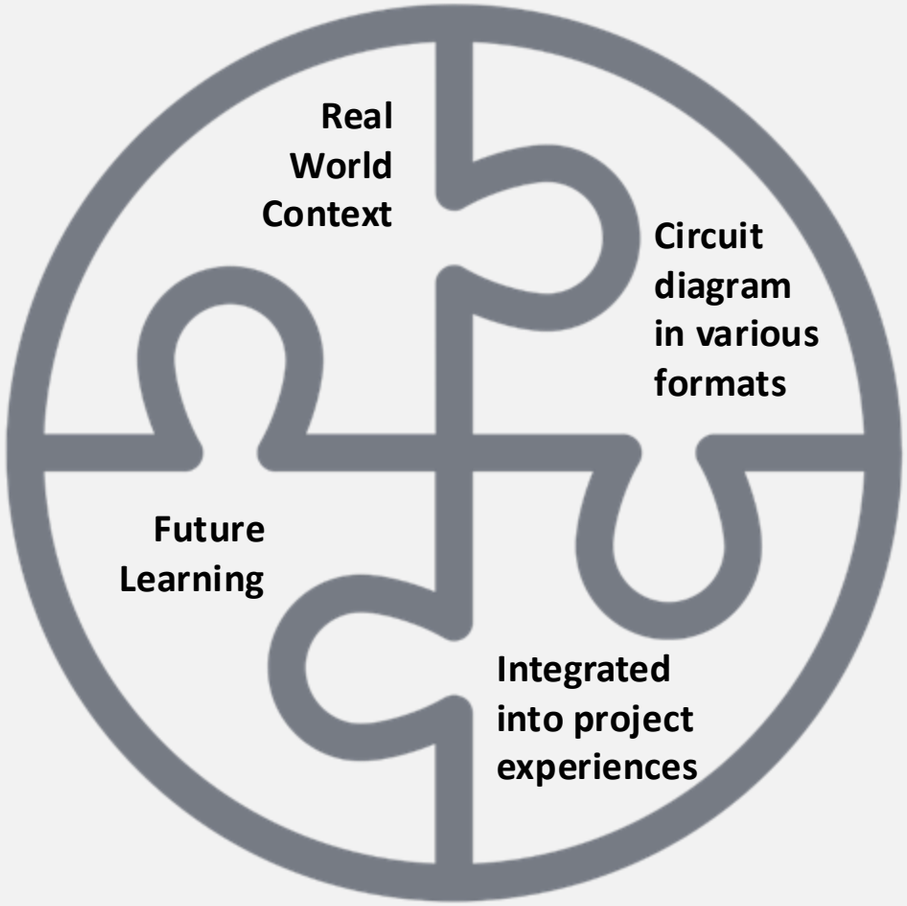


Fault-Finding Resource

Sample Electrical Circuits

Simple Logic Circuit

Series /Parallel Circuit



Motor Reversal Circuit

Sensor Circuit

Simple Logic Circuit

Function

This circuit demonstrates the AND Gate function.

Switch 1 and 2 must be closed for the motor to rotate

Components

1 x Battery snap connection

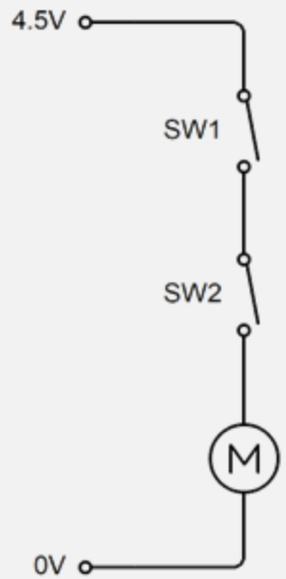
2 x Toggle switches

1 x 6/9V motor

Operation

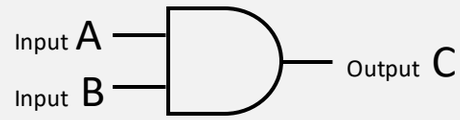
With switch 1 and switch 2 open there is no path for the current to flow from the top (positive) rail to the bottom (negative) rail, so motor is stopped.

If switch 1 is pressed, there is still no path from positive to negative rail, so the motor remains stationary.
If both switches are pressed, then a path is provided for the current to flow through from the positive to the negative rail through the motor. The motor will then rotate.



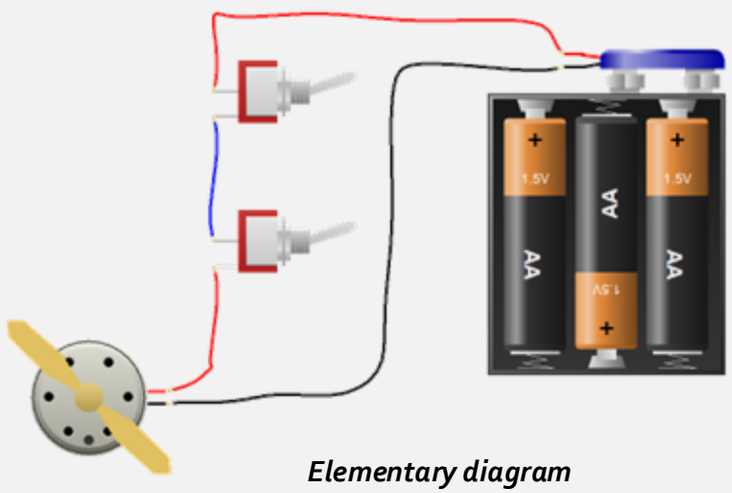
Circuit diagram

2 Input AND gate



A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

Truth Table



Elementary diagram

Logic Circuit | Real world Applications | Classroom Application | Circuit Diagram GIF | Opportunities for Further Learning

Simple Logic Circuit

How could a simple logic circuit be applied in these real world examples?

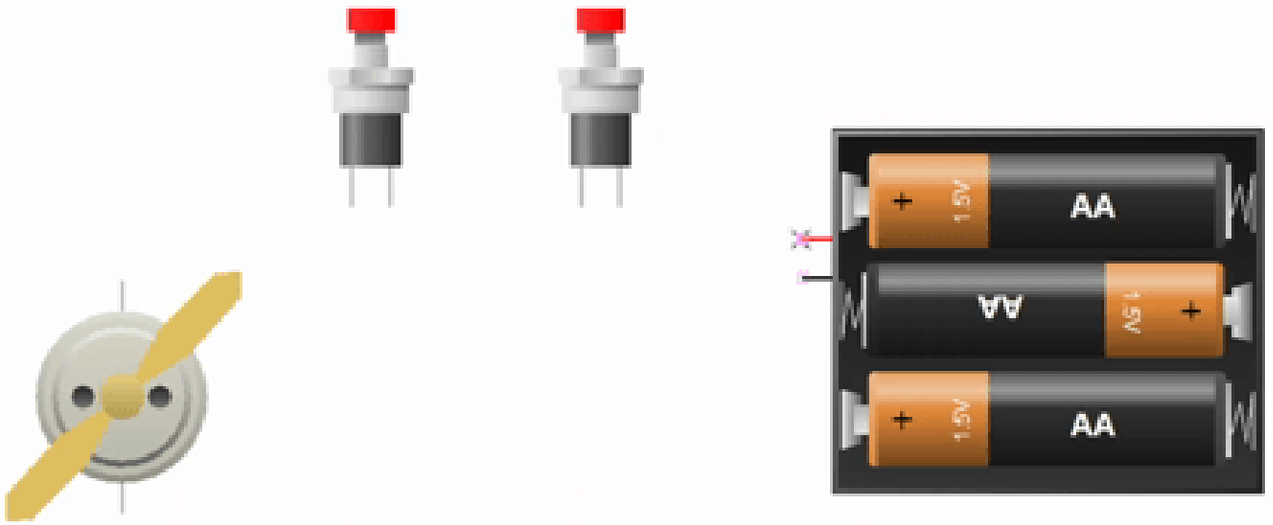
Logic Circuit | Real world Applications | Classroom Application | Circuit Diagram GIF | Opportunities for Further Learning

Simple Logic Circuit

The drill guard must be closed
AND
the power button must be
activated for the pillar drill to operate.

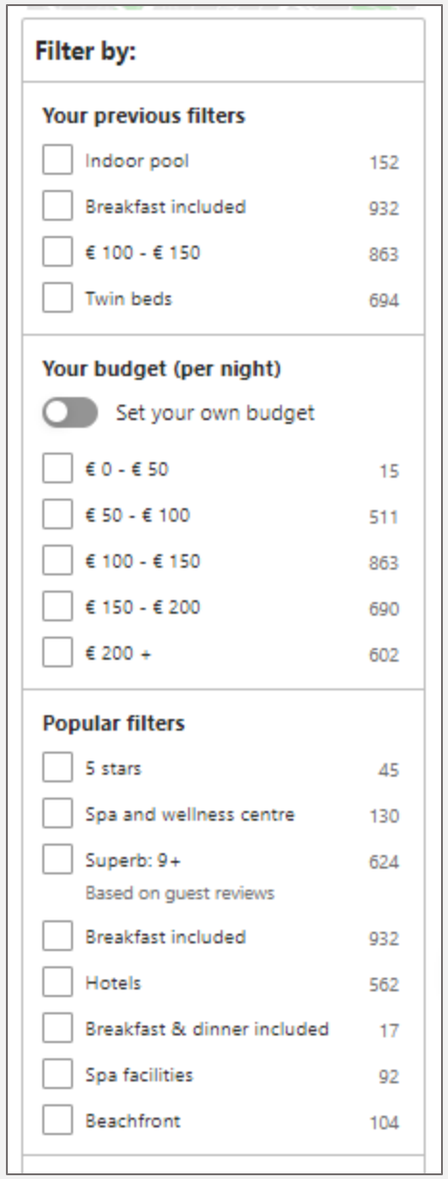
Logic Circuit | Real world Applications | Classroom Application | Circuit Diagram GIF | Opportunities for Further Learning

Simple Logic Circuit



Logic Circuit | Real world Applications | Classroom Application | Circuit Diagram GIF | Opportunities for Further Learning

Opportunities for Further Learning



When searching for a hotel room online, a consumer can refine a search by using filters.

Discuss how **logic** can be used when filtering a search for goods or services online.

