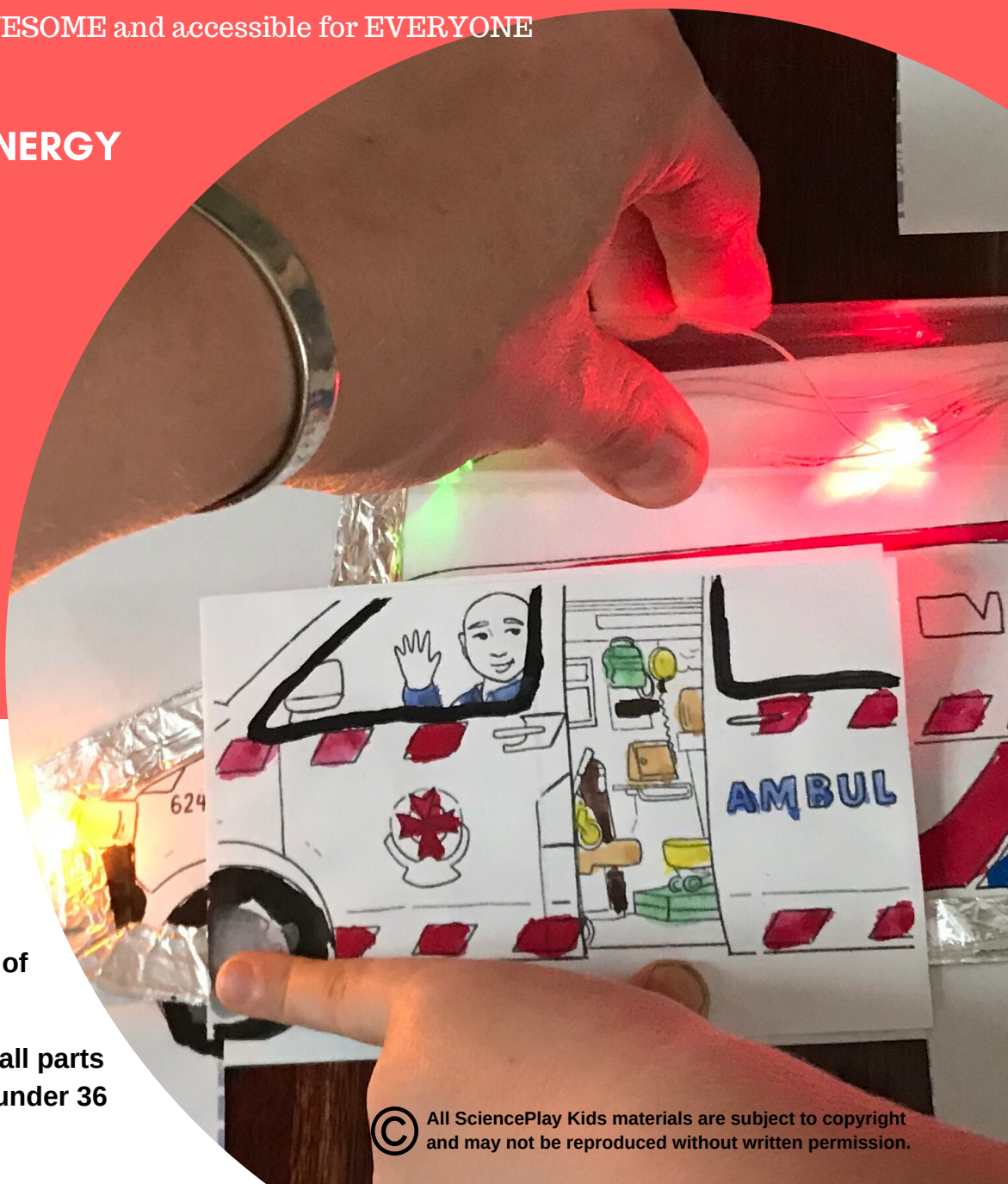
SCIENCE PLAY KIDS

Making science AWESOME and accessible for EVERYONE

ELECTRICAL ENERGY KIT #1



WARNING

WARNING -Please read SAFETY warning for use of 3V button batteries.

CHOKING HAZARD – Small parts not suitable for children under 36 months.

MAKING SCIENCE AN EVERYDAY CONVERSATION

.... a note to the grown-ups

SciencePlay Kids
... an idea was sparked:

SciencePlay Kids was created from a love of Science (I have a PhD in Biochemistry and Molecular Biology) and the joy I witnessed when I introduced my 2 and 4 year old to science based exploration.

Kids are born explorers. They ask 100s of questions every day. The desire to investigate, explore and experiment is an AMAZING characteristic that children possess but something that unfortunately wanes as they grow older. Science is often considered to be a dry and complicated topic and as such many parents and teachers shy away from discussing it. But that doesn't have to be the case....

Through our hands on, messy, tactile, visual, science meets art approach (no, I'd say science collides with art approach), our kits aim to bring back the magic of science and ignite a passion to discover, create, explore and be ever-curious. Our mission, through our play based approach, is that every individual is able to see and understand the science of THEIR world and explore science CREATIVELY in their EVERYDAY lives.

STEM (science, technology, engineering and mathematics) based careers are the way of the future so learning in STEM fields is important. More important, however, is the skill of problem solving. Children that ask questions and seek answers, that explore, experiment and investigate are problem solvers! Encouraging and nurturing the desire to test and experiment can have a huge impact in teaching your child to understand and solve problems every day later in life. Imagine a future generation of curious problem solvers.... our world would be filled with some very innovative, creative and incredible individuals indeed!

This kit is aimed for children 4-12yo. This is the age when their mind is most open to ideas and their desire to explore is greatest. They get excited by science, REALLY excited. If they develop a love for science now, then it won't matter if science in high school is "boring" or if they get distracted by peers or parties or romance, because the passion for discovery has already be ignited and the torch is burning brightly. My other aim is to involve parents heavily in the exploration process, not only to spark or re-ignite a love of science in the 'Bigger kids' (us grownups) but to empower them to have science based conversations, every day, regardless of background and education. To this extent, I have tried to explain the science concepts behind each activity and point out everyday, relatable examples to talk about with your children. Science should be accessible for all!!

DR. LORIEN PARKER (AKA. DR. LOZ)
Creator of SciencePlay Kids

21 Sc Science
PLAY KIDS

SAFETY NOTE: READ BEFORE STARTING ANY EXPERIMENTS

3V Batteries - DO NOT SWALLOW

No 'button' batteries are supplied in this kit except for the one inside the Energy Stick. This is secured inside the tube and should NEVER be taken out (it cannot be replaced either). If you notice the end of the Energy stick is open and you have small children in the house, please dispose of the Energy Stick appropriately.

Not only are coin 'button' batteries a choking hazard because of their size, they can cause serious harm if swallowed. When swallowed, these small batteries get stuck in the oesophagus. The saliva triggers an electric current which causes a chemical reaction that can severely burn the oesophagus in as little as two hours. If your child swallows a coin 'button' battery, go to EMERGENCY immediately.

If your children are old enough to understand the dangers associated with these batteries and you feel confident that they will never put one in their mouth, then you can complete the activities in the last pages of the booklet where loose 3V 'button' batteries are required -THESE ARE NOT SUPPLIED IN THIS KIT.

Electricity and water

Tap water can conduct electricity because it contains 'ions' (metals such as sodium). In solution (dissolved in water), these ions allow an electric current to flow.
DO NOT ever put anything that is plugged into the electricity socket into water. The Energy Stick's Voltage is only about 30 milliVolts. The current output depends on the circuit it is connected through but is always only a few milliamps at most. The voltage we are working with in these experiments is, therefore, too low to harm us if dropped in water, like a hairdryer might if it fell in the bath, but it is good practice to remind children that water conducts electricity, so generally, they don't mix. Even though nothing harmful will happen if the Energy Stick is dropped in water, it will stop working, so it is best to keep it away from water.

Experimenting with Electricity at home

It is also important to point out to children that the current that is running though your house, that powers your light and appliances, has a **MUCH** higher voltage than what we are playing with in our experiments. Please point this out. It is VERY DANGEROUS to poke anything into the electrical sockets in the walls or to touch any wires anywhere in the house.

Getting Started

Included in this kit are instructions for some experiments/activities relating to electrical energy. Instead of loose 3V 'button' batteries or more dangerous 9V batteries, I have opted to use the Energy Stick as the 'battery' in all of the experiments (except for the last one which requires a 3V but is optional and only recommended for children that WILL NOT put batteries in their mouth). This means children as young as 3 can explore (with assistance) some cool electrical energy experiments (just not the last one if you have other littles in the same house).

Please READ all the way to the end of each experiment BEFORE beginning the task. This will allow you to understand the science that is going on and thus explain/understand what is happening DURING the experiment.

There are quite a few new terms in these experiments so perhaps. it's best just to introduce the ones that correspond to the experiment you are undertaking. If the children are young, ask them to repeat each new word after you as you use them. Around 2-3 new terms at a time is ideal. See if you can use them in day-to-day life as often as you can to solidify their meaning.

The 'Vocabulary' section goes into a bit of detail in some places. Please do not feel that you need to understand everything that is listed there. I feel that it is important to include extra information for the older kids (and adults) if they want it. Otherwise, just take from it what you can.

As with our other Kits, I have included some questions to ask during the experiments but I would recommend asking many more throughout. I also like to ask, before the kids do anything, "What do you think is going to happen?" Often replying with "wow, that's a good hypothesis (idea), let's try and see" or "wow, that sounds cool... why do you think that might happen?" or "that's very interesting, we can test it and see".

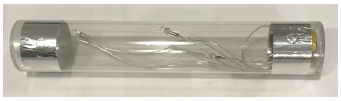
The experiments listed here are just the beginning. It is amazing what you can do with some simple conductors, like kitchen foil, a battery source, like the Energy Stick, some lights and a bit of creativity. Once you understand how to make circuits and switches, you can design anything you want. Light up ALL your drawings! Get creative!

You are NOT limited by what is supplied in the kit. Feel free to use other materials, like felt, textas or other craft items to finish off the projects. Make as much use of recycled materials as you can. You can even use the materials you have on hand to inspire the project you make - got a flat bit of cardboard? make a light up aeroplane runway!... got a box? make a house with lights!

