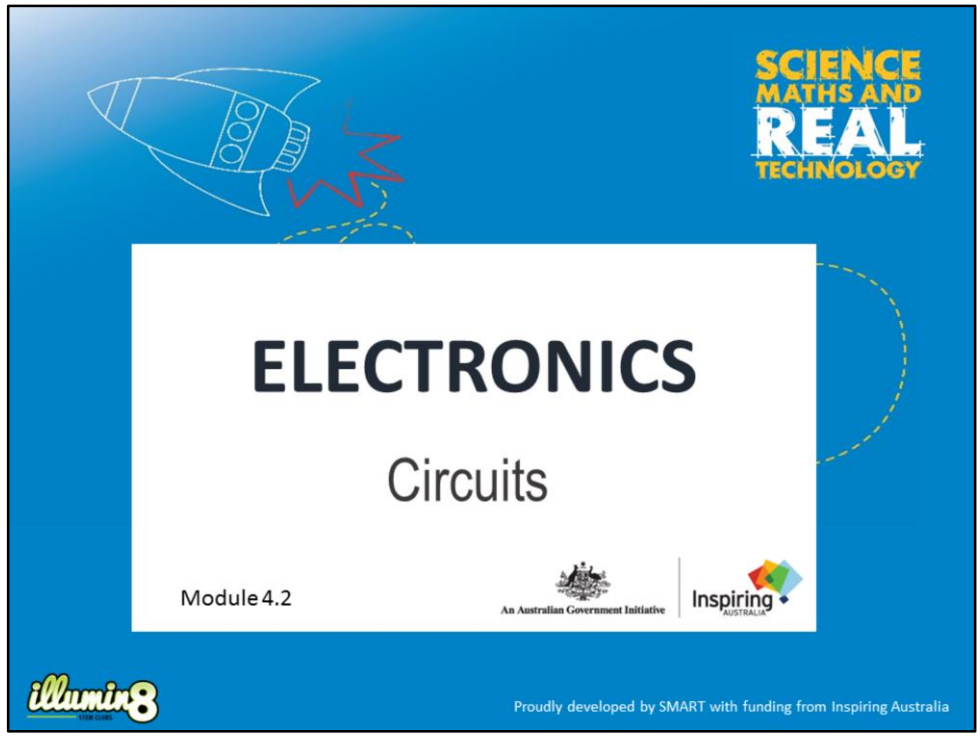
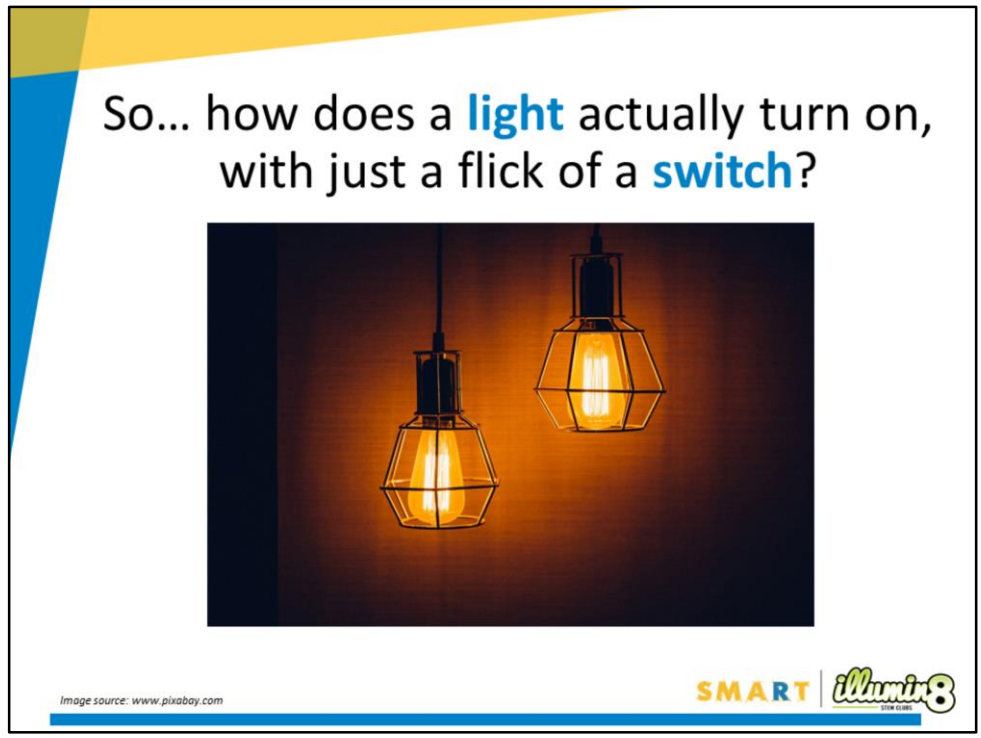