Logic Circuit | Real world Applications | Classroom Application | Circuit Diagram GIF | Opportunities for Further Learning

Series / Parallel Circuit

Function

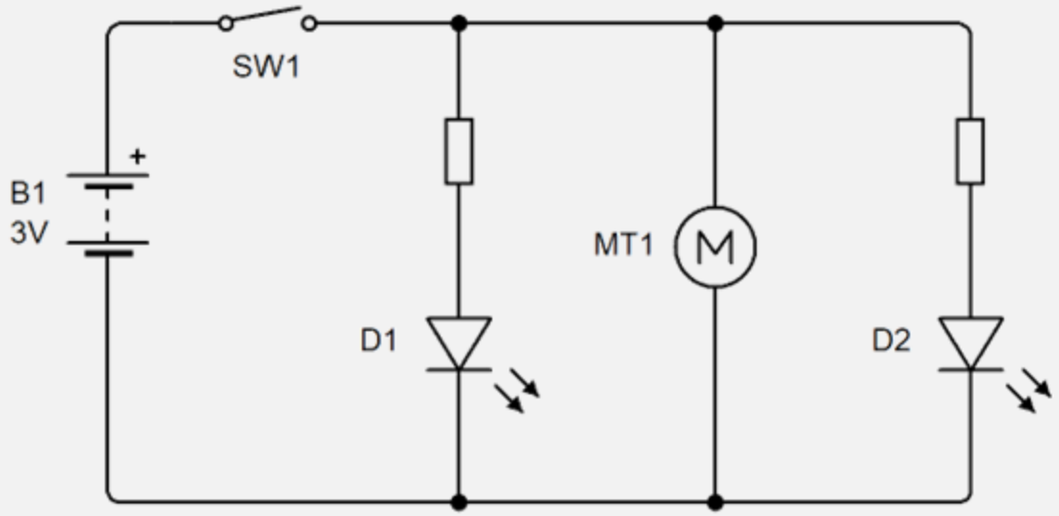
This circuit demonstrates the operation of a parallel circuit using LEDs and a motor.

Components

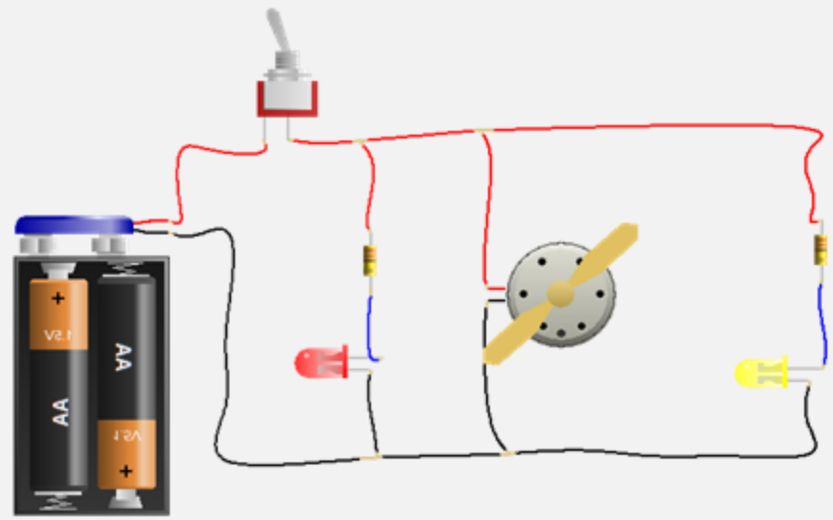
1 x Battery snap connection
1 x SPST switch
1 x 3V motor
2 x 330 ohm resistor
1 x Standard 5mm Red LED
1 x Ultrabright white 5mm LED

Operation

Once the circuit is activated, the motor turns and both LEDs light. The use of different coloured LEDs could be used depending on the application of the circuit. For example, the ultrabright LED could simulate the front light of a car and the red LED could simulate the rear light of a car.
Note: Protective resistors should be used if the voltage supply is increased.



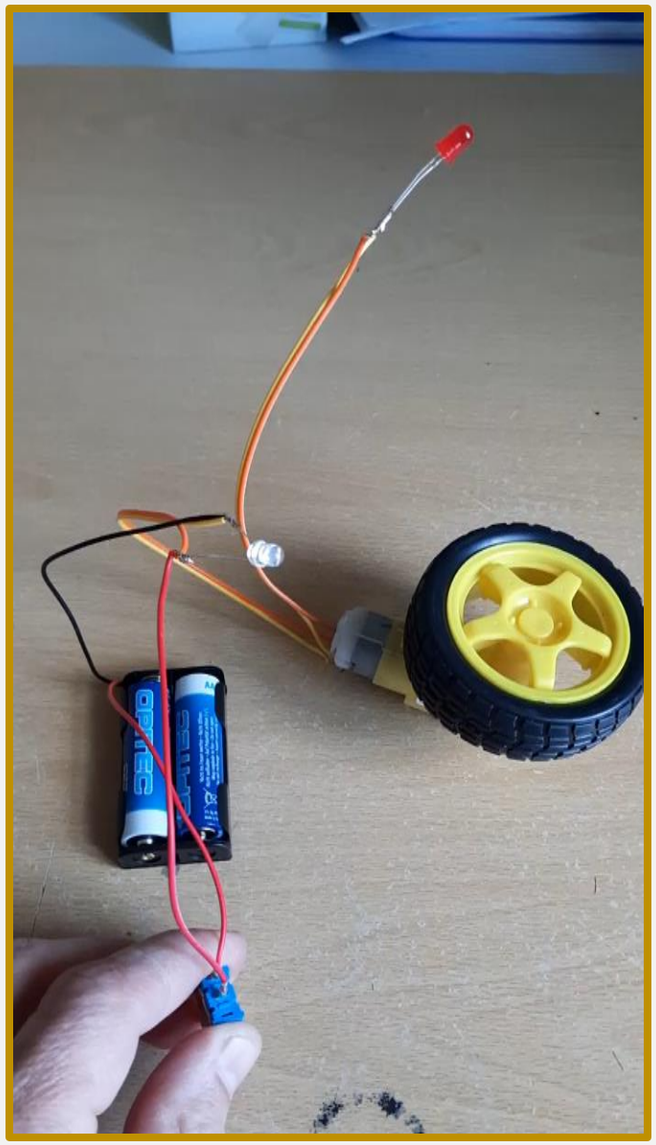
Circuit diagram



Elementary diagram

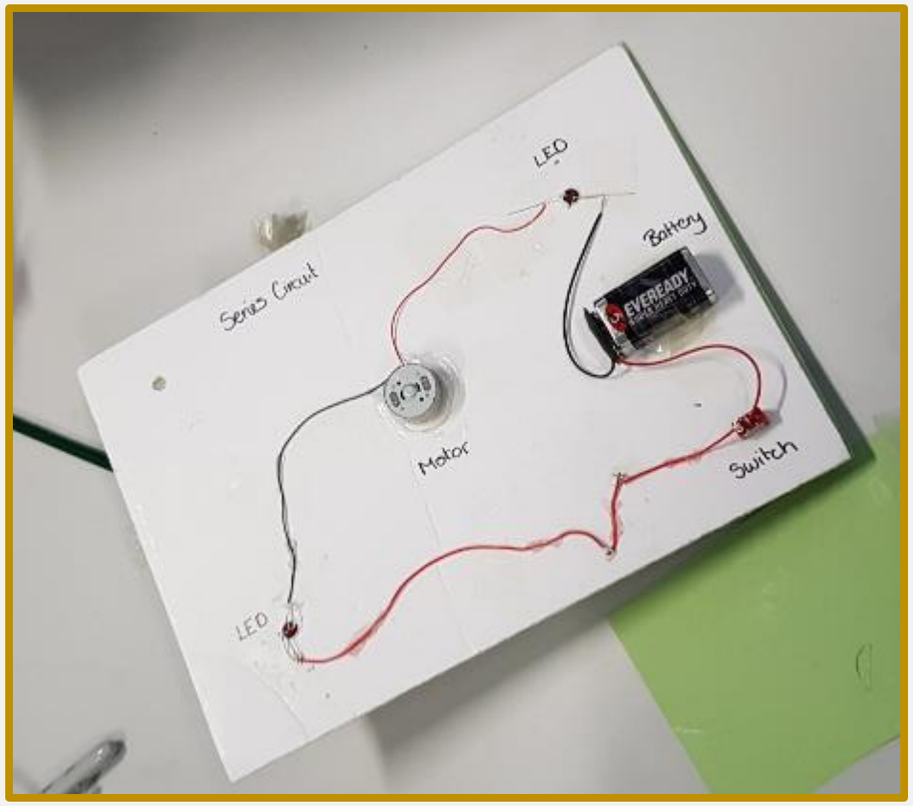
Series/Parallel Circuit | Circuit Application | Project Application | Circuit Diagram GIF | Opportunities for Further Learning