Contents

Included:

1 x Energy Stick



10 x Mini LEDs

1 x 54 page Instruction booklet with loads of cut out templates (You are reading it now)

3 x Wooden badge backs

1 x Calico Storage bag

Additional items you will need:

- Foil

- Glue stick

- Scissors

- Textas

- Other craft material to decorate

- Objects to test for conductivity

Some of the items listed below:

- Cutlery and utensils (a variety - some metal, plastic and wooden ones)
- wooden or plastic clothes pegs, r bands, pipecleaners or other stati
- items like pencils (grey-led and c textas, pens etc
- plastic items (toys, plastic contain buckets etc) kitchen items (Frypar cookware, drinking glass, ceramic thermos etc)
- clothes, shoes, hats, sunglasses, e necklaces etc
- items from the garden (leaves, gr lemons, gum-nuts, rocks, branche
- fruit (carrots - these work REALLY well), apples (pealed vs. non-peeled), watermelon, banana (pealed vs. non-peeled) etc
- other food (crackers, bread, peanut butter, jelly, jam, chocolate)
- liquids - (tap water, deionised water (from supermarket), salt dissolved in water, milk, slime, oil etc)
- big things (the couch, TV, door and door handles, table legs, washing line, stop sign, playground equipment etc)
- money (notes and coins)

Vocabulary

- ATOM: Building blocks of life. The smallest unit of a chemical element. A typical atom consists of a nucleus in the centre, with protons (positive) and neutrons (no charge). Negatively charged electrons orbit around the nucleus. Atoms are too small to see but they are there and they make up everything!

- ELEMENT: What is an element?? Everything in the universe, from your nose to your clothes, from the ocean to the mountains, from the fish to the clouds and even the stars, everything is made from tiny building blocks called atoms. Currently, we know of 118 different types of building blocks – these are the elements. They can exist alone or combine with other elements to make compounds. The Periodic Table is a way to arrange these different elements into a picture that allows us to more easily see their similarities and differences and thus understand how they might behave. Each type of element has a different number of protons, electrons and neutrons. An element is the simplest substance that cannot be broken down further.

- METAL: Type of element. Almost 80% of elements are Metals. They tend to be shiny, malleable, ductile, good conductors of heat and electricity, which is why we will use them in these experiments.

- BATTERY: A source of chemical energy that can produce electrical energy. Batteries have a positive side and a negative side.

- ENERGY: Energy is the ability to 'do work'. Energy allows things to move, change, heat up, light up, make sound and even create new things. Energy is transferred from one thing to another and often converted from one form to another. For example, the chemical energy stored in a battery of a torch is converted to electrical energy when we turn on the switch, which is in turn converted into light energy allowing us to see in the dark.

- ELECTRICITY: Electricity is a form of Energy, it is called electrical energy. Electricity is the flow of electrons. Remember, atoms, small particles that make up all matter, have neutrons and protons in their centres and electrons on their outers. Some materials, like metals (see periodic table diagram), are made from atoms that can give up their electrons more easily. When electrons can 'flow' from one atom to another, a current is generated. This flow of electrons is what we know as electricity.

- CIRCUIT: A closed loop/pathway that electrons can flow through. In a circuit the electrons move from a voltage source, the battery, through wires or similar, to another object like a light or speaker and then back to the battery.

Vocabulary continued

- SWITCH: An opening in a circuit that can be closed to allow electrons to flow. Switches can be simple, like a single switch that turns something on or off, or they can be more complicated systems of multiple switches in the same circuit. These are called 'logical AND' or 'logical OR' switches. The 'logical AND' switches all need to be on at the same time for the electrons (and thus a current) to flow. The 'logical OR' switches, however, do **not** all need to be on at once, just one of the switches OR the other switch needs to be on for electrons to flow. You can remember it like this: For the current to flow with 'logical AND' switches, Switch 1 **AND** Switch 2 need to be on. For the current to flow for 'logical OR' switches, either Switch 1 **OR** Switch 2 needs to be on.

- VOLTAGE: The current is pushed around the circuit by the battery. The amount of push provided is called voltage.

- CURRENT: The flow of electric charge (electrons) is called the current.

- CONDUCTOR: In a conductor, electric current (electrons) can move easily from atom to atom. Generally, only things that contain metal atoms can conduct electricity.

- INSULATOR: In an insulator, electrons do not move easily. Things like plastic, wood, paper etc are insulators as they do not conduct electricity well.

- LED: Light emitting diode. These are the small coloured lights with little metal legs, called terminals. Notice that one leg is longer than the other leg. This is the 'positive' terminal - Remember this as it is important when we make our parallel circuits.

Sourcing extra materials:

The little LEDs can be ordered online from our shop. Or, if you have an electronics store nearby you can get them there. They are called 3mm or 5mm LEDs.
Dr. Loz also has millions of Energy Sticks in stock so if you want an **extra one so a sibling can join in on the science fun too**, you can buy one online at:
https://www.scienceplaykids.com.au

Electricity is a form of energy.

Remember, electricity, travels via a pathway called a **circuit**. This is a loop that, when complete, allows electrons to travel around. These electrons start at a source, like a battery and travel to a device, like a computer. Let's look at electricity in more detail through the experiments in this booklet.

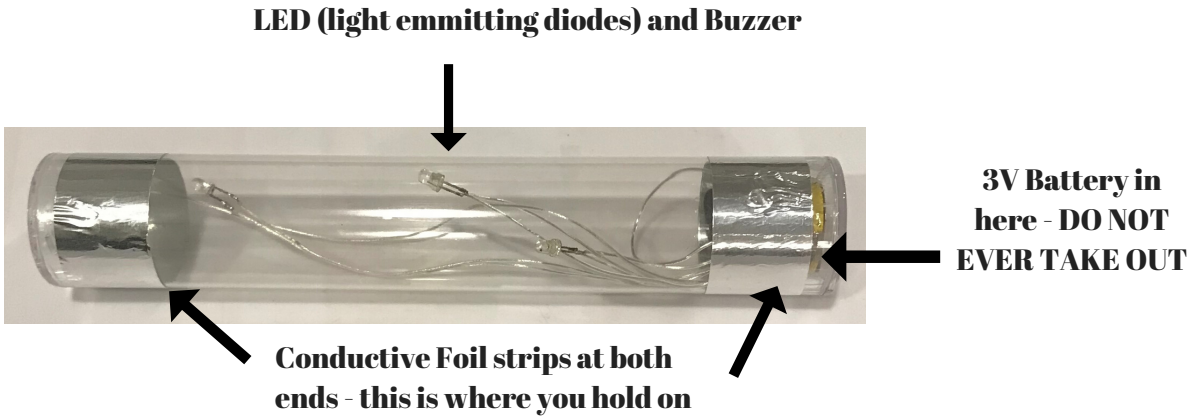
Things that use electricity:

- Lights
- Heating and cooling
- Dishwasher
- Washing machine and dryer
- Fridge and freezer
- Trains and trams
- TV, computers, radios
- Kitchen appliances like a microwave, blender or oven
- Mobile phones and the INTERNET

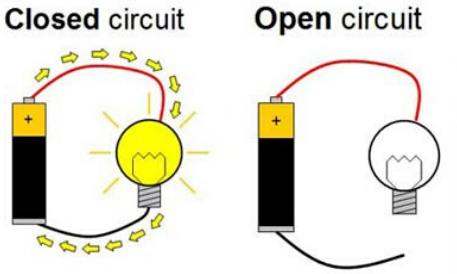
Draw some things that you can find around the house that use electricity:

Energy Stick

The Energy Stick is a fantastic tool for exploring circuits, transformation of energy and properties of materials.



What is a Circuit



)A circuit is a closed loop that allows electrons to flow from one end (terminal) of a battery, through a light/motor/buzzer and back to the other end (terminal). This loop needs to be complete, or closed, for the electrons to flow. If the circuit is incomplete, the electrons don't flow.

For electrons to flow through through this circuit, we need a source of energy. Can you think of something inside the Energy Stick that might supply energy?? (hint - look at the picture above, yes, it's a battery). Remember, energy is not created nor destroyed, it is just transferred from one object to another and from one type to another.

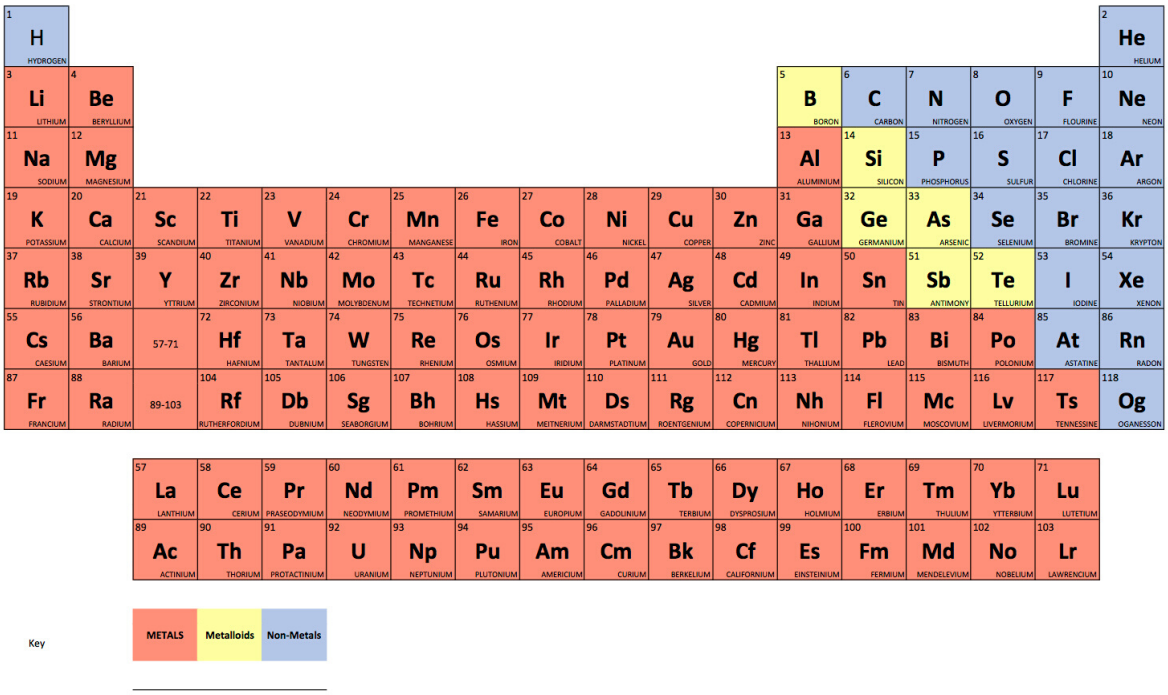
In this case, the energy starts as **chemical energy** that is stored in the battery. When we create a circuit by touching both ends, that chemical energy is transformed into **electrical energy** and the electrons flow through the circuit and then back into the Energy Stick. When it gets back to the Energy Stick, some of it is transformed into **light energy** and **sound energy**. The light energy we see when the lights flash and the sound energy we can hear as the buzzer sounds.