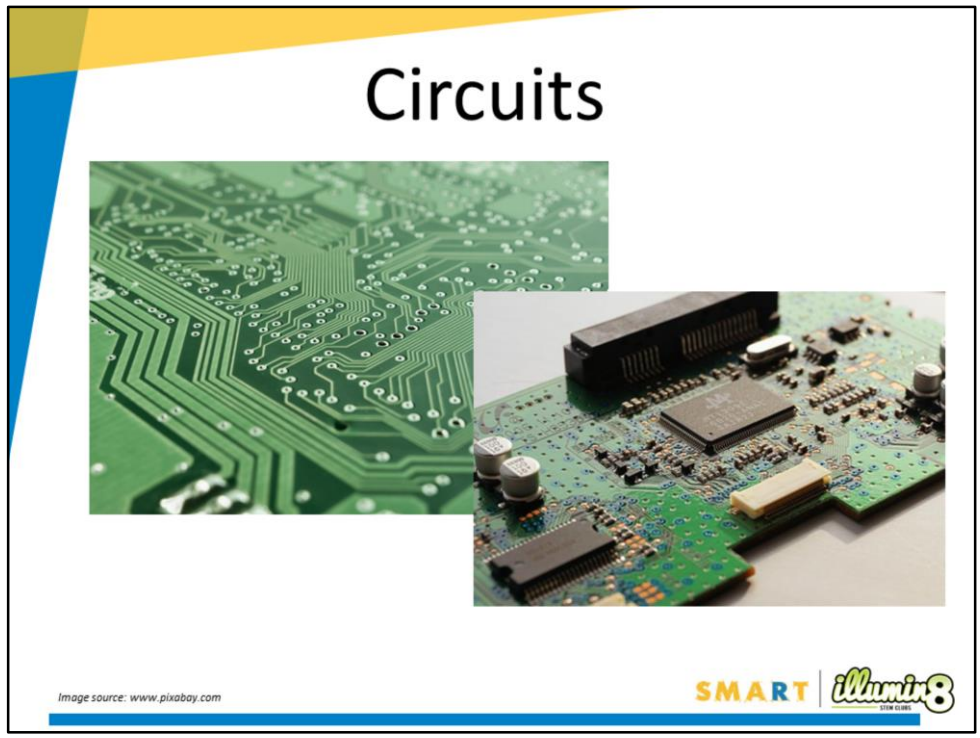
Welcome! In the last session, we explored a powerful topic… energy!
We started to look at some different types of energy, ways energy can be stored, and how energy can be transformed.
This week we're going to take a closer look at circuits. All electronic and electrical systems and equipment are built from circuits.



Ask students to share their ideas – how does a light actually turn on?

Discussion prompts:

- Where does the energy, or power, for lights come from? (Power supply sources include power stations, solar panels, wind turbines, batteries)
- How does power reach our homes, schools, street lights? (Power is transferred from power supply sources, along systems of wires)
- What role does the switch play? (Switches allow, or stop, the flow of electrical current)



Energy reaches our lights thanks to carefully designed systems of electrical components, like switches and wires. All electronic and electrical systems and equipment are built from **circuits.**

Circuits are composed of: power sources (stored power), conductors (such as wires), and electronic or electrical components that carry out specific tasks (such as lights, switches, bells).

Any object that requires electricity has a circuit!

A circuit allows the transfer of stored energy to a device to complete a task, for example, turning on a light. In the previous session, we made circuits using power supply sources (lemons and other "batteries") and wires to turn on small LED lights.