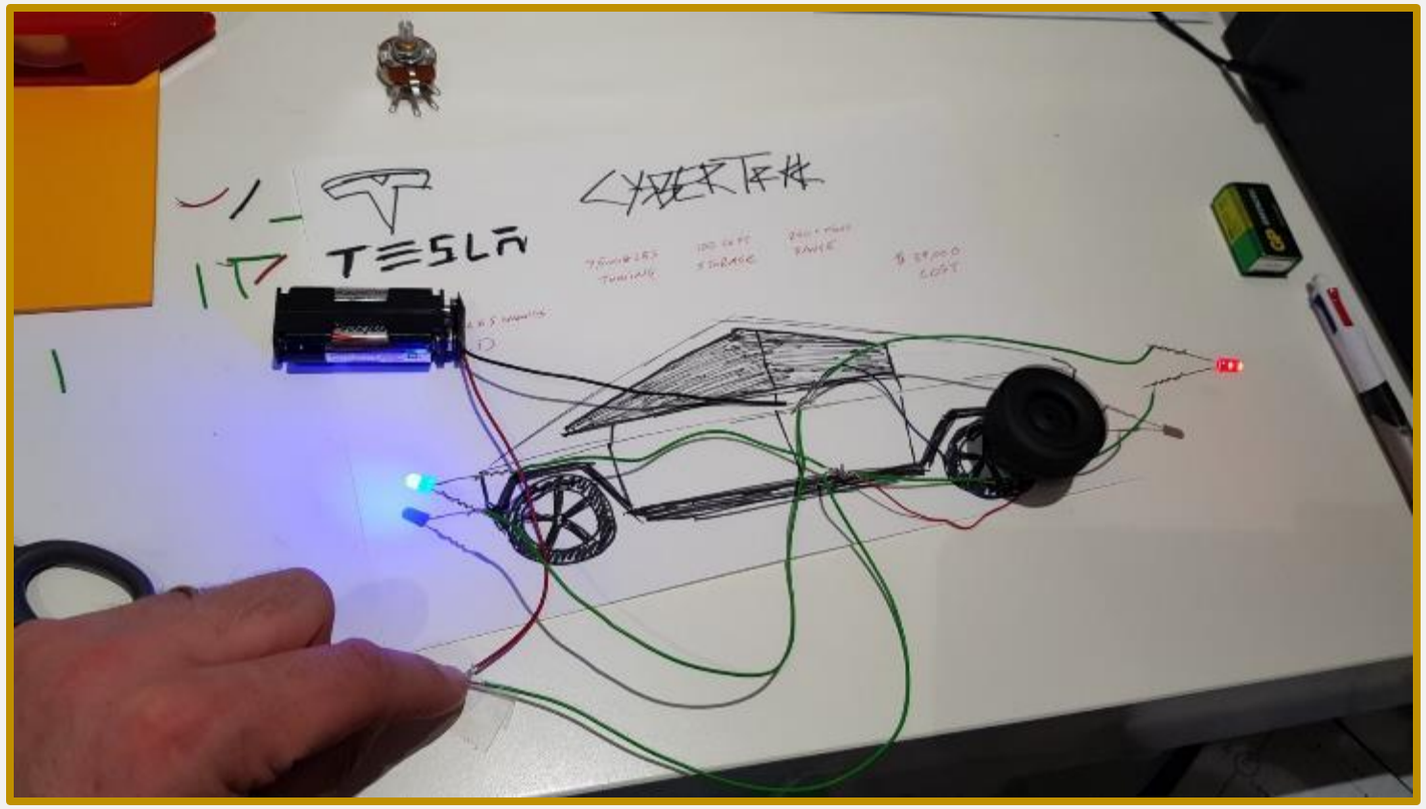
Series / Parallel Circuit



Series/Parallel Circuit | Circuit Application | Project Application | Circuit Diagram GIF | Opportunities for Further Learning

Series / Parallel Circuit



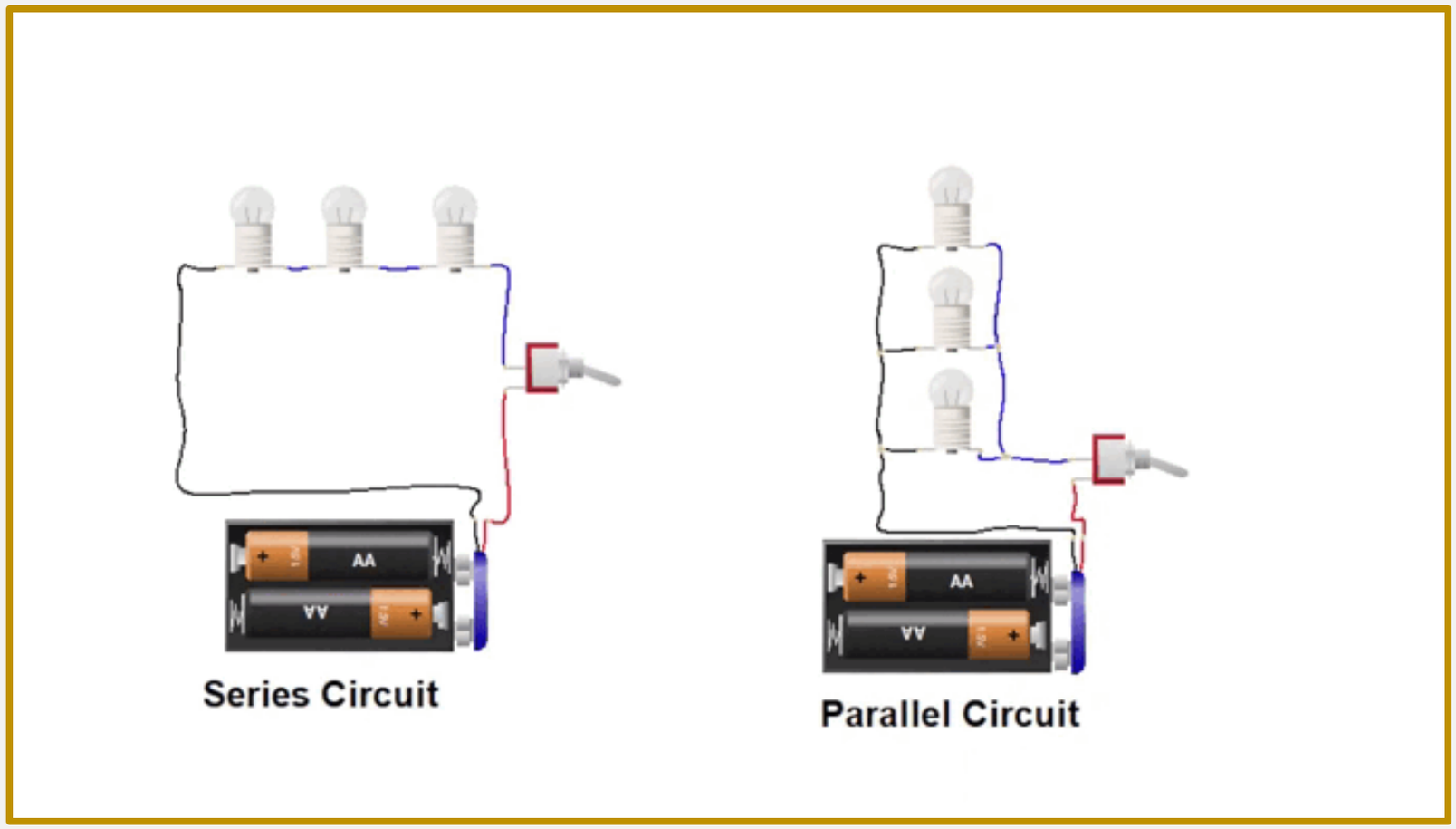


Series/Parallel Circuit | Circuit Application | Project Application | Circuit Diagram GIF | Opportunities for Further Learning

Series / Parallel Circuit

Watch the video below of both circuits.

- What do you notice about the levels of light in both circuits?
- Can you explain what is happening?



Series/Parallel Circuit | Circuit Application | Project Application | Circuit Diagram GIF | Opportunities for Further Learning

Group Opportunities for Further Learning

Watch the video and consider the following:

- How does a wind turbine circuit operate compared to a simple motor circuit powered by a battery?
- Consider the benefits and challenges of creating wind turbine farms in Ireland.

Series/Parallel Circuit | Circuit Application | Project Application | Circuit Diagram GIF | Opportunities for Further Learning

Motor Reversal Circuit

Function

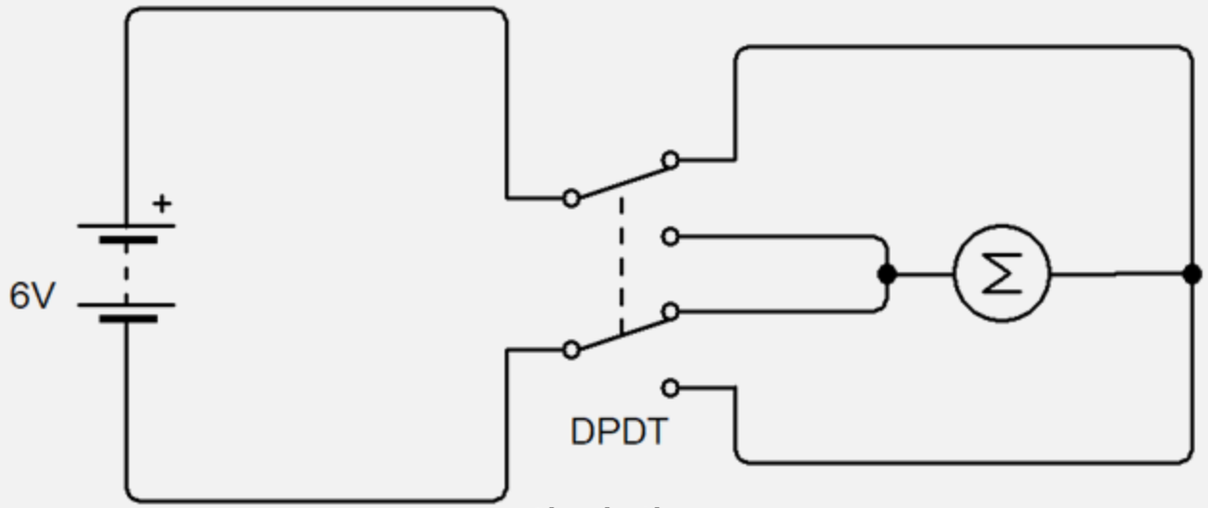
This circuit demonstrates the forward and reverse direction of a motor using a DPDT switch.