Let's see if we can make a circuit and watch/hear the energy transferring from **chemical energy** to **electrical energy** to **sound** and **light energy**:
1. Hold one side of the Energy stick only. Does anything happen? No - the circuit is not complete.
2. Hold one end of the Energy stick with one hand and the other end with the other hand (make sure you are touching the silver parts). Now, what happens? Can you see/hear anything???

What is a circuit? continued

3. This time make your circuit bigger. Hold the energy stick with one hand. Hold a friends hand with the other hand. Ask your friend to hold the other end of the energy stick with their free hand. What happens? Does the electrical energy travel though both of you? Experiment with more people. How long can you make your circuit? Once you have completed the next experiment, you will discover some other objects that can conduct electricity. See if you can use these to make your circuit longer. Rather than holding hands with the person next to you, can you hold a metal spoon between you, or a carrot? How many different items can you join into your circuit, including people, to make it super long?

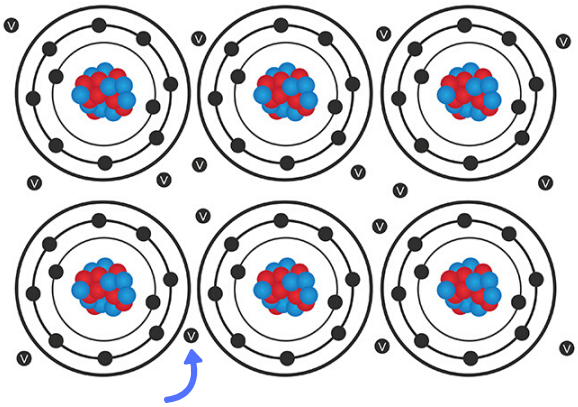
Why do people conduct electricity?? Because people are 60% water and dissolved in this water are lots of little metal atoms (called ions). Some examples of these are **Sodium ions**, **Potassium ions** and **Calcium ions**. They are essential for life - Electricity is required for the nervous system to send signals throughout the body and to the brain, making it possible for us to move, think and feel (you can read more about this when you make the Brain Circuit).
Let's have a quick look at the Periodic Table of Elements:



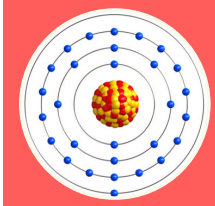
Nearly 80% of the elements in the Periodic Table are **metals** (coloured **RED**). Many of these form compounds with themselves and have typical 'metal' appearance and properties. Some, however, like Na (Sodium) or Mg (Magnesium) form molecules by bonding with **non-metals**, like Cl (chlorine) to form 'salts'. Salts, like in sodium chloride (table salt!) contain some metal atoms (the sodium ones) but do not look like or behave like pure metallic compounds (because they have non-metal atoms too) **BUT** many can still conduct electricity if they are dissolved in a solvent (like water). This is why people (and ALL living things) conduct electricity - we all contain sodium, potassium, magnesium, calcium and other metal atoms in the fluid in our bodies. Remember this piece of information when you are testing items in the next few experiments.

What type of things conduct electricity?

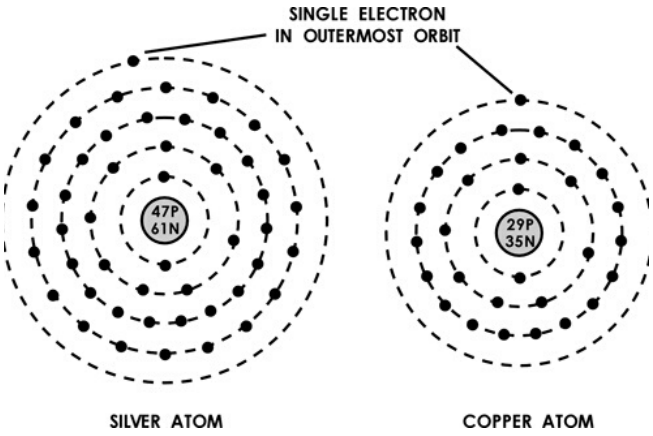
The stuff that travels through a circuit are called **ELECTRONS**. Electrons move around the outside of an **atom.** Remember**, EVERYTHING** is made of tiny little things called atoms but they are so small we can't see them.



Metal atoms tend to have a few electrons on the outside, these are the ones they can let go of easily. The rest are held more snuggly to the centre of the atom and cannot escape so easily.



Copper Atom



Some types of atoms hold on to their electrons really tightly while other types don't. Some of these are metals. Metals let some of their electrons go free. These electrons move around from atom to atom. This movement is what causes electricity to flow!

Materials that let electricity flow are called **CONDUCTORS**. Things that don't are called **INSULATORS**.

Materials:

- Energy Stick
- Conductor/Insulator page for categorising (last page of this booklet)
- Items from around the house to test (some ideas are listed to the right).

Items to test:

- Cutlery and utensils (a variety - some metal, plastic and wooden ones)
- Wooden or plastic clothes pegs, rubber bands, pipecleaners or other stationary items like pencils (grey-led and coloured), textas, pens etc
- Plastic items (toys, plastic containers, buckets etc)
- Kitchen items (Frypan, other cookware, drinking glass, ceramic plates, thermos etc)
- Clothes, shoes, hats, sunglasses, earrings, necklaces etc
- Items from the garden (leaves, grass, lemons, gum-nuts, rocks, branches etc)
- Fruit (carrots - these work REALLY well), apples (pealed vs. non-peeled), watermelon, banana (pealed vs. non-peeled) etc
- Other food (crackers, bread, peanut butter, jelly, jam, chocolate)
- Liquids - READ NOTE on next page FIRST (tap water, deionised water (from supermarket), salt dissolved in water, milk, slime, oil etc
- Big things (the couch, TV, door and door handles, table legs, washing line, stop sign, playground equipment etc)
- Money (notes and coins)

Method: PTO

What type of things conduct electricity?

You can repeat this experiment many times, each time choosing items from a different location to test - for example:

Day 1 - items from the kitchen (cutlery, crockery, containers, foil).

Day 2 - items from the garden.

Day 3 - things we find on our walk to the playground (take the Energy Stick with you when you go out for a walk and experiment on the go (take a lab book if you want to record your observations or take photos with a phone and then print and glue onto the categorising sheet at the back of the booklet).

Day 4 - things in the bedroom (different types of toys, clothes, shoes etc).

Day 5 - different types of food (fruit and veg you have in the fridge/pantry (try these with the peel/skin on and with the skin/peel off - it makes a BIG difference),

Day 6 - solutions and liquids (things like salt, sugar, flour, electrolytes mixed with deionised water* as well as juice, milk etc

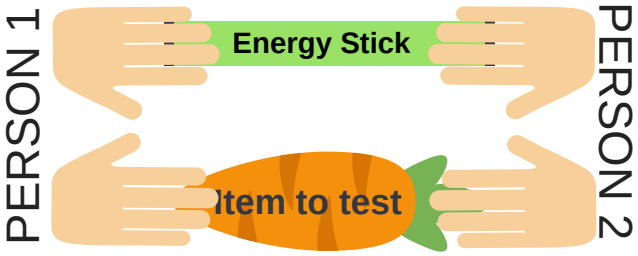
[NOTE - make sure you don't put the energy stick into the liquid, work with a partner and just dip your fingers into the solution].

*Deionised water has been filtered so that the 'ions' are removed - this should mean that there are NO metal atoms in the water.

Method:

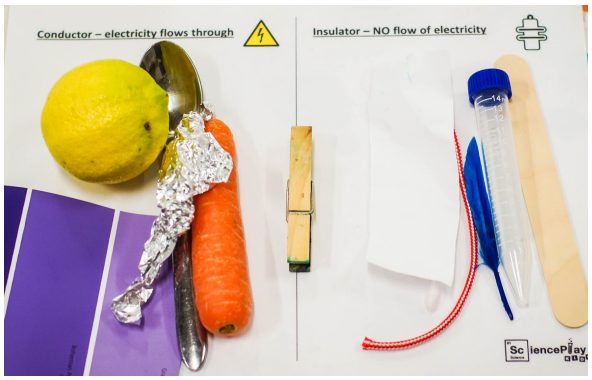
1. Look at the items you collected. Hypothesise (have a guess) - will they will conduct electricity (conductors) or not (insulators)?

2. Hold one end of the Energy Stick with one hand (make sure you hold the silver tape) and hold the item you are testing with the other hand.



3. Get your partner to do the same so that you make a closed loop.

4. If you have a 'conductive' material the Energy Stick will flash and make sound. Test all the items and sort them into the categories:
Conductor OR Insulator
(this page is at the back of the booklet)



What's happening:

Not all materials conduct electricity. Remember, this is because of the way the atoms are, some don't want to let their electrons go. However, some materials, like certain metals, eg copper, have electrons buzzing around the outside of their atoms, far from the centre of the atom.

Conductor or insulator?

In metals like copper, the electrons on the outside are not held on as tightly as they are when they are close to the centre of the atom, so, if something pulls them away, they can escape from the atom. These 'free' electrons can flow. This is what electricity is - the flow of electrons.
Other elements, like non-metals, usually hold on more tightly to their electrons so they are not able to escape. This is one of the reasons that they can't conduct electricity, the electrons **cannot** 'flow'.

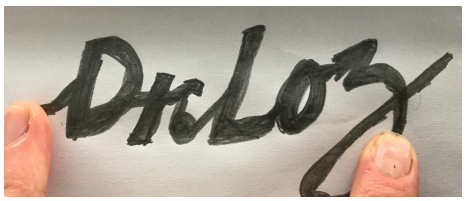
Questions:
Which of the materials that you tested conducted electricity? What did these 'conductors' have in common?
These materials MUST have metal atoms in them if they conducted electricity (with the exception of any items that contained graphite - see below). Do the things that conduct electricity look like typical metals? are they shiny?

Extension: Zappy Signatures
There is an *exception* to the rule that only metal elements can conduct electricity. The element carbon, which is NOT a metal, **can** conduct electricity when it is in the form of graphite (like inside a grey-led pencil). Carbon is the **only non-metal element** that can conduct electricity as a solid.

Method:
1. Find a grey-led pencil and sharpen both ends. If you and your partner touch the sharpened ends (the graphite that runs down the middle of the pencil), your Energy Stick should light up.

2. Now, draw a line on some paper about 15cm long. Make sure it is a dark and thick line.

3. You and your partner can each touch one end of the line while holding the Energy Stick in the other hand. It should light up.



4. Next, draw a picture, squiggly line or even write your name. Let's see if it conducts electricity.

If not, why not (Hint: if there are not enough carbon atoms rubbed off onto the paper, you will not get much current flowing through. Carbon is **not** a very good conductor so the lines need to be DARK. Since carbon is not the best conductor of electricity, the lines need to be short. Shorter, thicker lines work better than long, thin lines. Also, make sure there are no gaps in the line.