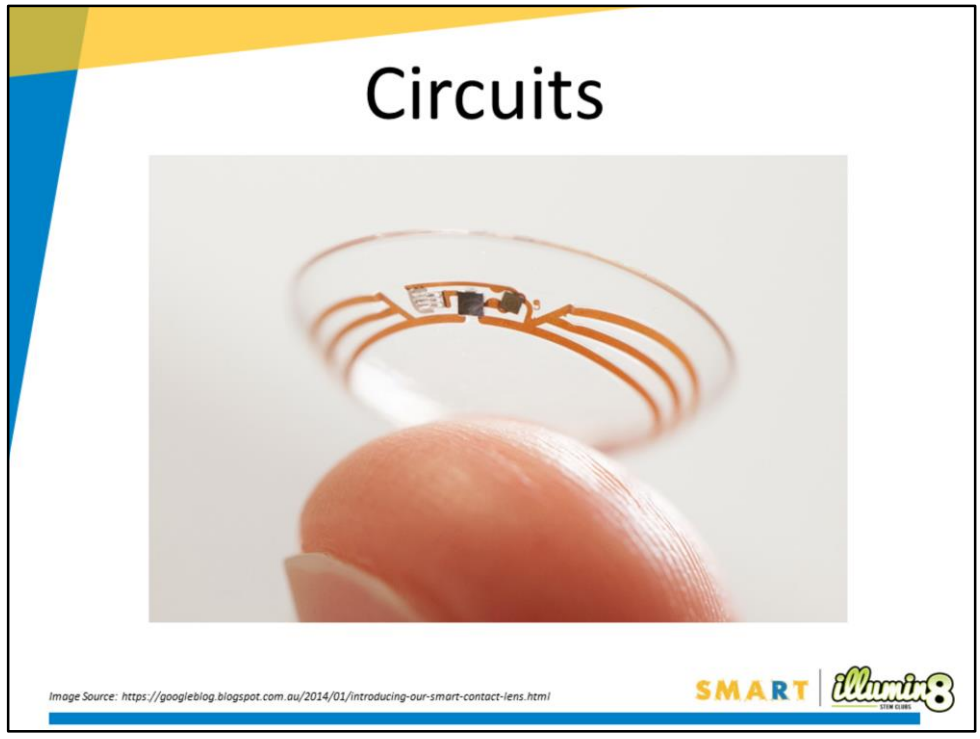
Ask students for some suggestions of where circuits might be found.

Examples: computers, clocks, watches, phones, power stations, cars, trains, radios, cameras, headphones, speakers etc.

……

Extension:

Modern electrical circuits can be built onto tiny rectangles of silicon to make microchips. **Microchips** are called **integrated circuits** because the components are all constructed together. Electronic components of integrated circuits are so small, they are only visible under a microscope. **Circuit boards** contain many microchips and other components, and form a key part of many devices (for example, laptops and desk top computers).



Modern electronic circuits can be so small, reliable and sensitive, that they can even be worn or implanted in humans to help with sight, hearing and other medical conditions.

Sight:

Retinal implants can help some partially sighted people to see. A tiny electrical device is implanted in the eye. Light falling onto the implant is converted into electrical signals that stimulate the optic nerve. The brain interprets these signals as patterns of dark and light, and allows the patient to "see" objects.

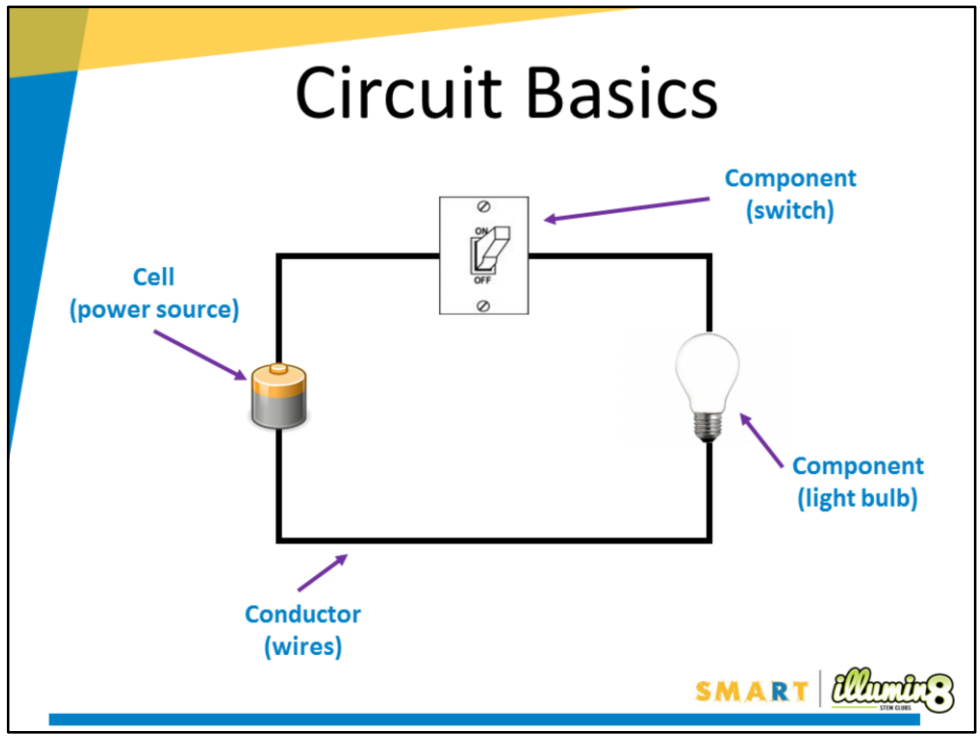
Hearing:

A Cochlear implant is a small electronic medical hearing device that is implanted into the human ear, to do the work of damaged parts of the inner ear (cochlea) and provide sound signals to the brain. An external battery powered processor captures sounds and coverts it to digital code. The code is transmitted to the implant, and converted into electrical impulses to stimulate the hearing nerve, sending sound-like signals to the brain.

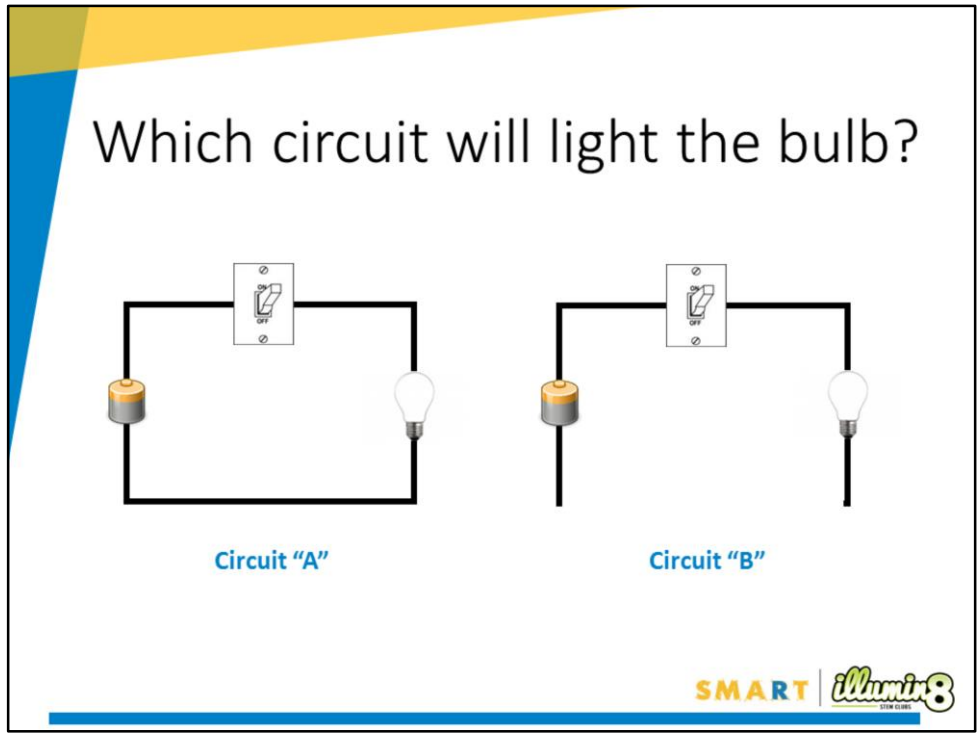
Diabetes:

Google are working on a smart contact lens, that's built to measure glucose levels in tears using a tiny wireless chip and miniaturised glucose sensor embedded between two layers of soft contact lens material and worn in the eye. The hope is this could someday lead to a new way for people with diabetes to monitor their glucose levels and manage their disease.