Components

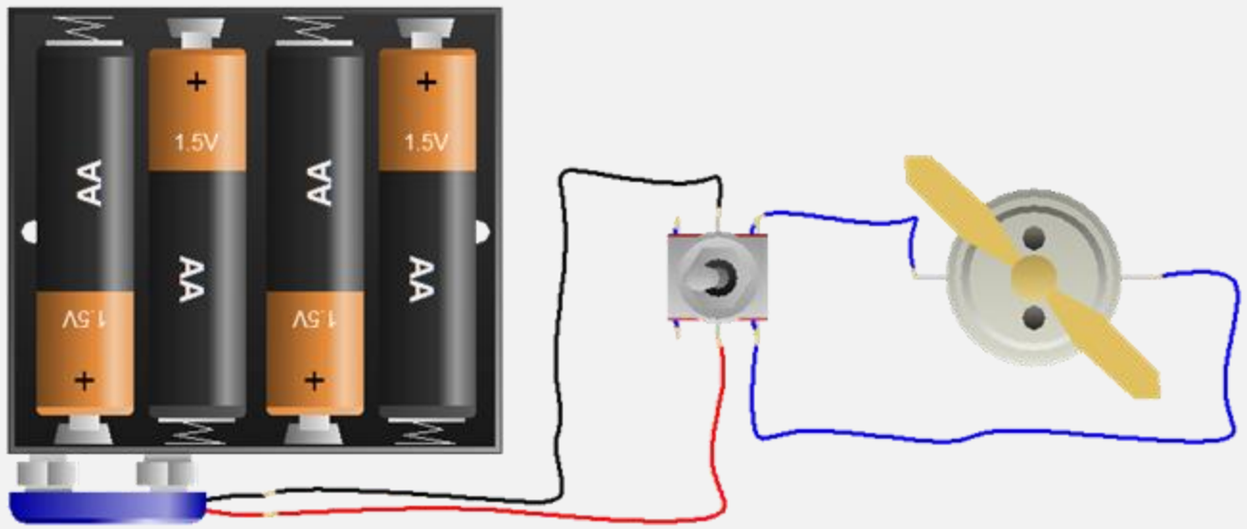
1 x Battery snap connection
1 x DPDT switch
1 x 6/9V DC motor

Operation

Once the circuit is activated, the direction of the motor is controlled by the DPDT switch.



Circuit diagram



Elementary diagram

Simple Motor Reversal Circuit | Real World Application | Elementary Circuit GIF | Circuit Diagram GIF | Opportunities for Further Learning

Motor Reversal Circuit

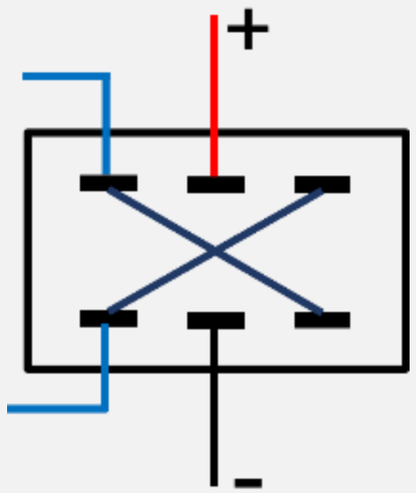
Where else could a motor reversal circuit be used in everyday life?

Roller door automation

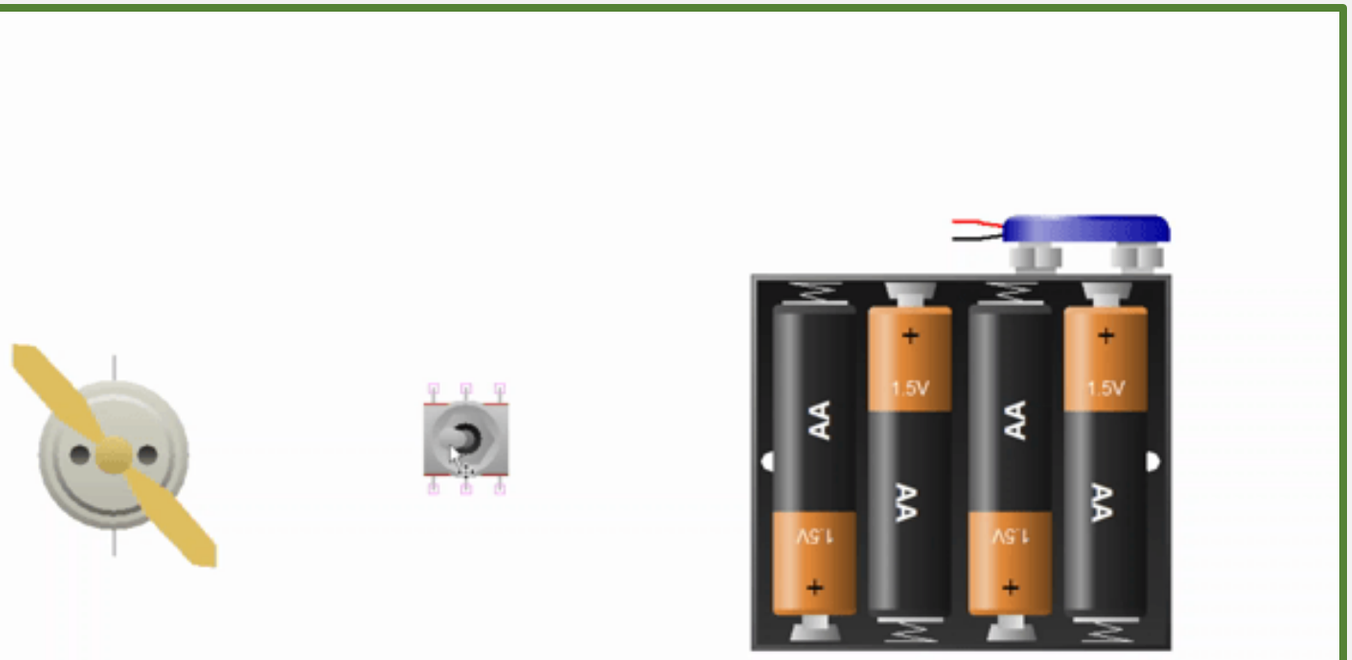
Adjustable office desk

Simple Motor Reversal Circuit | Real World Application | Elementary Circuit GIF | Circuit Diagram GIF | Opportunities for Further Learning

Motor Reversal Circuit

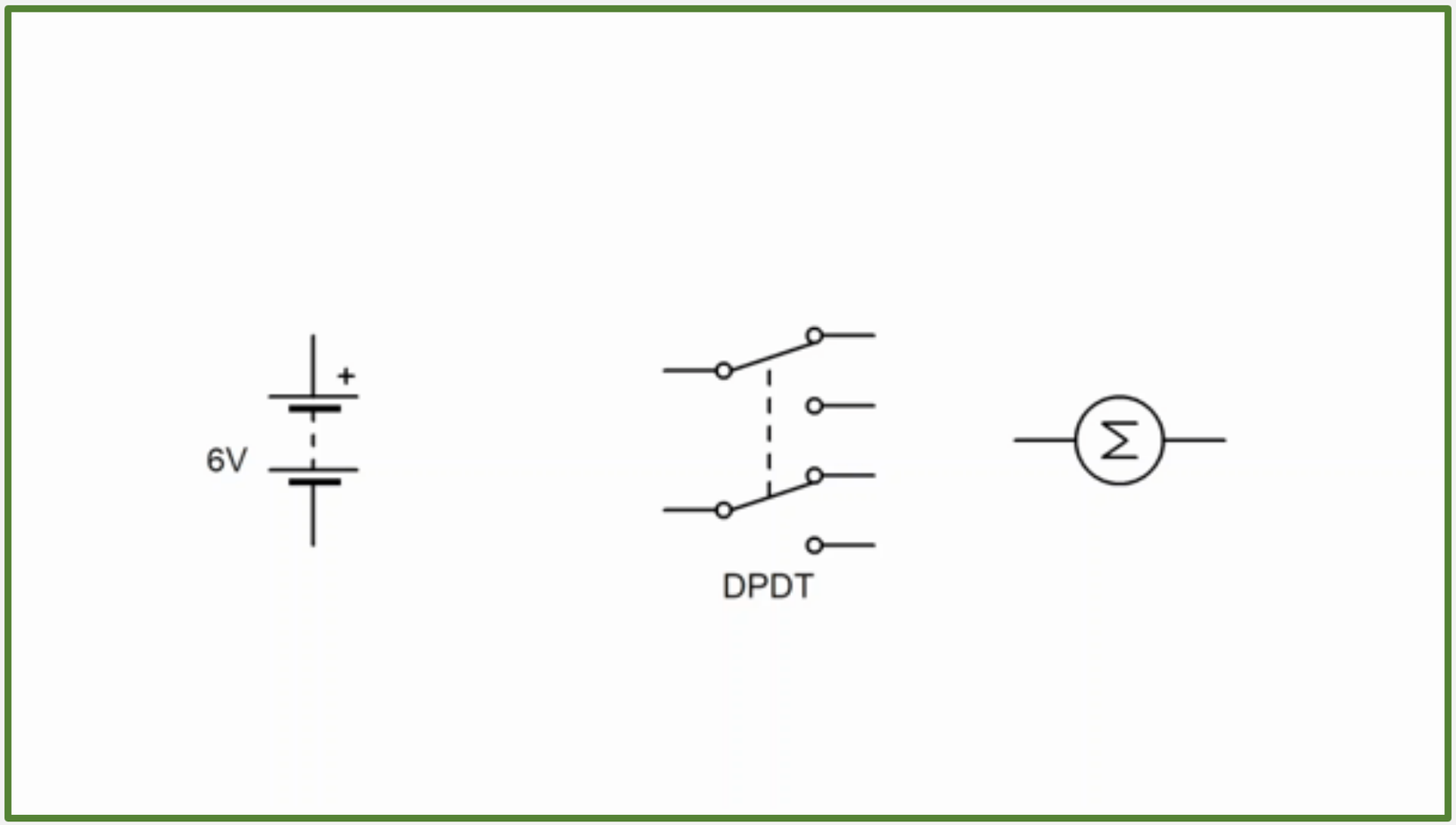


Wiring diagram for
DPDT switch



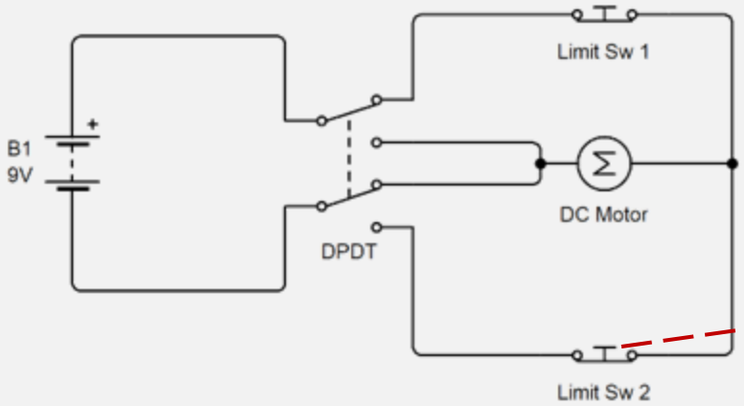
Simple Motor Reversal Circuit | Real World Applications | Elementary Circuit GIF | Circuit Diagram GIF | Opportunities for Further Learning