Foil Circuits

Hopefully one of the items you tested in the previous experiment was aluminium foil (if not, test it now). Aluminium is a metal and conducts electricity reasonably well. We can make a circuit on the next few pages, from foil, that will light up a little LED as well as the Energy Stick

NOTE: we will use the Energy stick as the battery source for these circuits as it is safer than using a loose 3V button battery and is therefore safe to do the following experiments with small children.

Materials:

- energy stick
- glue stick
- small LED light
- Rocket picture (pg 16.)
- foil, cut into strips about 35cm long and 7cm wide
- textas to colour picture
- other craft materials to decorate finished picture

Method:

1. Fold your foil lengthways so the strip gets thinner but not shorter. Then fold again so you have strips of foil about 1-2cm wide. You will need a few for each circuit.

2. Run your glue stick over the pink dotted lines in the pictures (ensure you leave a gap where it says "leave a gap, put light here". If you are making a parallel circuit (version 2 of the Rocket picture, pg. 18) then you don't need to leave a gap for the lights as the prongs will span from one strip to the other - this will make sense as you go).

3. Glue the foil strips on to the picture, trying to follow the pink dashed lines as carefully as possible. It is OK to bend the foil to turn a corner, but try not to rip it. If it does rip, just glue a new strip continuing on from the end of the last strip but make sure they OVERLAP.

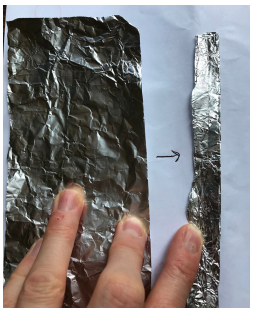
4. Spread the LED prongs apart and flatten them so that they can sit flat. Push the wires under the foil and glue the foil down on top of the wire. You can secure it further by putting sticky tape on top of the foil.

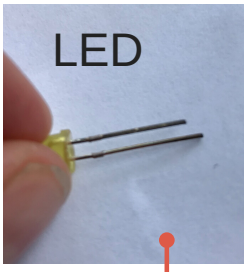
5. Once the LED is secure, place the Energy Stick on the ends of the foil, at the top of the page, to complete your circuit.

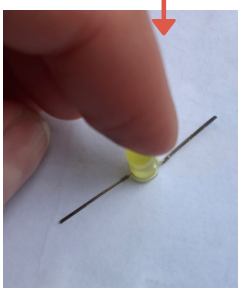
If your **LED does NOT light up**, flip the Energy stick around -the LED has a positive and negative terminal and so does the battery inside the energy stick so if the positive end of the Energy stick is connected to the negative side of the battery inside the Energy stick (which is hard to see), the LED will not light up.

Positive needs to connect with positive.

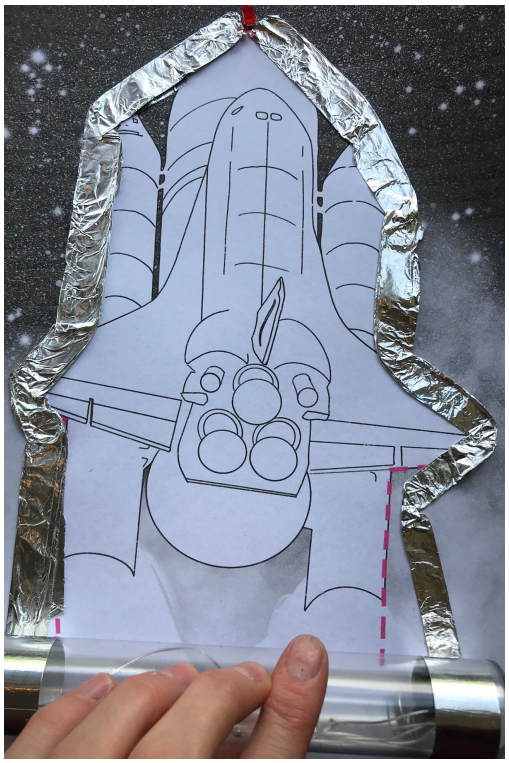
Trouble shooting: (see next page for tips)







Foil Circuits: continued



This is what it should look like once the foil is glued.

The first example is a **simple circuits** - it has one LED that joins two strips of foil, each of which connects to one end of the Energy Stick.

The next few are more complicated **parallel circuits** that have several LEDs connected in a row. In these circuits ALL the positive LED prongs (the longer ones) need to contact the same bit of foil and all the negative prongs (short ends) need to contact the other .

The last few circuits use **switches**. A switch is a gap in the circuit that can be closed by adding a connecting piece of foil or other 'conductor' (see experiment extensions for ideas). When closed, the electrons can flow through the whole circuit and light the LED but when the switch is open, the electrons cannot flow so the light does not work

T**rouble shooting** - if you LED doesn't light up, try these:

- First, try flipping the Energy Stick over, most of the time this should fix the problem. Remember the positive ends needs to connect to the positive terminal on the Energy Stick and the negative to the negative.

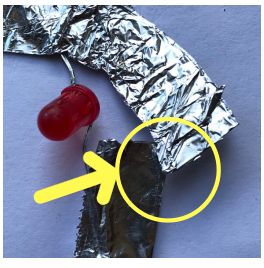
- Make sure that the wires coming from the LED are contacting the foil properly. Give them a wiggle and make sure they are snuggly under the foil strip. Sticky tape the foil to the paper to secure it all in place.

-Also, make sure the silver strips on the Energy stick are contacting the ends of the foil circuit.

If not, the circuit will not be 'closed' and the electrons will not flow.

- Make sure that the foil strips do not cross or touch each other. Electrons always seem to be in a hurry so will always try to take the shortest path. If you have an accidental connection between the foil strips (like in the picture below), directly connecting the negative to the positive, the electrons will scoot across and skip the LED, meaning it will not light up. The Energy stick will probably still work, but not the LED. If you were using batteries instead of the energy stick, this will short the circuit and quickly drain the battery. It could also heat up and become very dangerous - this is another reason we are using the Energy Stick instead of a 3V or 9V battery.

Overlaps will create a short cut for the lazy little electrons and the LED will not light



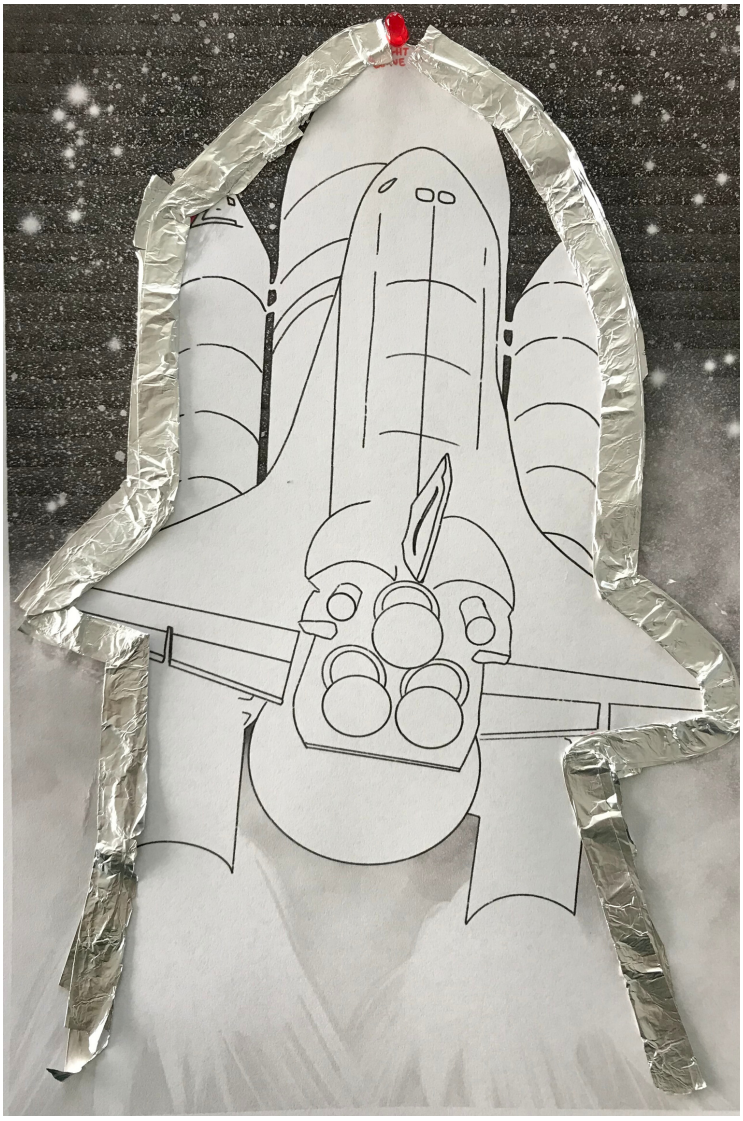
Simple Circuits:

Let's start with a simple circuit. Cut out the page opposite.