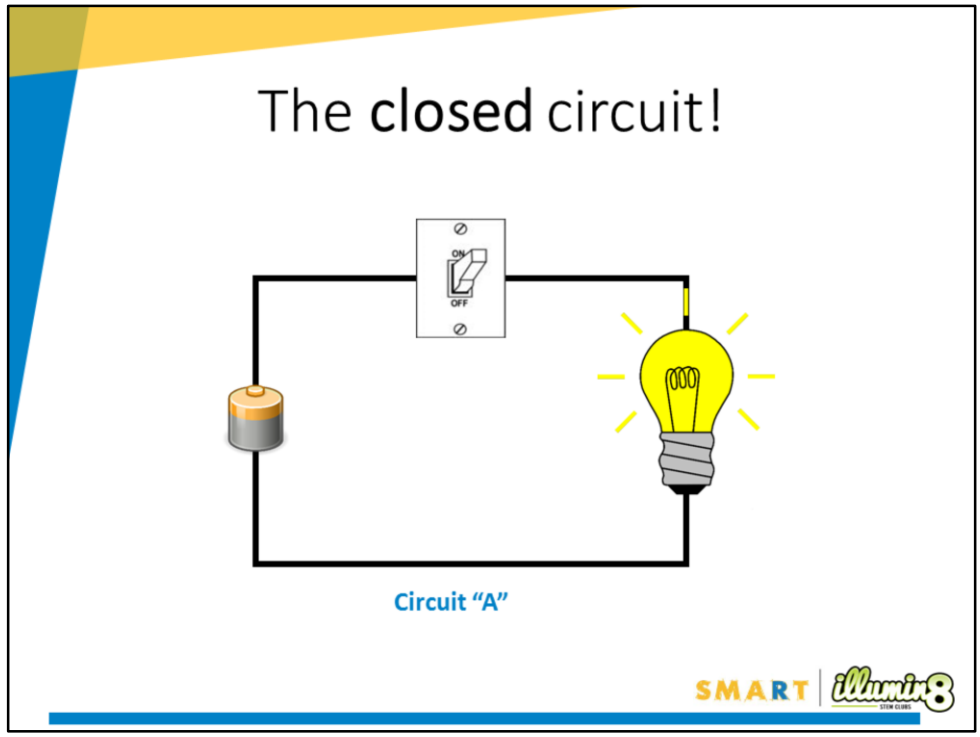
https://diabetesnsw.com.au/smart-contact-lens-to-provide-glucose-readings/



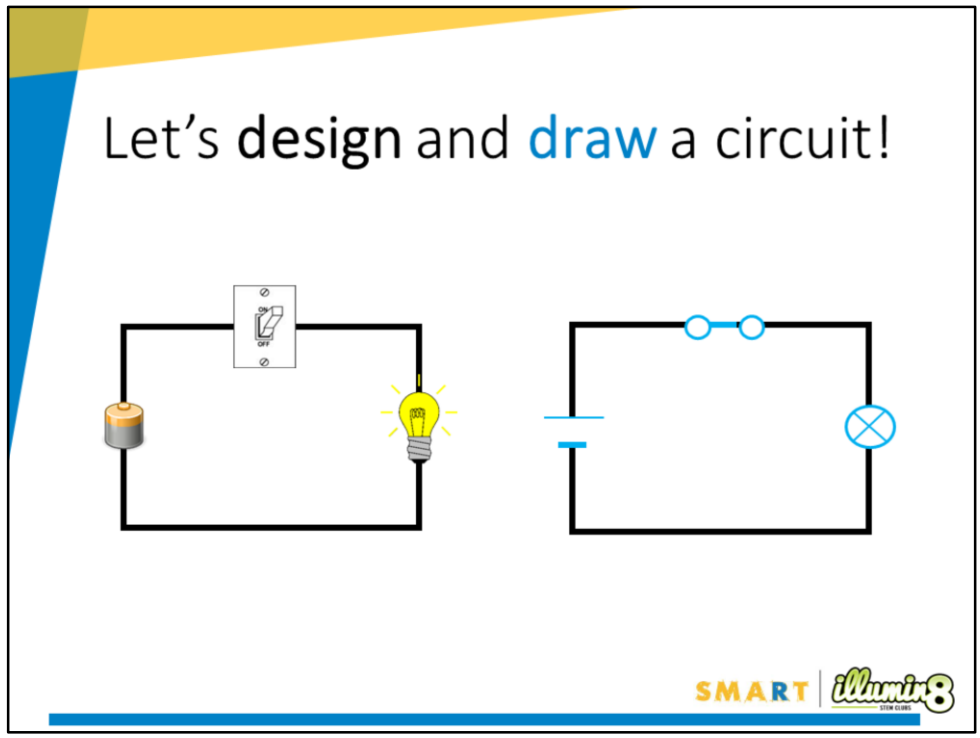
In any circuit, a **power source** (such as a cell) pushes electrical current along one or more **conductors** (often wires).
When the current passes through a **component** (such as a light bulb), the component changes (or transforms) the electricity, and also changes itself in response. For example, a light bulb will start to glow when an electrical current passes through it in a circuit.
Electricity flows when a circuit is complete, and each component is connected to the next. If a circuit is broken, by means of a switch for example, the electrical current will stop flowing.



