SparkLab, Sciencentre

Maker Space: *Switched on*

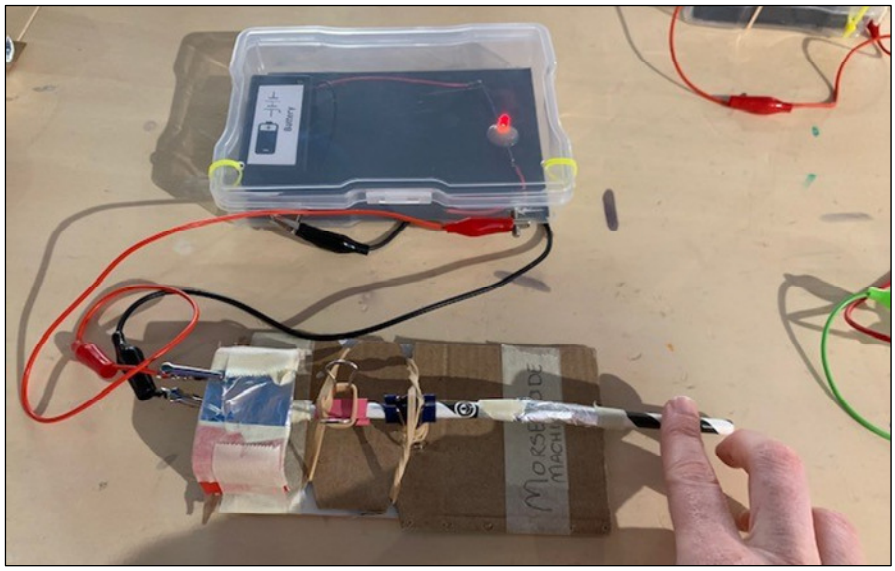
The Challenge

Design a switch to turn on a light. How creative will your switch be?

Use your skills to design and build a switch using wires, batteries and a collection of unusual items. Control the flow of electrical energy as you create different types of switches to turn on and off various lights. What is the purpose of your switch and how will it work? Who are you designing it for and what might be their needs?

Learning Outcomes

- Develop understanding that a complete (unbroken) circuit is required to allow the flow of electricity.
- Increased familiarity with the features of electrical circuits and electrical devices such as switches.
- Explore the properties of different materials and how materials function in a circuit
- Gain skills in manipulating materials to build a functional switch.
- Develop skills with new tools such as alligator clips, pliers and wires.
- Increase participant's understanding and confidence of the design process.
- Develop design skills through a process of thinking of a design solution, making and testing a switch, observing areas of the design that need improvement, posing a new design solution, making a change and observing the impact of that change.
- Enjoy creating a unique switch and watching the lights turn on and off
- Be inspired by the designs of other visitors, and enjoy testing their switches
- Feel and recognise success in implementing creative solutions to real world challenges. Apply this approach in their everyday life.
- Express enjoyment in engaging in the challenge and sharing ideas and understandings.



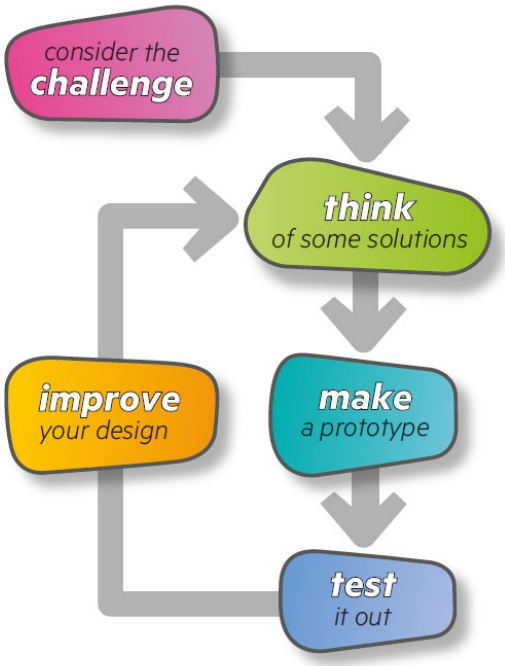
Equipment
Pre-made circuits including:
- 2 x AA batteries
- Battery holder
- Red LED light
- 220 Ohm Resistor
- Alligator clip wires
- A5 square of cardboard
- 2 x 6mm hex bolts
- A5-size clear plastic box
- Hobby wire

Design Materials
- Alfoil
- Paper/cardboard
- Foil tart pans
- Paper clips
- Paper straws
- Plastic cup lids
- Rubber bands
- Bulldog clips
- Masking tape

Optional materials
- Various metallic objects, e.g., keys, tins, tent poles, spoons, metal washers
- Various non-conductive materials, e.g., buttons, foam, plastic clips
- Various mixed-material objects, e.g., pegs, toy cars, battery clips, antenna wires

Set-up steps:
1. Build your -pre-made circuit – see page three for detailed instructions.
2. Design and build your switch!
3. Connect your switch to the circuit using alligator clips or conductive material.