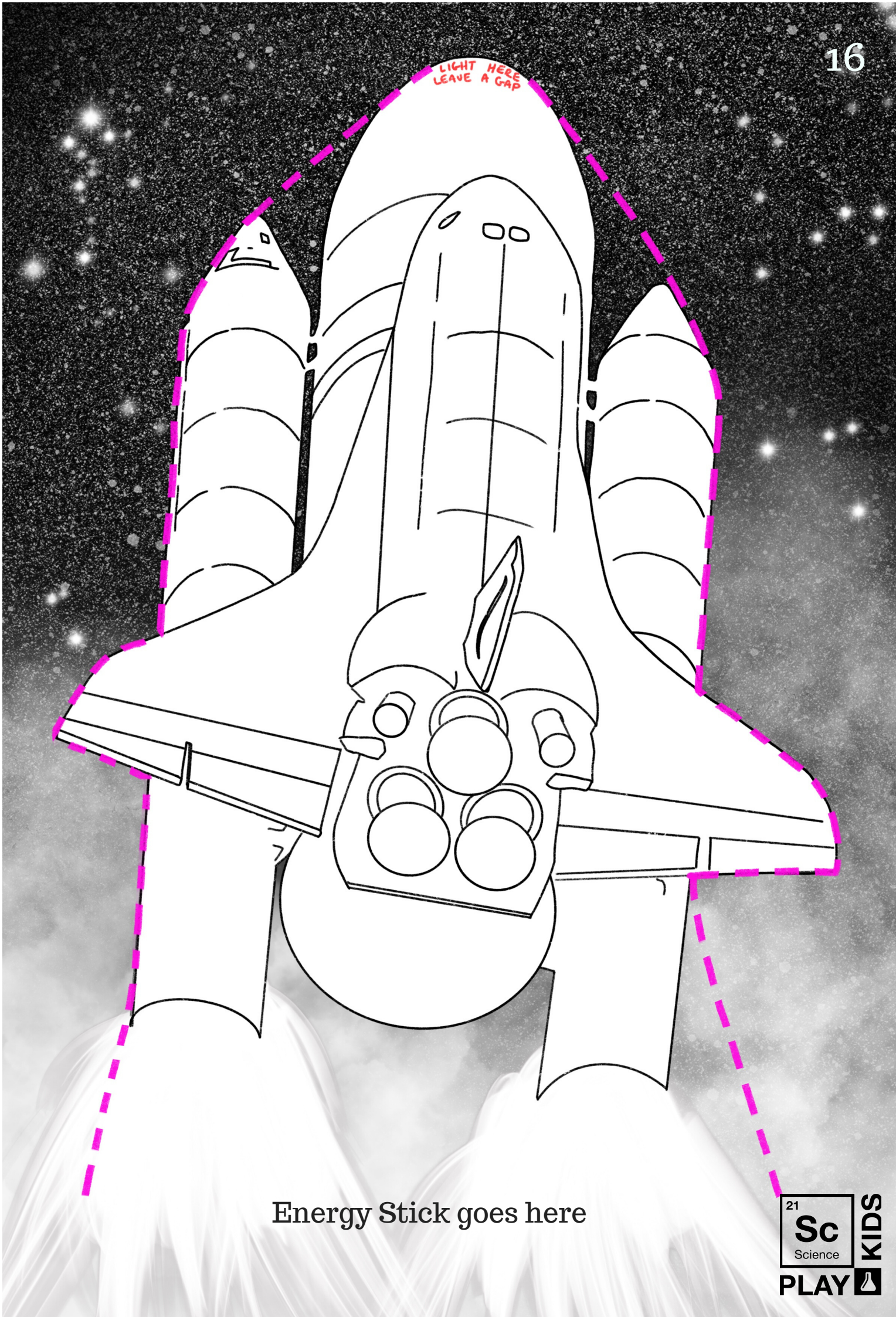
You will need one LED and two strips of foil.

The strips of foil are the 'traces'. A **trace** is a path that takes the place of a wire in a traditional circuit.

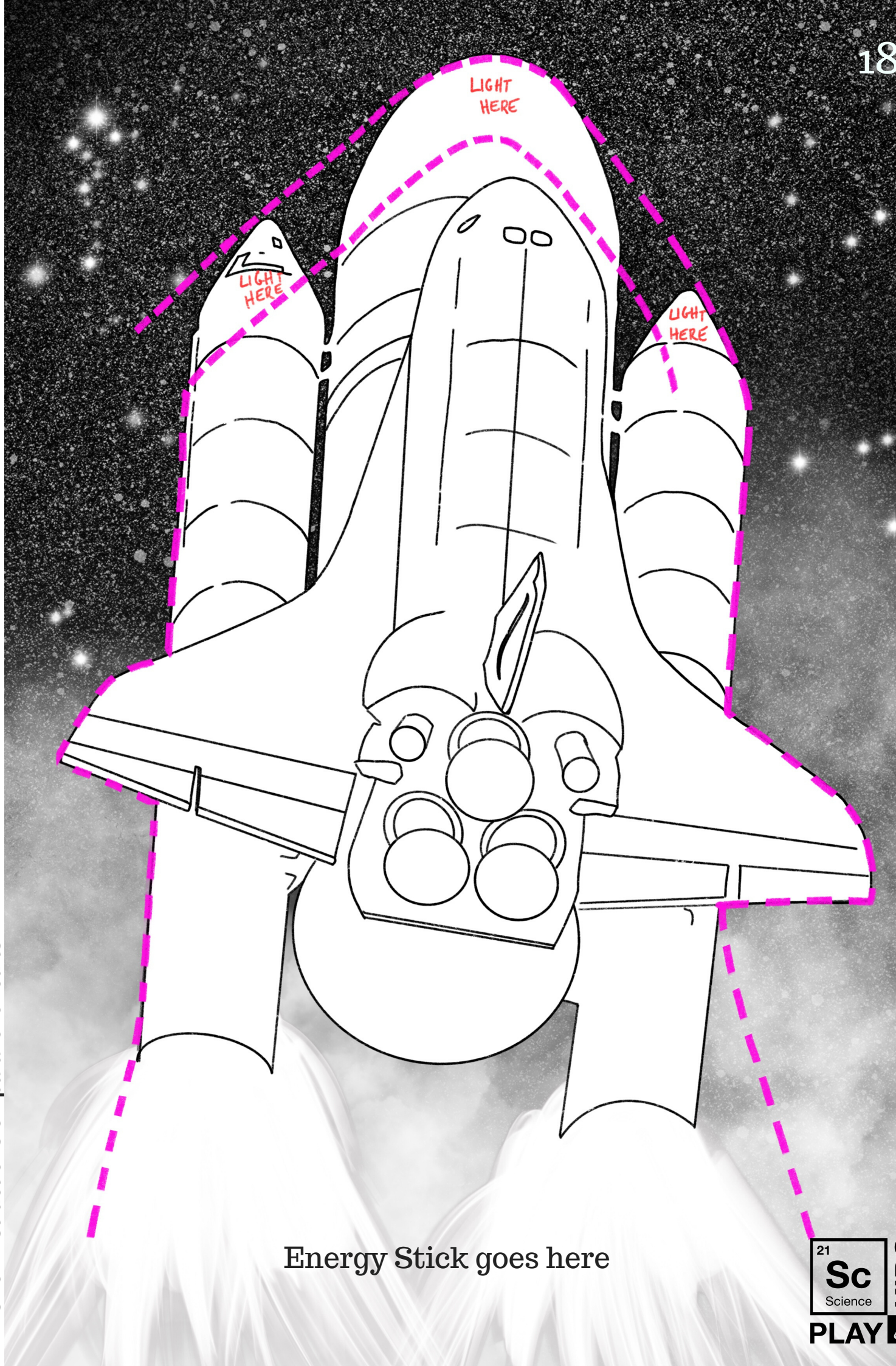
Remember, fold the foil into long thin strips. First, glue it over the dashed pink lines and LEAVE a small gap at the top of the rocket for the light. When you add the light, make sure the prongs are covered by the foil -you can put them under the foil and glue it down OR you can put them on top of the foil and sticky tape over the top to hold them in place.



Finish up your drawing however you like. Then take it into a darker room, touch the Energy Stick to the ends and watch as the electrons flow through the foil 'traces', through the LED and then back through the Energy Stick. **Chemical energy** is released from the battery in the Energy Stick and transformed to **electrical energy** as the electrons flow. When they reach the LED, this is transformed into **light energy**. The remaining electrical energy flows back through the Energy Stick and is transformed into more **light energy** and **sound energy**!!! Cool huh!



Energy Stick goes here

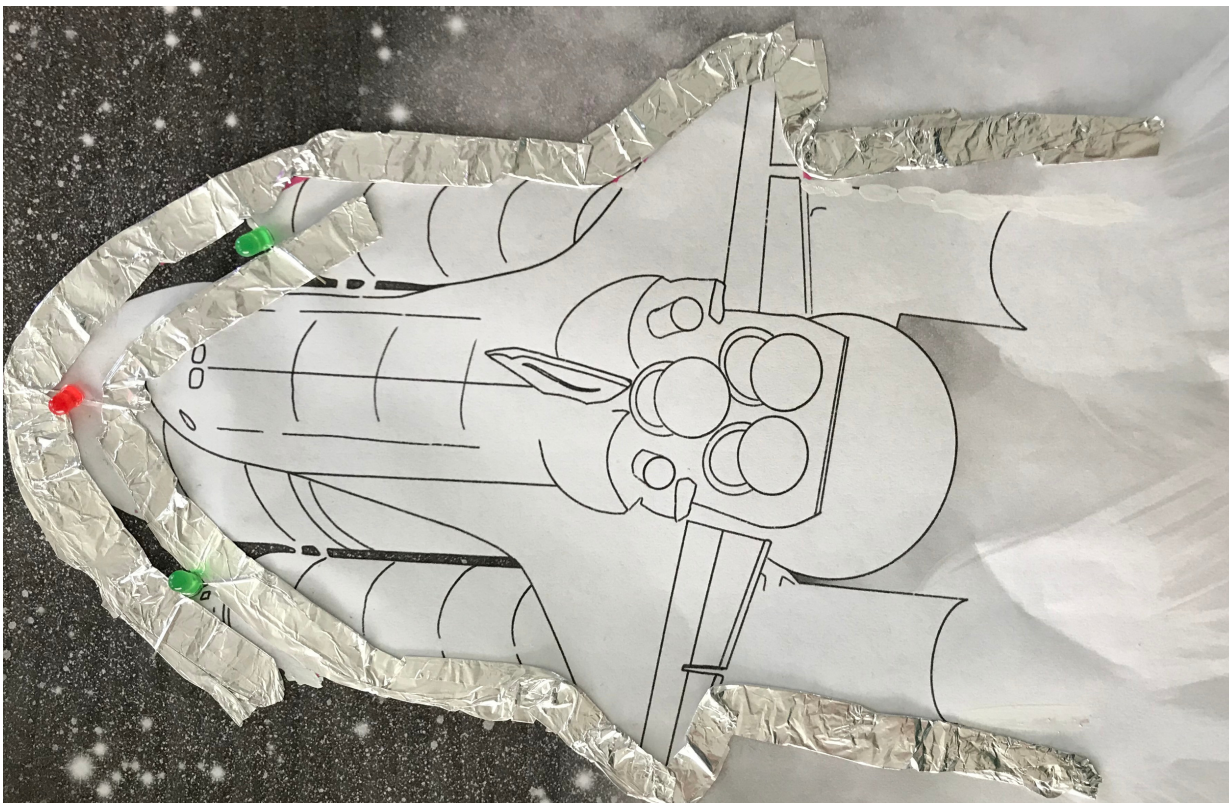


Energy Stick goes here

PTO for instructions on parallel circuits

Parallel circuits:

This time, let's build a **parallel** circuit. We can add more than one light in a parallel circuit. To do this we need to make sure that all the positive legs (the long ones, called anodes) of the LEDs are touching one foil strip and all the negative legs of the LED (the shorted ones, called the cathode), are touching the other foil strip. If one is the wrong way, it will not light up.



Parallel Circuits cont.

This parallel circuit uses three LEDs. See if you can complete the circuit and light up a few of the important steps in the development of ideas ie. thinking like a scientist!

Usually we start with a question, something we are trying to find out.
Then we do some research to find out what we can.
Next, we do some experimenting and test our hypothesis.
Once we have completed our testing, we analyse our results and come up with a conclusion!