Motor Reversal Circuit

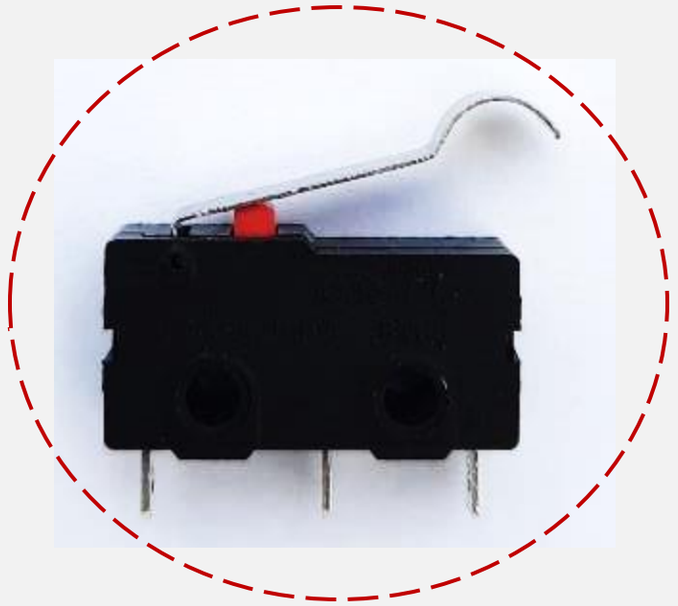


Simple Motor Reversal Circuit | Real World Applications | Elementary Circuit GIF | Circuit Diagram GIF | Opportunities for Further Learning

Opportunities for Further Learning



Motor reversal circuit incorporating limit switches



The image shows a lever microswitch (limit switch).
Investigate this component in further detail using the prompts below.

Through **primary research** I learned that…..

1._____

2._____

Through **secondary research** I learned that…

1._____

2._____

Simple Motor Reversal Circuit | Real World Applications | Elementary Circuit GIF | Circuit Diagram GIF | Opportunities for Further Learning

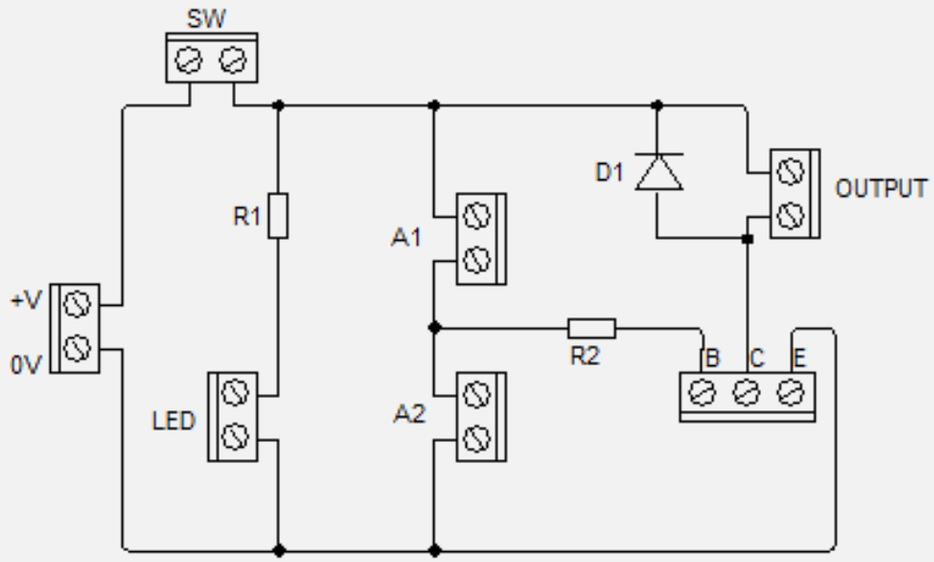
Sensor Circuit Board

Function

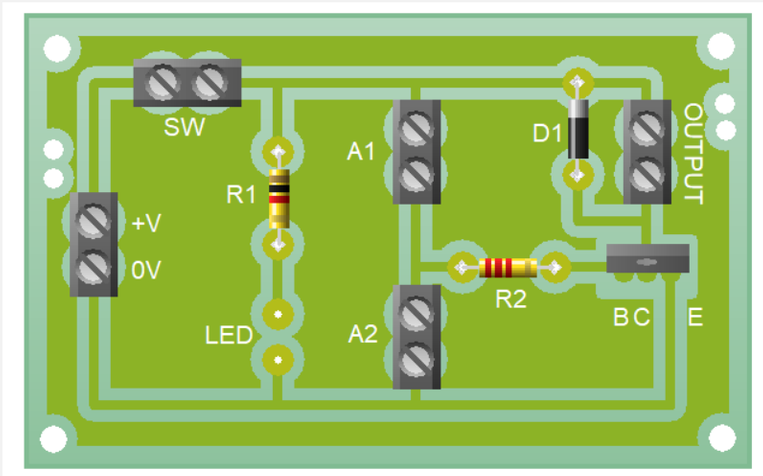
This circuit layout is common to many senor-based circuits. Depending on where the components are placed, many useful circuits can be create that use sensors to activate outputs.

	Components
+V 0V	Power supply
SW	Master on/off switch
R1	470 ohm resistor (to protect the power-on LED)
LED	Light Emitting Diode
A1	Variable Resistor/Sensor
A2	Sensor/Variable resistor
R2	Resistor (to protect transistor)
B	Base leg of Transistor (BC108, TIP121, etc.)
C	Collector leg of Transistor
E	Emitter leg of Transistor
D1	Diode
OUTPUT	

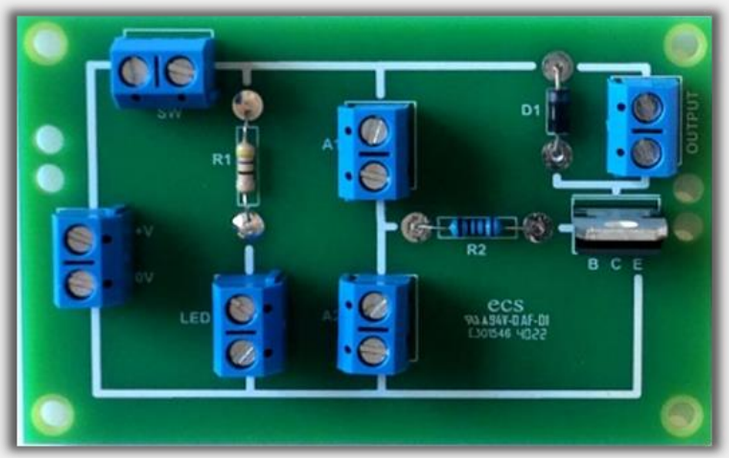
** Sensors- LDR, Thermistor, moisture probes, etc.*
** Output device- LED, motor, buzzer, etc.*



Circuit diagram



Elementary circuit layout



Printed Circuit Board (PCB) layout

Sensor Circuit Board | **Light Sensor Circuit** | **Temperature Sensor Circuit** | **Moisture Sensor Circuit** | **Opportunities for Further Learning**

Light Sensor Circuit

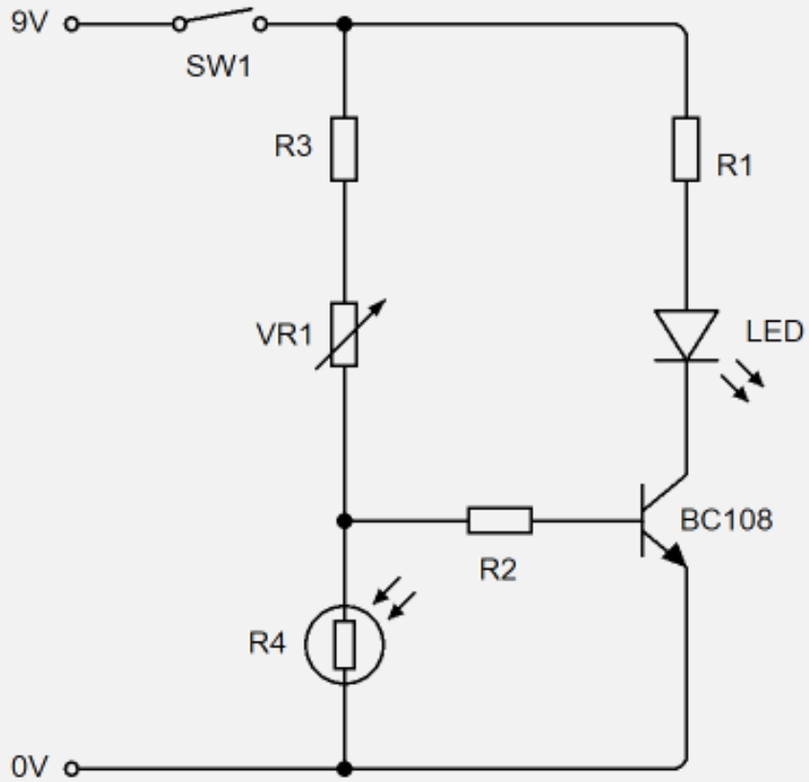
Function

In dark conditions the LED will light. In bright conditions the LED is switched off. The sensitivity at which the LED lights can be adjusted using the variable resistor.

	Components
R1	470 ohm
R2	2200 ohm
R3	1k ohm
R4	LDR
VR1	1M Variable Resistor
SW1	SPST Switch
BC108	Transistor
LED	5mm Light Emitting Diode

Operation

This circuit uses a transistor (BC108) as an electronic switch. During dark conditions, the resistance of the LDR (R4) is high, activating the transistor. This allows the LED then to light. During bright conditions, the resistance of the LDR is low and acts as a path of least resistance for the current. In this context, the transistor is not activated and the LED does not light.



Circuit diagram

By using a MPSA13 or TIP121 transistor, a motor can be used instead as the output device. These transistors provide a greater current gain necessary to activate a motor.

Did you know?