Design process



This activity follows a design process. Below are some questions that will help at each stage of the process.

Think of some solutions

- What real world examples of switches do you use every day? How do they work?
- How does a switch help to control the flow of electrical energy in a circuit?
- Who is going to be using this switch? What are their needs?
- What is the switch being used for and how will your switch move and operate?
- What ideas do you have for a design?

Make a prototype

- How can you use the different properties of materials in your design?
- What materials will you use to build your switch?
- How will you attach your materials together?
- How will you make your prototype secure?
- What tools and equipment do you need to use in your making?
- What part of your design are you finding tricky to build?

Test it out

- Test it out by connecting your switch design into a circuit. What happened when you turned on the switch?
- How does your switch operate? Is it operating how you had hoped?
- Did anything unexpected happen?
- What part of your design worked really well?

Improve your design

- What changes can you make and how will this improve your design?
- What would happen if you used different materials or added a new part?
- What ideas could you incorporate from someone else's design? Talk to a friend or search online.
- If you started again, what would you do differently? What would you do the same? Create a record of your design to guide future projects.
- What advice would you give other people who want to make a design like yours?

Background information

An electrical circuit is a continuous loop, or path, through which electrical energy can flow to power a device, like a light. If there is a gap, or break anywhere along the path of the circuit, the electrical energy will not be able to flow.

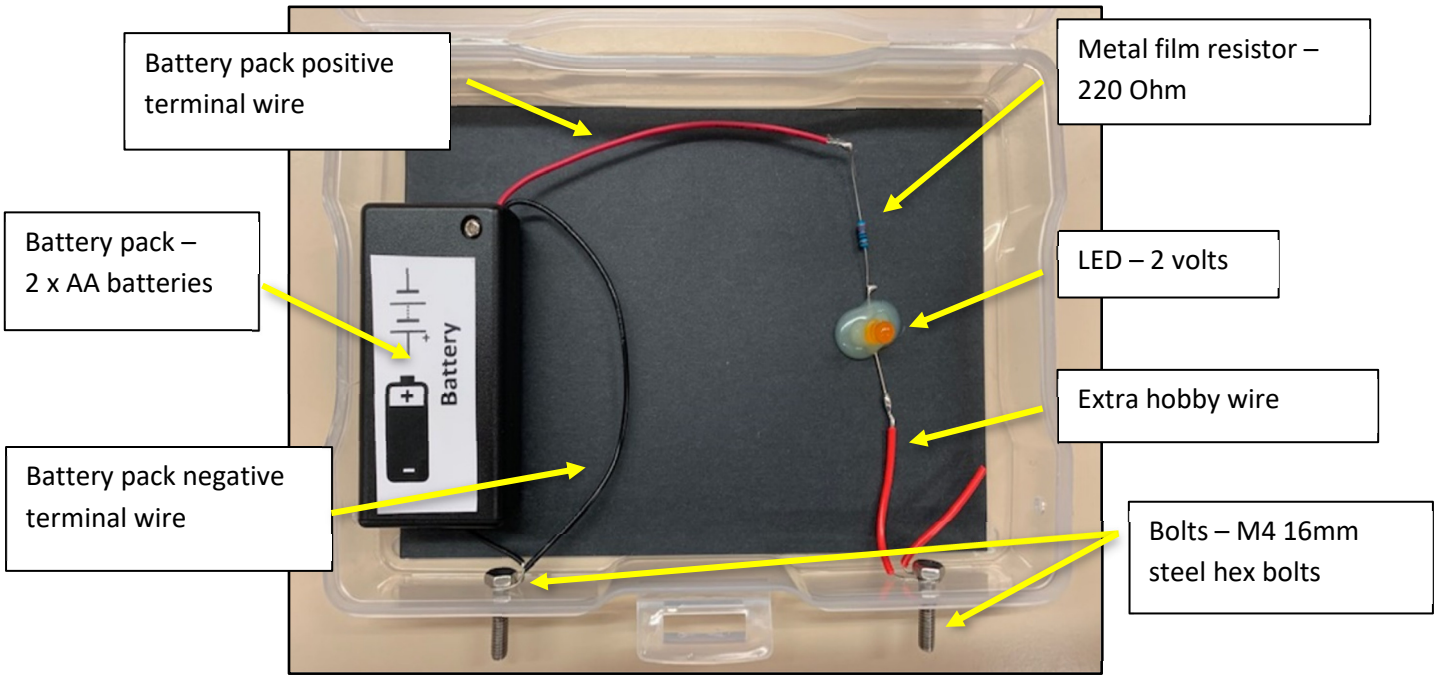
The flow of electricity through a circuit can be controlled using a switch. When the switch is closed, electrical energy flows around the circuit and the light will turn on. When the switch is open, there is no longer a continuous path for the electrical energy to flow through, and the light will turn off.