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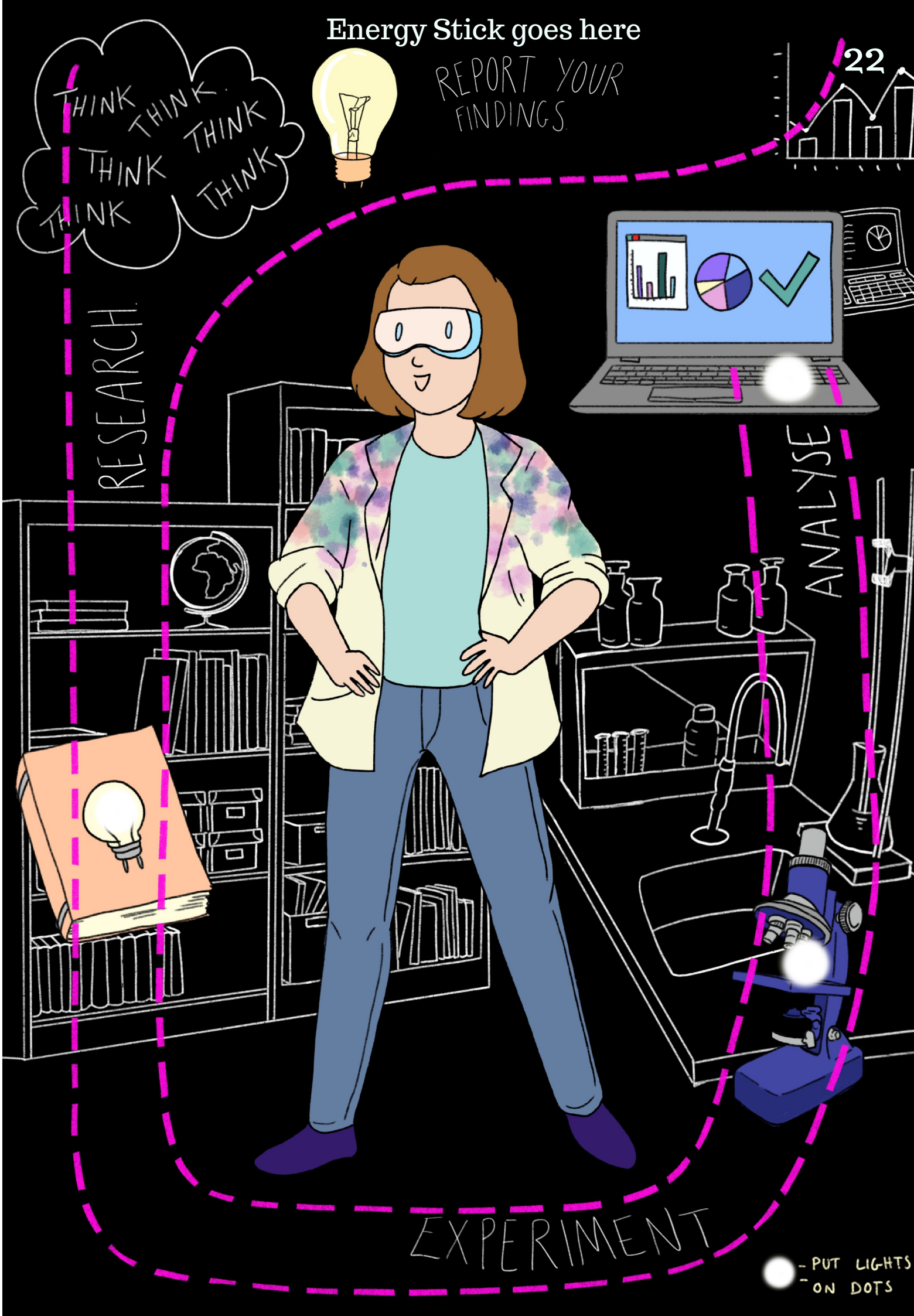


Energy Stick goes here

Electricity in our bodies:

Without electricity you would not be reading this page! That is not just because the computer used to make this document wouldn't work, it's because **your brain wouldn't work (nor would your heart or lungs for that matter)!**

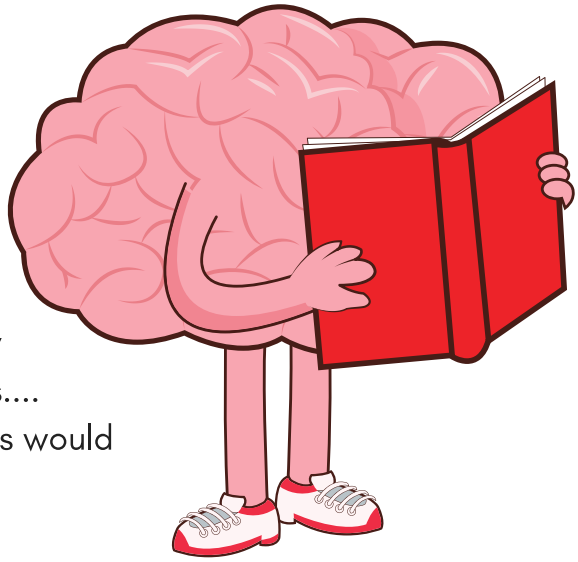
Everything we do is controlled by electrical signals that run through our body. These are **not** the type that harm us but are small electrical pulses that carry information from our nerves to our brains and from our brains to our muscles, making them contract, which in turn allows our body to move and groove.

The circuits in our body work a little differently to the circuits we are making here. There are no electrons flowing through the circuit, instead, an electrical charge, triggered by an imbalance of 'ions', like potassium and sodium, allows an electrical message to jump from cell to cell. This sounds a bit complicated, but basically one cell tells the next cell a message and then that cells tells the next cell and then that cell tells the next cell and so on and so forth, kind of like a chain reaction.

These electrical signals are super fast. Think about how quickly you feel the cold when you touch an ice block or pain when you step on something sharp. The nerves on your fingers or foot sense the icy cold (or pain) and, almost instantly, this information is sent from the cells in your finger or foot all the way to the cells in your brain in a millionth of a second.

How does it work? (In a bit more detail for those who are interested).
Right now, all the cells in your body that aren't sending signals, are negatively charged. When your nerves want to send a signal to your brain, the cell opens a gate and lets some 'ions' in and some 'ions' out. This makes the cell slightly more positively charged and acts like flipping on a switch. The electrical 'impulse' can now flow to the next cell, in turn triggering its gates to open and letting the ions flow in and out. This then results in this cell becoming more positively charged, enabling the electrical 'impulse to flow to the next cell and so on and so forth, like a chain reaction.

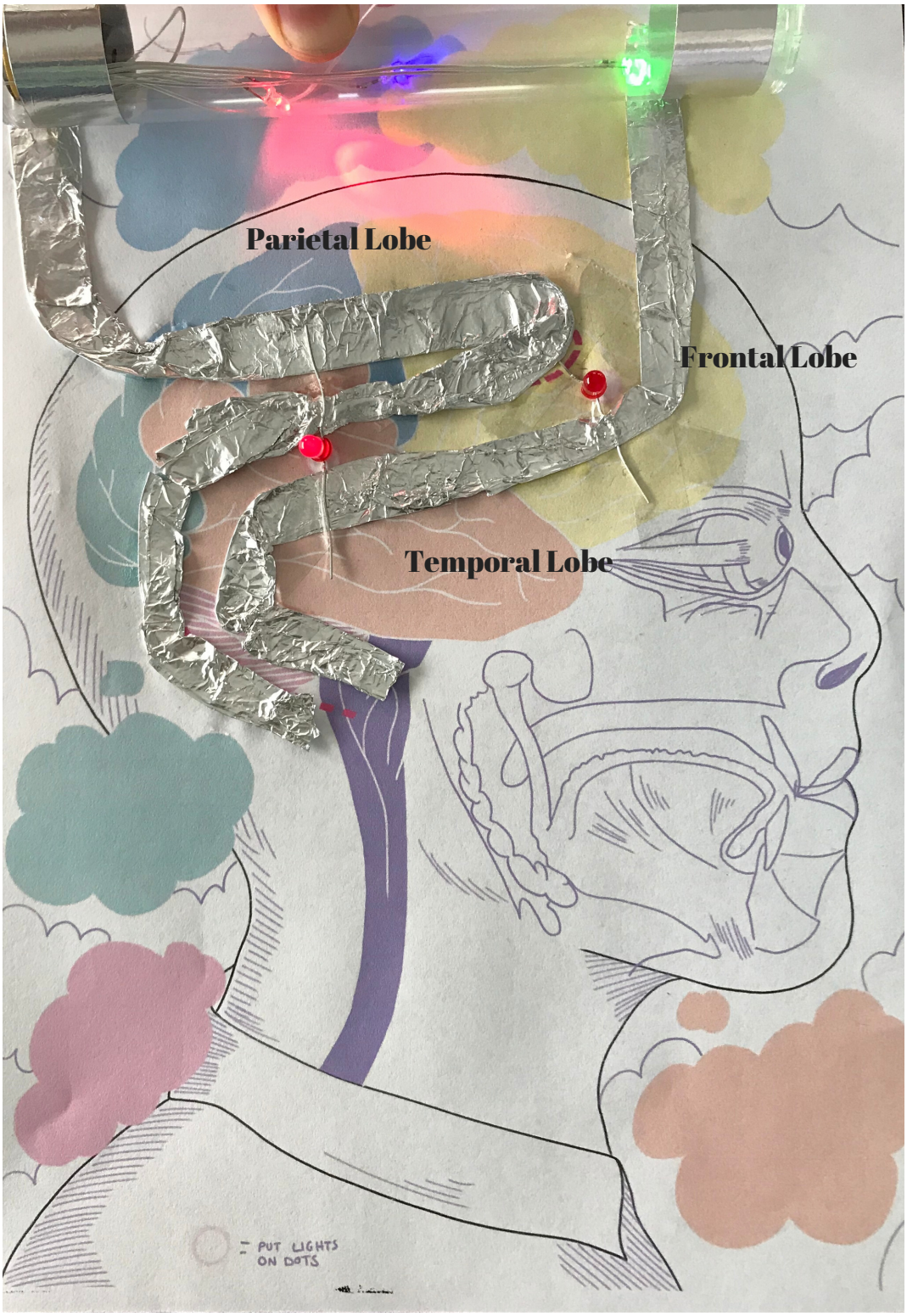
These messages, sent as electrical impulses, are what allows us to read the words on this page and understand them, move our arms around so we can glue on the foil strips in the following experiments and see the lights flash and hear the buzzer in the Energy Stick. Without electricity in our body we would not be able to do any of these things.... in-fact, our heart would not pump and our lungs would not breath, so electricity IS ESSENTIAL for life.



Parallel Circuits cont.