Sensor Circuit Board | Light Sensor Circuit | Real World Application | Classroom Application | Circuit GIF

Light Sensor Circuit

Automatic night lights

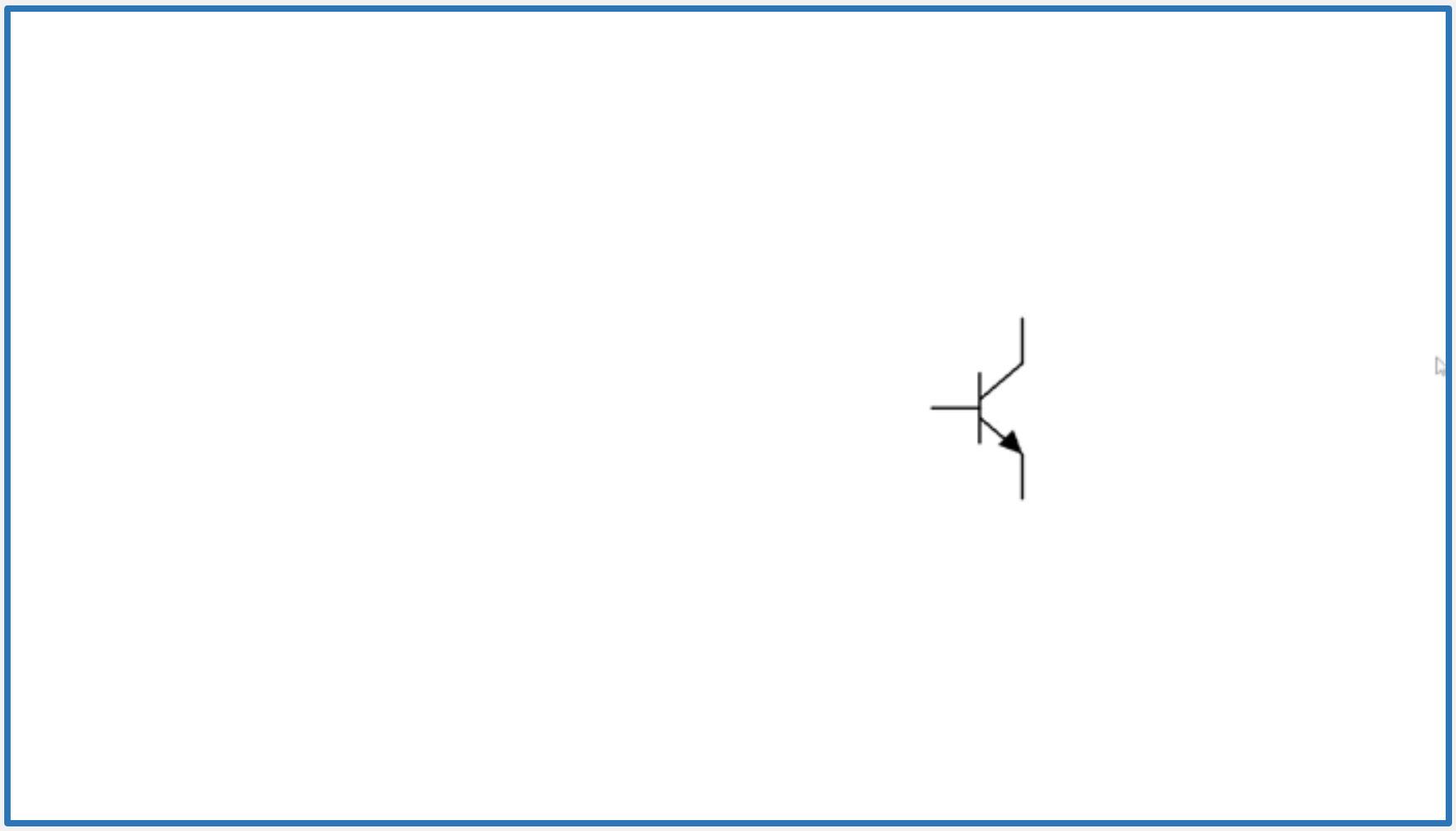
Sensor Circuit Board | Light Sensor Circuit | Real World Application | Classroom Application | Circuit GIF

Light Sensor Circuit

Using the Sensor Circuit Board to operate a Light Sensor Circuit

Sensor Circuit Board | Light Sensor Circuit | Real World Application | Classroom Application | Circuit GIF

Light Sensor Circuit



Sensor Circuit Board | Light Sensor Circuit | Real World Application | Classroom Application | Circuit GIF

Temperature Sensor Circuit

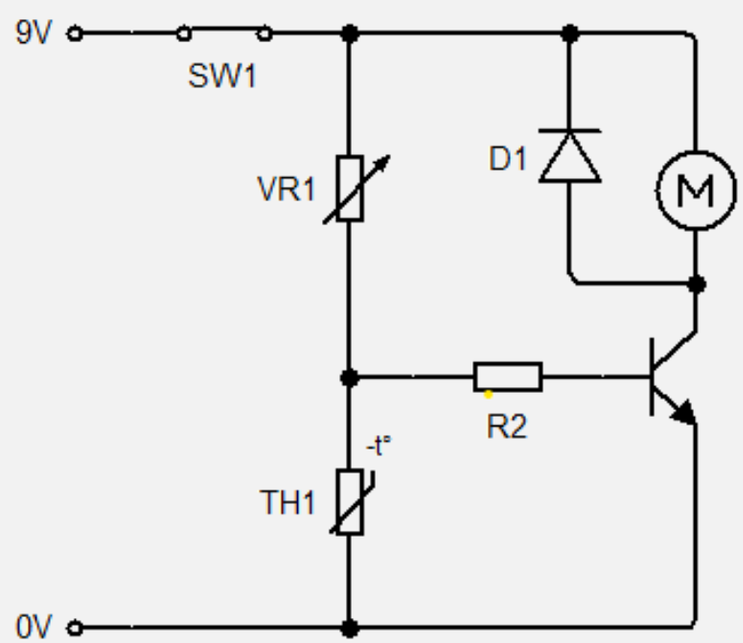
Function

In cold conditions the motor will activate. In hot conditions the motor is switched off. The sensitivity at which the motor activates can be adjusted using the variable resistor

	Components
R1	LDR
R2	2200 ohm
VR1	100k ohm
D1	1N4001 diode
SW1	SPST Switch
Transistor	TIP121 or MPSA13

Operation

This circuit uses a transistor (MPSA13) as an electronic switch. During cold conditions, the resistance of the thermistor is high, activating the transistor. This turns the output on. During hot conditions, the resistance of the thermistor is low and acts as a path of least resistance for the current. In this context, the transistor is not activated and the output does not turn on.



Circuit diagram

Temperature Sensor Circuit

What type of Temperature Sensor Circuit might you used in the everyday items shown below?

					
	Paper Shredder	**Oven**	**Polytunnel**	**Fridge Freezer**	**Solar Tubes**
Heat Sensor Circuit					
Cold Sensor Circuit					
Both Sensor Circuits					

Sensor Circuit Board | Temperature Sensor Circuit | Real World Application | Classroom Application | Circuit GIF

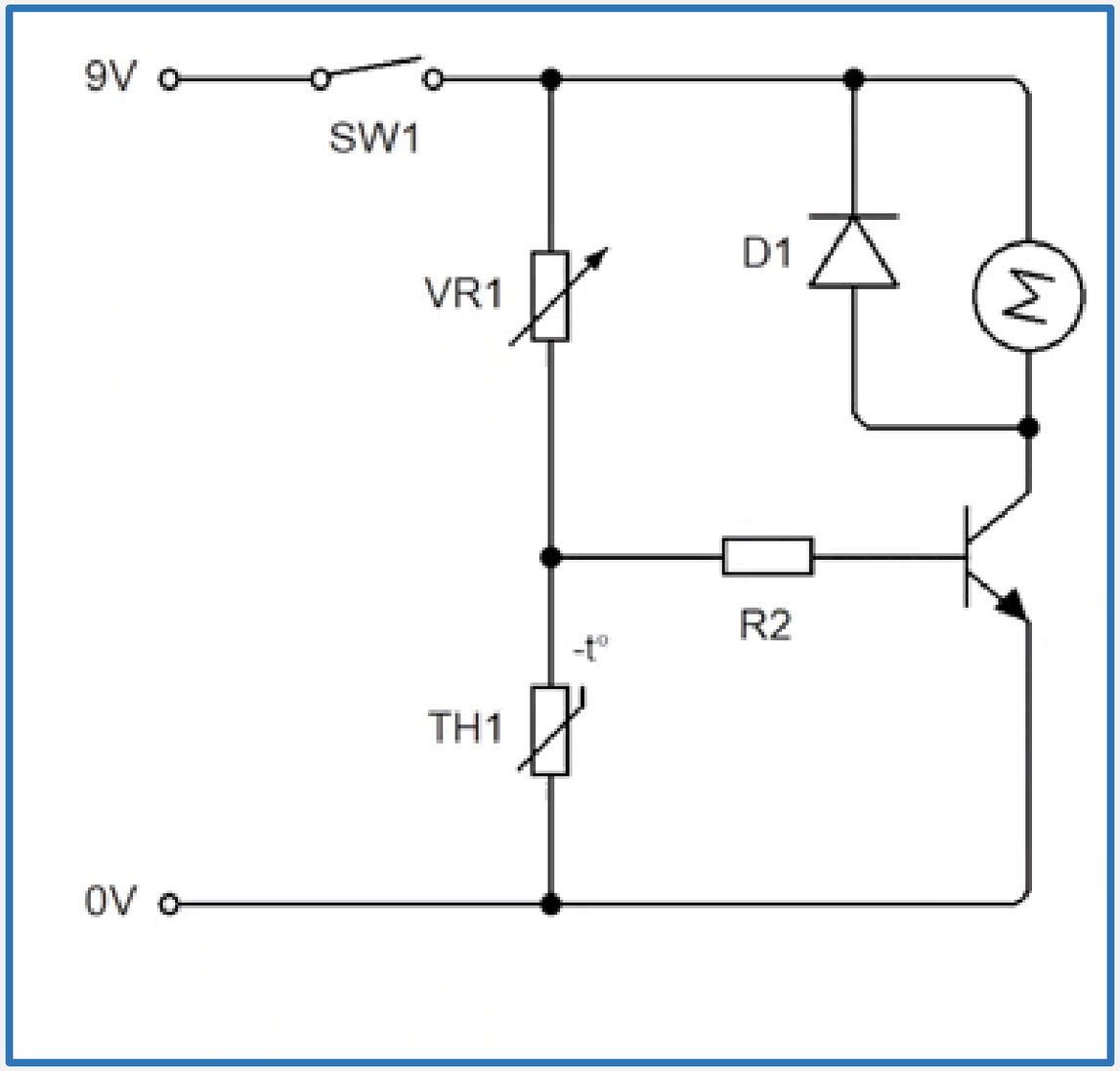
Temperature Sensor Circuit

Using the Sensor Circuit Board to operate a Heat Sensor Circuit

What could a project look like using this circuit?