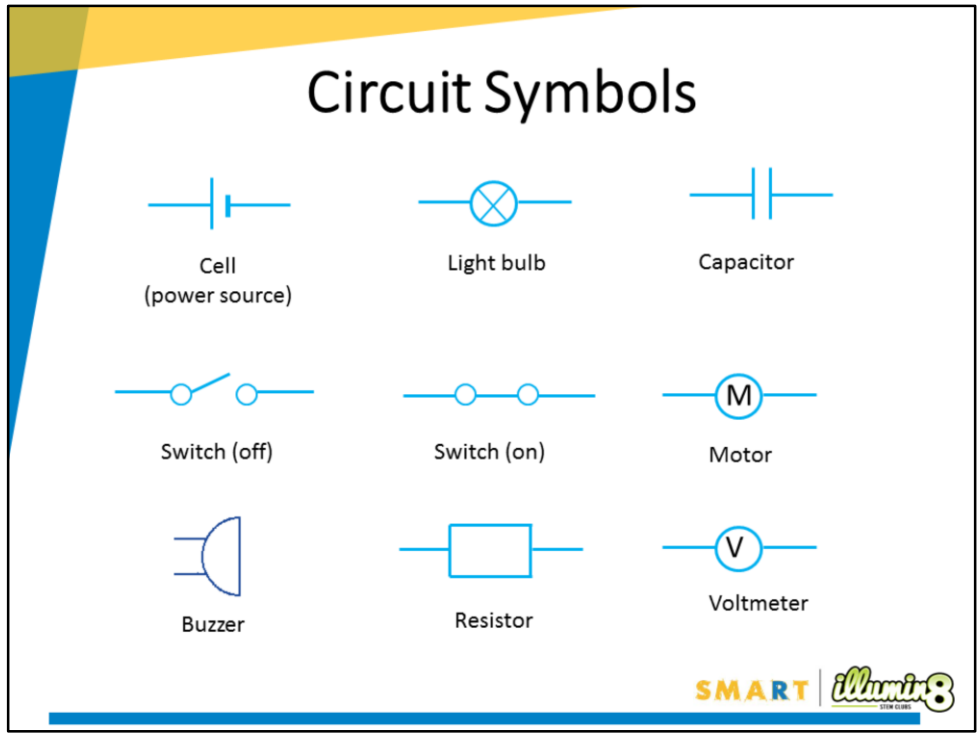
Ask students to make predictions, and explain their hypotheses, about which of the two circuits shown will allow the light bulb to glow…



Circuit "A", the closed circuit, will light up the bulb!
Circuits need to be **closed** to allow the flow of electrical current. The current will stop flowing around the circuit if there is a break at any point. In this circuit, the current will stop flowing and the light bulb will stop glowing if the switch is changed from the "on" position to the "off" position. Turning the switch off will break the circuit.