Switches often contain moving parts that are made of materials that allow the flow of electrical energy (conductors), and other materials which resist that flow (insulators). Switches come in many different forms that have been designed for a particular user or purpose. There are push switches, sliding switches, toggle switches, sensor switches and digital switches to name a few.

Key Search Terms: Electrical circuit, electricity, conductivity, light switch, design, electronics

Appendix

Detailed Set Up: Building your pre-made circuit box - Optional

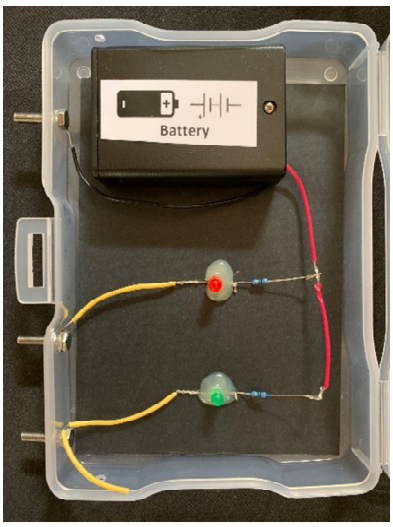


To focus attention on the design of creative switches with a specific purpose and user in mind, we built robust and safe circuit boxes. You could include creating the circuit as part of the activity.

1. Connect the long arm of the red LED (the positive terminal) to the resistor by bending and twisting them together. (For a more reliable connection solder the joins together with lead-free solder on all the connections in this circuit.)
2. Connect the other end of the resistor to the positive terminal of the battery case. You may need to strip back some of the plastic around the battery case wires to do this.
3. Connect 5 – 10cm of hobby wire to the short arm (negative terminal) of the LED.
4. Secure the parts of your circuit to the black cardboard using double-sided tape, or hot glue.
5. Drill two small holes in the front side of your plastic box approximately 10 cm apart. Screw your hex bolts through the holes from the inside out.
6. Place your circuit inside the clear box, using tape or glue to secure the card to the base of the box.
7. Using the hobby wire, connect the LED to the base of one of the hex bolts, and connect the negative battery wire to the other.
8. Check the circuit is functioning by adding some batteries and connecting the two hex bolts together using alligator clips. If the LED does not light up, check that your LED is connected the right way around.

Notes and optional extras:

- Including a resistor in your circuit is important to prevent accidentally shorting the circuit. Although AA batteries are relatively low voltage, a shorted circuit can produce a lot of heat in the wires. A resistor also prolongs the life of your LED and slows down the battery usage.
- To create a child-proof circuit, we drilled two holes into the sides of the box and two into the lid and secured the box shut using zip ties.
- Create circuits with multiple LEDs that can be individually switched on an off. Different colours may require a different voltage depending on the manufacturer, so you may need to use 3 x AA batteries (particularly for blue, white or green LEDs).



Links to Australian Curriculum

Science Curriculum:

Year	Curriculum
Prep (F)	**Chemical sciences** Objects are made of materials that have observable properties (ACSSU003).
1	**Chemical sciences** Everyday materials can be physically changed in a variety of ways (ACSSU018). **Physical sciences** Light and sound are produced by a range of sources and can be sensed (ACSSU020).
2	**Chemical sciences** Different materials can be combined for a particular purpose (ACSSU031)
4	**Chemical sciences** Natural and processed materials have a range of physical properties that can influence their use (ACSSU074).
6	**Physical sciences** Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources (ACSSU097).

Design and Technologies Curriculum:

Year	Curriculum
Prep (F)-2	Identify how people design and produce familiar products, services and environments and consider sustainability to meet personal and local community needs (ACTDEK001). Explore the characteristics and properties of materials and components that are used to produce designed solutions (ACTDEK004).
3-4	Recognise the role of people in design and technologies occupations and explore factors, including sustainability that impact on the design of products, services and environments to meet community needs (ACTDEK010). Investigate how forces and the properties of materials affect the behaviour of a product or system (ACTDEK011). Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes (ACTDEK013).
5-6	Examine how people in design and technologies occupations address competing considerations, including sustainability in the design of products, services, and environments for current and future use (ACTDEK019). Investigate how electrical energy can control movement, sound or light in a designed product or system (ACTDEK020). Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use (ACTDEK023).
7-8	Analyse how motion, force and energy are used to manipulate and control electromechanical systems when designing simple, engineered solutions (ACTDEK031). Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment (ACTDEK034).