Temperature Sensor Circuit

Is the motor in this circuit activated using a **heat** sensor or a **cold** sensor?
How do you know?



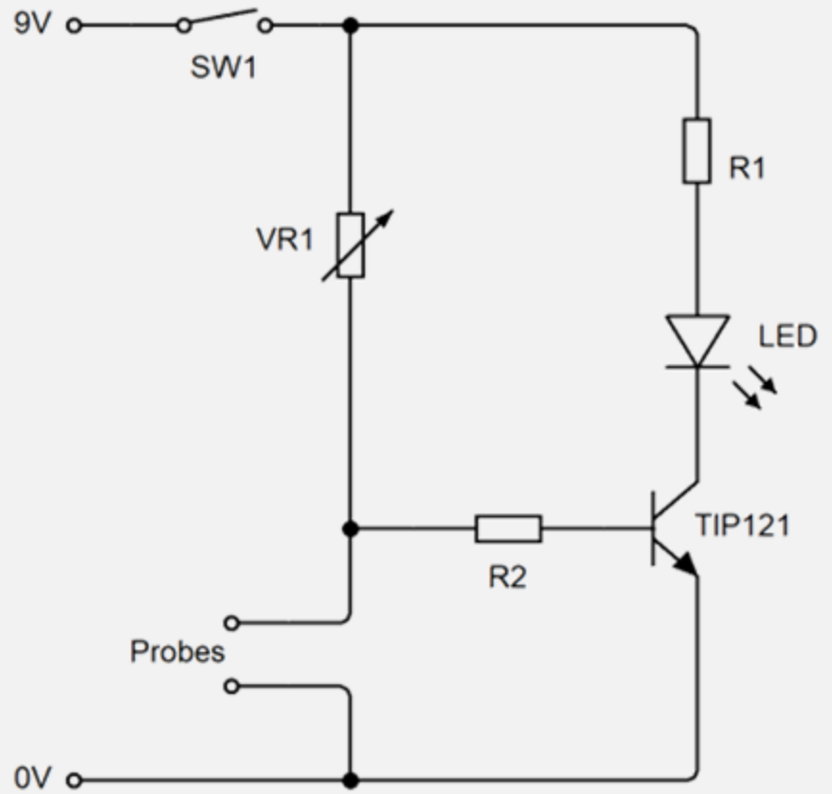
Sensor Circuit Board | Temperature Sensor Circuit | Real World Application | Classroom Application | Circuit GIF

Moisture Sensor Circuit

Function	
The moisture content in soil, for example, could be detected and the LED will light to indicate dry conditions.	
	Components
SW1	SPST Switch
VR1	100k ohm
R1	470 ohm
R2	10k
R3	1k ohm
Transistor	TIP121 or MPSA13
Probes	
LED	5mm Light Emitting Diode

Operation

This circuit uses a transistor as an electronic switch. When the voltage on the base of the transistor is less than 1.2V, the transistor is switched off. No current can flow through the transistor from the collector to the emitter, so no current can flow through R1 and the LED. If more than 1.2V is applied to the base, the transistor switches on, which in turn allows current to flow through the LED activating it.
In dry conditions, the resistance will be extremely high. In damp conditions the resistance will be relatively low.



Circuit diagram

In electronic circuits it is **not good** practice to have components operating at their upper limits so a resistor value of 390 or 470 ohms should be used for R1.
The larger the value of R1 the less current is drawn from the battery. The battery will last longer at the expense of the LED being a little dimmer. If more LEDs are used, R1 value can be reduced.

Did you know?

Sensor Circuit Board | Moisture Sensor Circuit | Real World Application | Classroom Application | Assembly GIF

Moisture Sensor Circuit

Watch the video and consider the following:

- With our changing climate, how could a moisture sensor circuit play a role in the conservation of water?

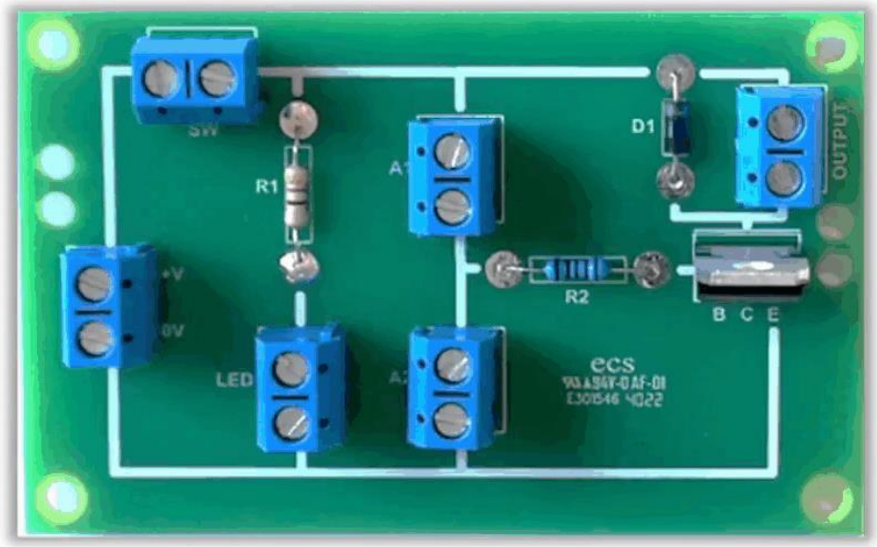
Sensor Circuit Board | Moisture Sensor Circuit | Real World Application | Classroom Application | Assembly GIF

Moisture Sensor Circuit

Using the Sensor Circuit Board to operate a Moisture Sensor Circuit

Sensor Circuit Board | Moisture Sensor Circuit | Real World Application | Classroom Application | Assembly GIF

Moisture Sensor Circuit



Sensor Circuit Board | Moisture Sensor Circuit | Real World Application | Classroom Application | Assembly GIF

Adding a Relay

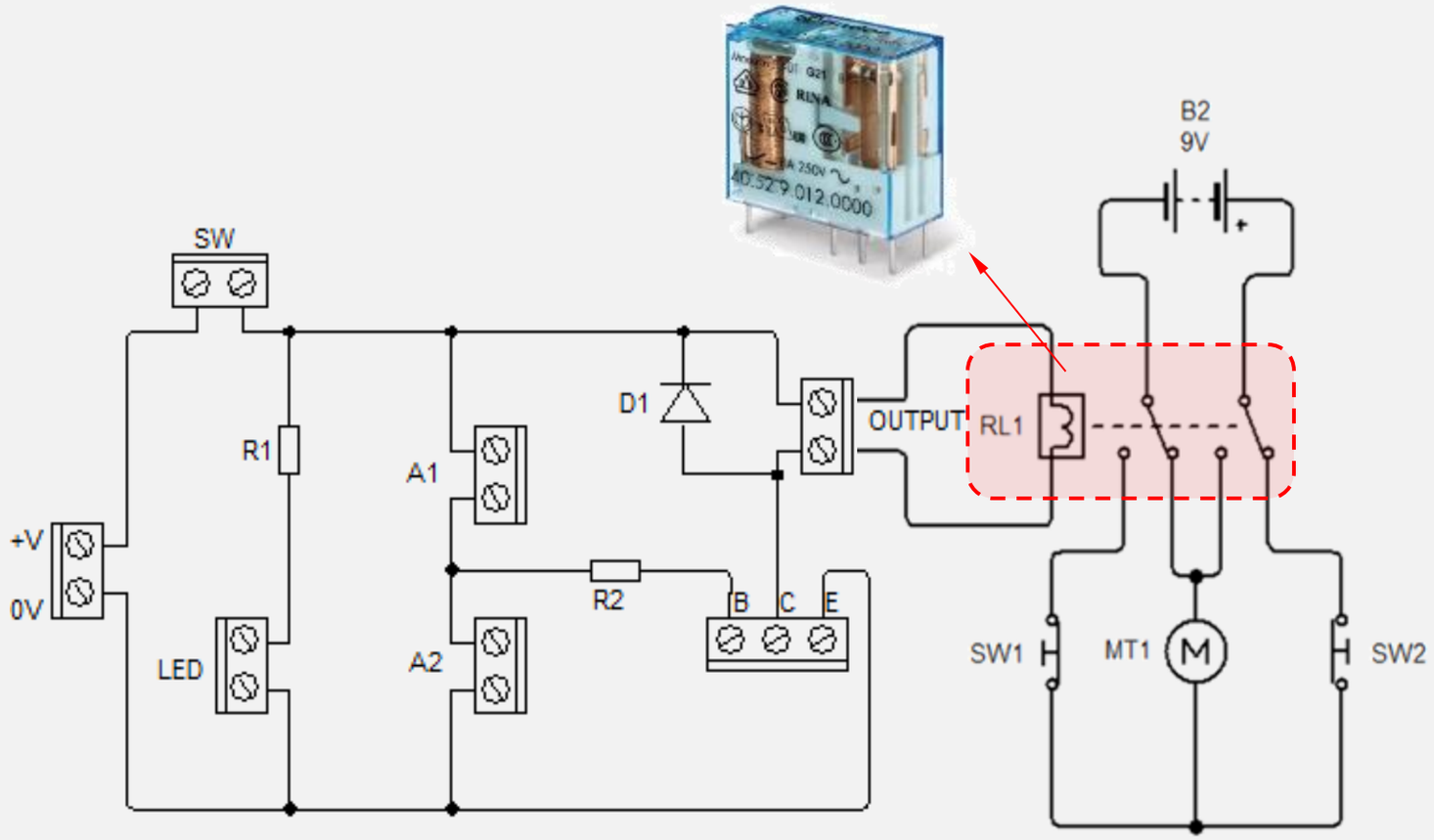
Note:

The sensor circuit board can be modified by inserting a relay switch to allow a secondary circuit to power a motor, pump or other electromagnetic device which requires more voltage than the bc108 transistor can output.