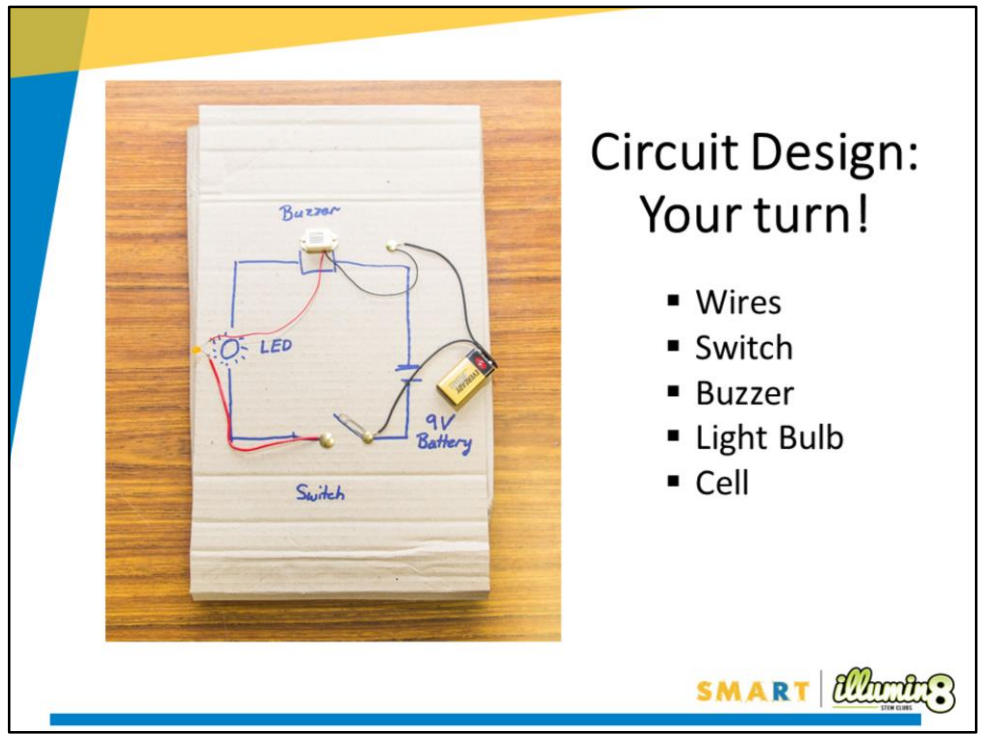


Before we make a circuit, we need to draw our designs. Electrical professionals (such as electrical engineers) use symbols to draw circuit diagrams. These symbols are recognised around the world, making it possible to communicate complex circuit designs with other people.
Each component within a circuit has it's own symbol.
Wires are shown as straight lines, in this circuit diagram, they are the black lines.
A **cell,** or power source, is represented by a small thick line and a longer thin line drawn side by side, with a white space between. The cell lines are drawn at right angles to the wires.
A **light bulb** is drawn as a circle with two crossed lines inside, like the letter 'X' drawn inside a circle.
A **switch** is drawn as two small, empty circles with a line in between. When the line between the circles is drawn like in the diagram, touching each circle and closing the circuit, the switch is "on".
Let's take a look at some other symbols used when drawing circuit designs.



Circuit components:

- A **cell** causes current to flow around the circuit
- A **switch** allows or halts (stops) the flow of current
- A **light bulb** will light up when current flows through it
- A **buzzer** converts electrical energy to sound when current flows through it
- A **motor** moves when current flows through it
- A **capacitor** is a device that stores electrical charge
- A **resistor's** purpose is to resist the flow of current (a variable resistor controls the amount of current, it's symbol is different)
- A **voltmeter** is a device which measures current voltage, in volts (an ammeter measures the current in amps, and is drawn with the letter A inside a circle).



We're going to have a go at making some simple circuits.
First, using the circuit symbols, draw a design for a circuit in pairs.
We have materials available to include a cell, switches, LED light bulbs and buzzers.
Once you have drawn your circuit design, swap drawings with another pair. See if you can read each others drawings! Discuss and explain your design ideas. You can then go ahead and make your design, or perhaps make another pairs design!
Note: It's a good idea to display the previous slide whilst students are completing this activity, or ensure a handout is available with symbols shown.
Refer to coordinator notes for activity 4.2.1 and risk assessment for Module 4 before proceeding.

Wire Loop Game Challenge!