Can you create a parallel circuit that lights up different areas of the brain at once? The brain is made up of different compartments that are responsible for different things.

Touch, smell and hearing are associated with three different parts of the brain, - the Parietal, Frontal and Temporal lobes, respectively. The frontal lobe is also where problem solving occurs, while memory, understanding and language are associated with the temporal lobe. If we learn through experience and hands on experimenting, like making, touching, seeing, hearing, experiencing an emotion and really creating, like you are doing now, the information we are taking in is stored in many locations across the brain and is much easier to recall later on.



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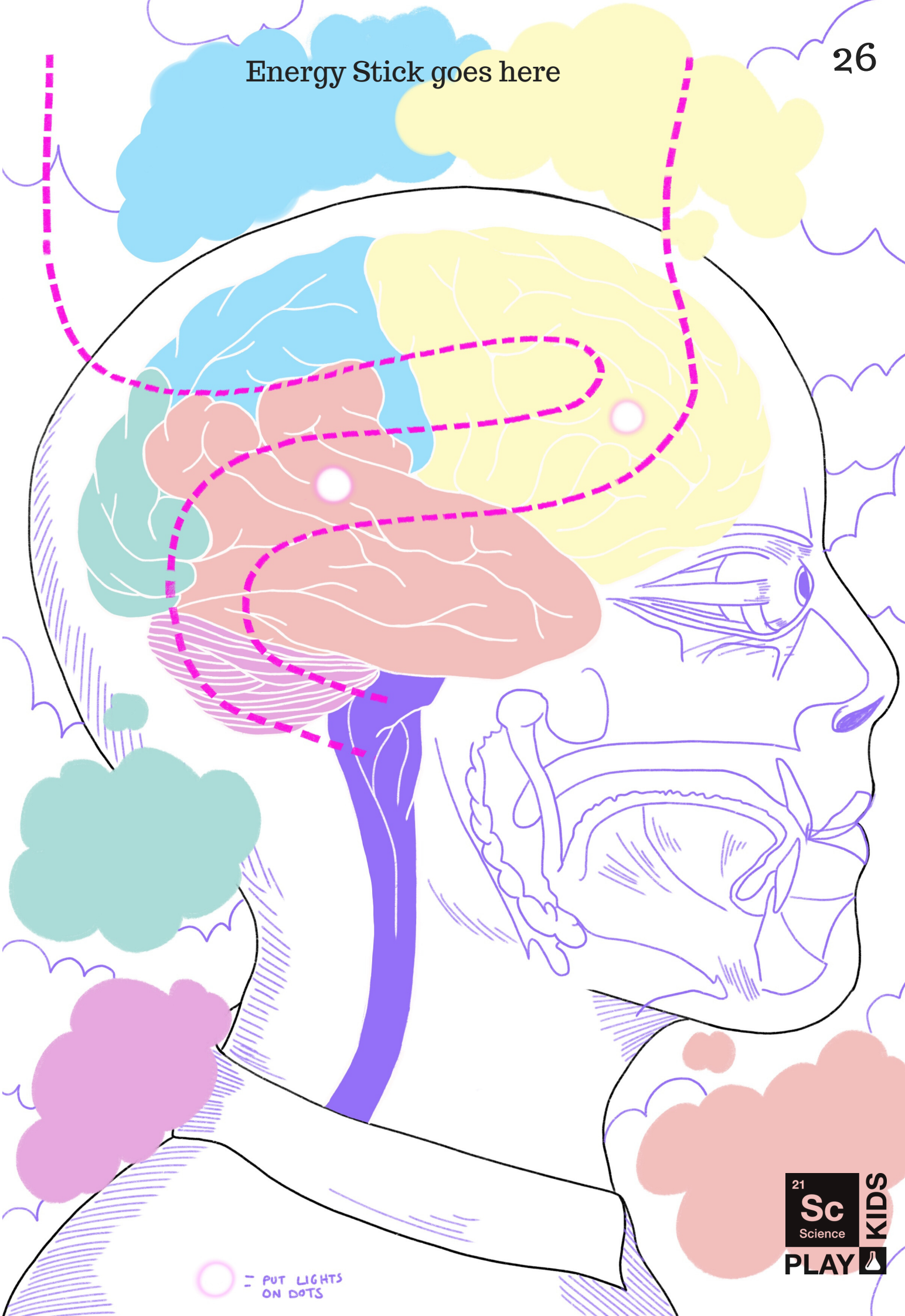


Electricity in our streets:

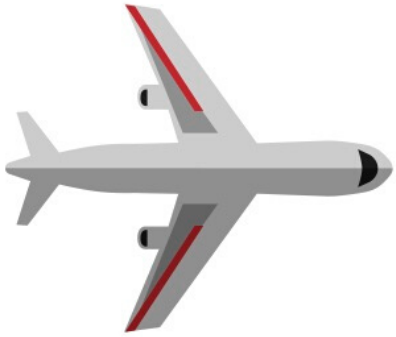
We use electricity when we travel too. Cars have a battery that provides energy to the car (along with petrol). The headlights, interior lights, air conditioning, heating, radio and other systems in your car need electricity to work.

Some new cars don't use petrol. Instead, they can be plugged into the wall. Scientists are working on inventing cool new cars that can use the chemical energy stored in food (just like our body does when we eat) to power the car - imagine putting compost and food scraps into the to get it started in the morning... amazing!

On the road, we use electricity for traffic lights. The electrical energy is converted into light energy that lights up the red, orange and green lights we use to tell us when it is safe to 'go' or when we should slow down and stop.

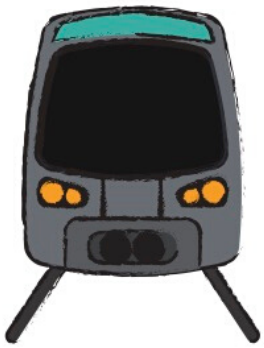
At night, street lights light up the roads so we can see where we are going.

What about a tunnel? Without lights guiding the way, it would be very dark and dangerous to drive.



Aeroplanes use light to guide them when they land on the runway.

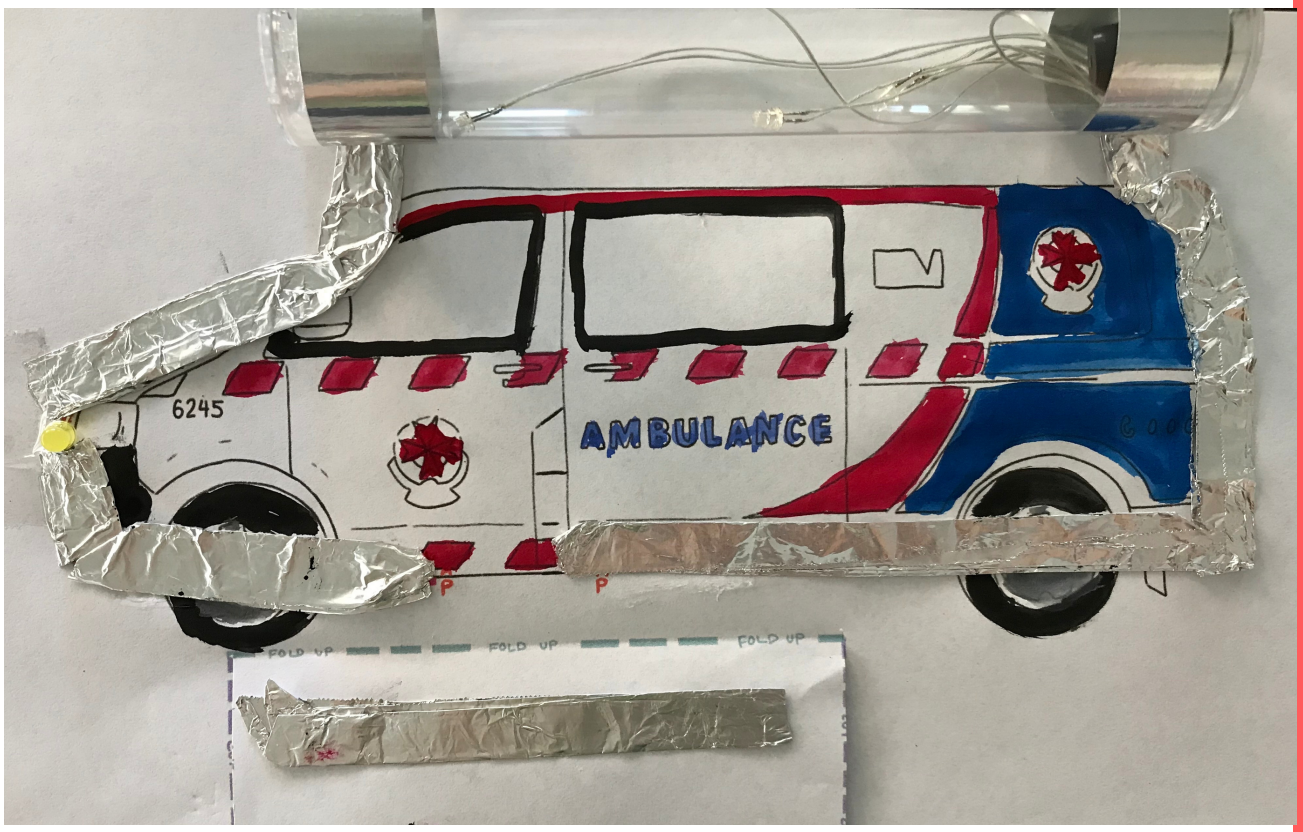
Trains and trams cannot run without electricity either.