	Relay Circuit Components
RL1	DPDT Relay
B2	Relay Circuit Power Supply
SW1/2	Push to Break Switch or Limit Switch
MT1	DC Motor

Operation

The sensor circuit board is used to control the switching of the DPDT Relay. As the sensor circuit switches the transistor on or off, this in turn controls the DPDT Relay. When the transistor is off the motor will rotate one direction. When the sensor circuit turns the transistor on the DPDT relay attached to the output will tigger and the motor will now rotate in the opposite direction. SW1 & SW2 will act as limit switches and stop the motor rotating.



Circuit Diagram

Design Task

Context:

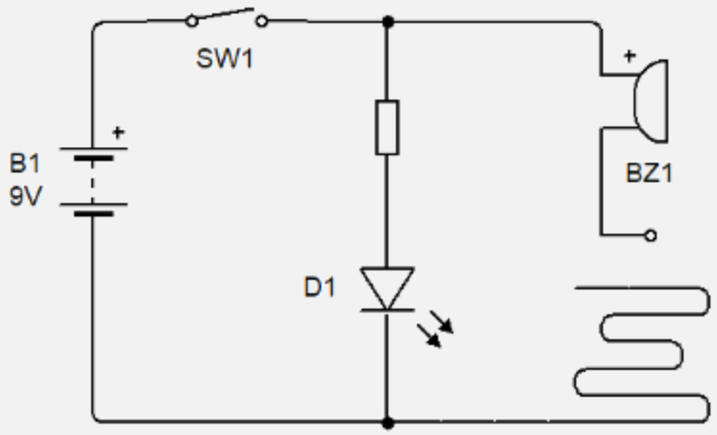
A smart greenhouse uses **sensors to control conditions** for the optimum growth of plants.

Student Challenge

Using your sensor circuit board, create a circuit that automatically activates an output of your choice (motor/LED) to meet the needs of a plant.

Sensor Circuit Board | Adding a Relay | Design Task | Communication and Creativity | Prototyping

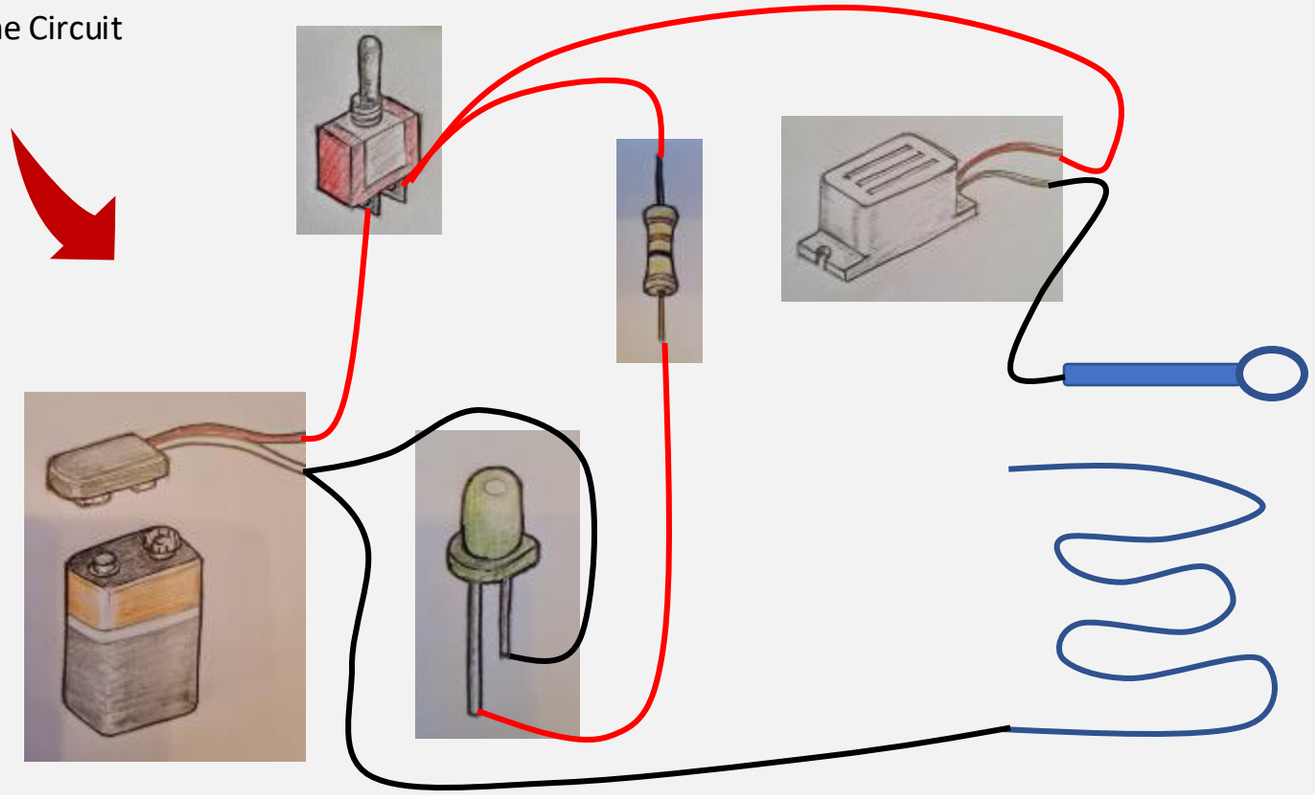
Promoting communication and creativity skills through sketching



Steady Hand Game Circuit

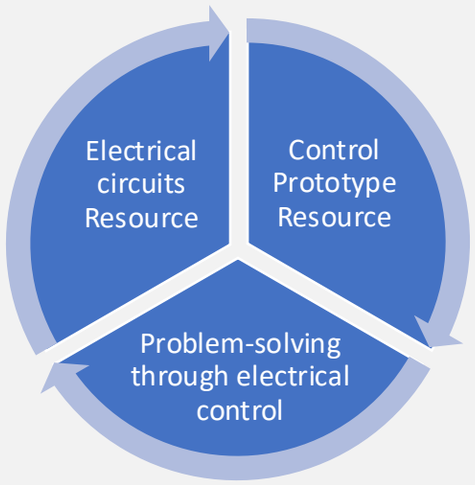
Student Task:

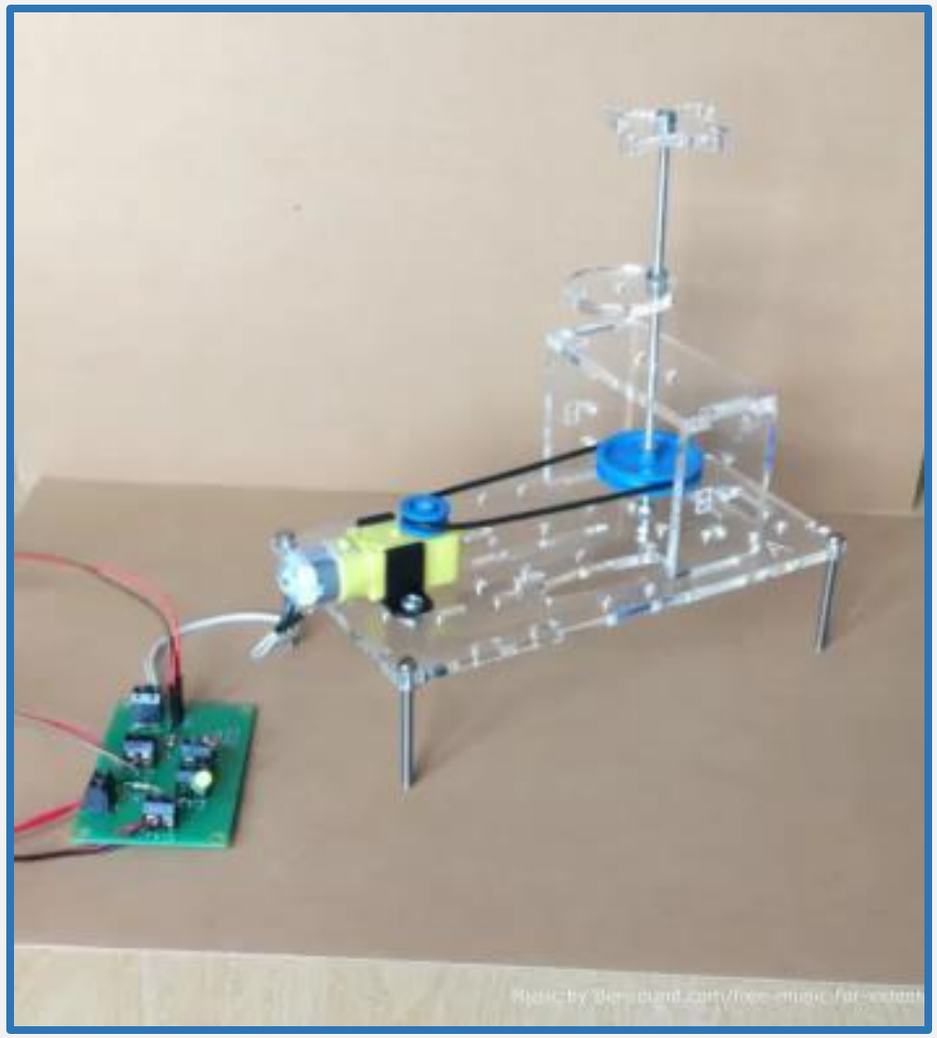
1. **Sketch** a range of electronic components on a page.
2. **Scan** and save the page in digital format.
3. Digitally **crop** each component and save separately.
4. **Create** a circuit of your choice using your scanned components.



Sensor Circuit Board | Adding a Relay | Design Task | Communication and Creativity | Prototyping

Prototyping to support learning





How can prototyping using these resources support students as they learn?

Sensor Circuit Board | Adding a Relay | Design Task | Communication and Creativity | Prototyping