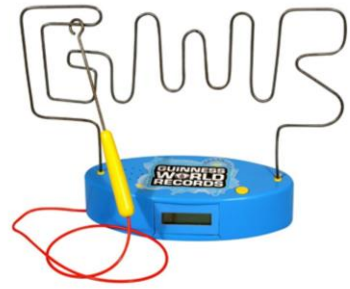


Image Source: https://www.amazon.co.uk/Guinness-World-Records-Automatic-Timer/dp/B00504AV5A/275-1818361-1515867?ie=UTF8&*Version*=1&*entries*=0

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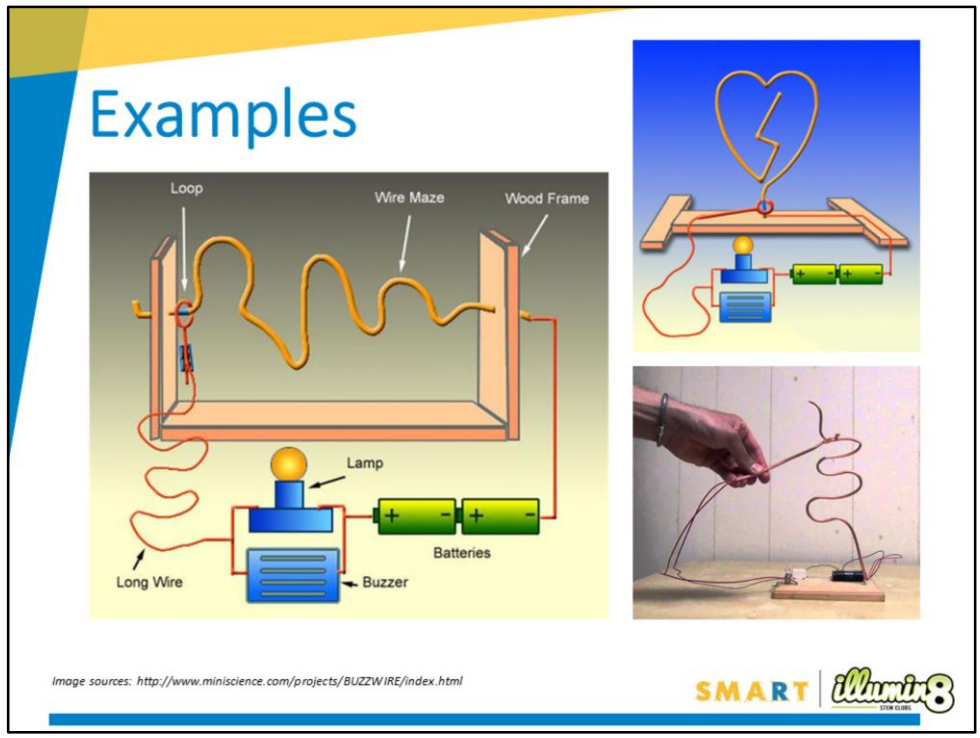
The Challenge

With your new knowledge of circuits…

- draw a circuit diagram for a wire loop game… include an LED light and a buzzer.
- construct your game!
- see if any members of your team can complete your game, without the buzzer sounding or light glowing!



Encourage students to explore their own design ideas, rather than creating one of the examples.
Where will the light be positioned?
Where will the buzzer be positioned?
What shape will their wire path have?
Will their wire path be on a stand, free-standing, or flat?
Will the wire loop be able to be removable, or will it stay on the wire path?
Will a switch be needed?

Note: The board game “Operation” is a similar game concept / design!

Rules

- You must include an LED light bulb and a buzzer in your game.
- Only one 9V battery can be used.

Materials

You will have the following materials per team:

- 1 x 9V battery and 1 x battery clip
- 1 x 9V buzzer
- 1 LED Light (3mm – 5mm)
- Thin (bare) copper wire (approx. 60cm per group)
- Electrical tape
- Thick cardboard / timber / foam for base
- Planning sheet / circuit symbols, pens/pencils

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Scoring

Groups receive points for:

- drawing their design prior to construction
- including both an LED light globe and a buzzer
- having a functioning game, i.e. the buzzer and/or light turn on when the wire loop touches the wire path!

Groups receive bonus points if… they can complete their own game successfully (without setting off the buzzer and light).

Groups receive additional bonus points if… they can complete another team's game successfully!

References

Circuits:

- http://education.abc.net.au/home#!/media/1478139/light-up-a-light-bulb
- https://science.howstuffworks.com/environmental/energy/circuit.htm
- http://education.abc.net.au/home#!/media/2190951/how-electricity-works
- **Circuits (playdough circuits)**
- http://www.abc.net.au/science/articles/2012/04/17/3479415.htm

Drawing Circuits:

- https://k8schoollessons.com/drawing-circuits/

Wire Loop Game:

- http://www.energizer.com/science-center/steady-hand-game
- http://www.miniscience.com/projects/BUZZWIRE/index.html

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