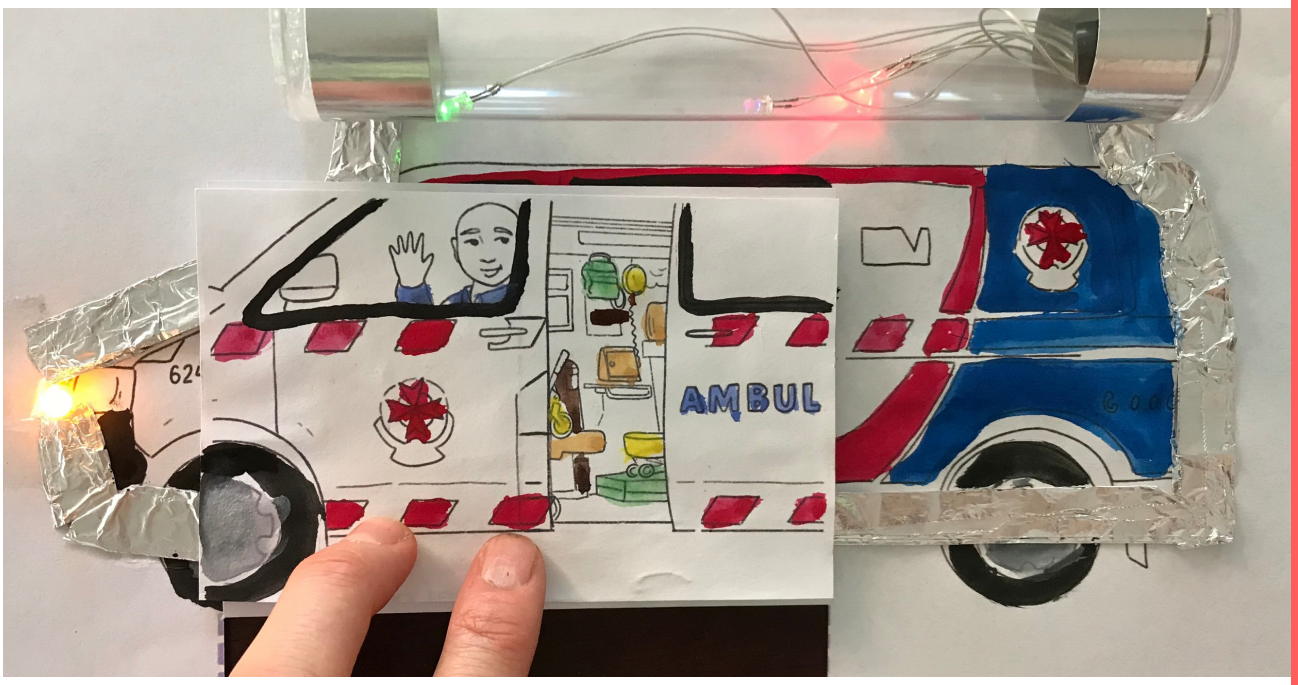
Switches:

Switches are a gap in the circuit that stops the flow of electrons. We call the switch 'open' when there is a gap. When you 'close' a switch, and thus close the gap, you allow the electrons to flow again, the circuit is complete and the light will glow.

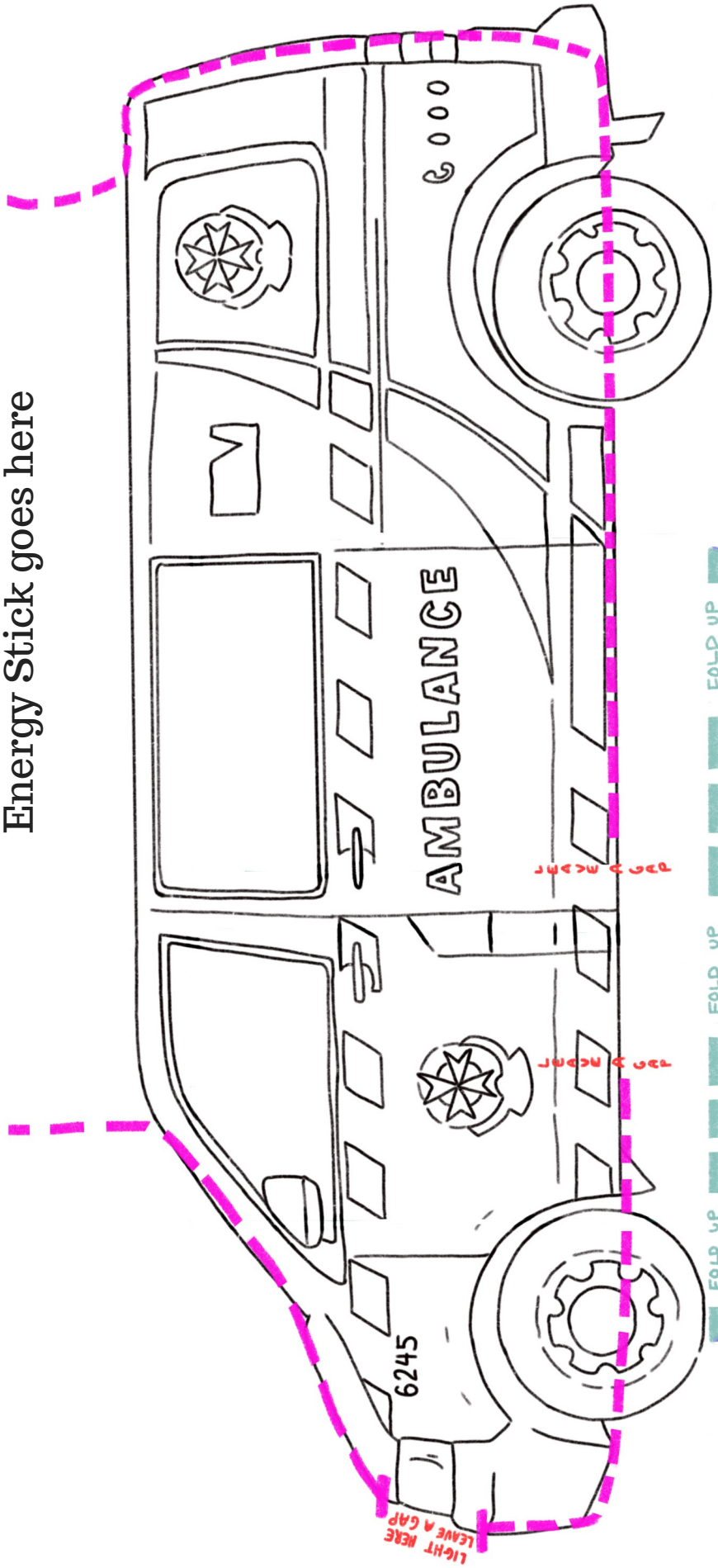
See if you can create this circuit: (make sure you leave a gap on the bottom of the drivers door and don't forget to glue some foil on the flap to make the switch).



Now watch what happens when you flip up the flap (this is the same as 'turning on' the switch). The foil strip on the back of the flap closes the gap in the circuit and the electrons flow all the way through to the LED and back into the Energy Stick!



Energy Stick goes here




AMBUL

Living in the dark:

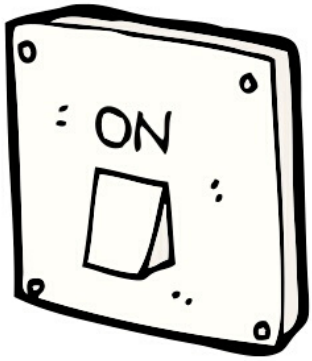
At night, how do we see?

During the day we have light energy and heat energy provided by the Sun. During the night, when our planet has rotated away from the sun, we no longer have access to these energy sources so we need to find another way to provide light and heat.

We use electricity instead. This allows up to turn on the lights so we can see what we are doing.

Have a look around your house. How many lights do you have in your home?

How many light switches are there in your house?



The switches on the wall of you house function the same as the switches you are making with foil in these experiments. When the switch is 'OFF' there is a gap in the circuit but when you turn the switch 'ON', you close the gap in the circuit and electrons can flow to the light bulb where the **electrical energy** is converted into **light energy**, lighting up your room.

What about animals outside? Do they have lights?

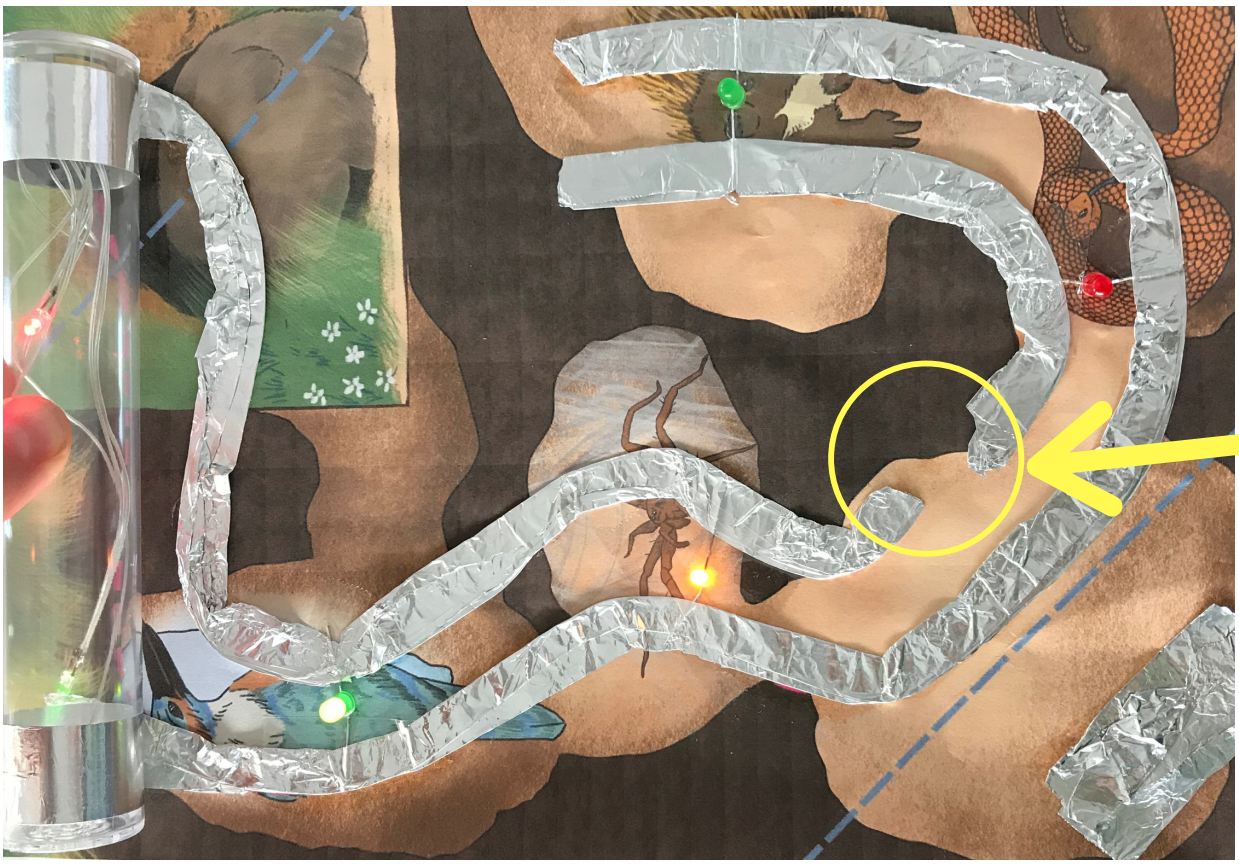
Some animals live in burrows where it is super dark. Living in burrows means that animals can be protected from the weather (rain, cold, hot) and from other animals.

Unlike us, these animals don't have electricity to light up their homes. Some can see in the dark though!!

Let's make a circuit on the next page and see if we can light up the homes of these burrowing animals.

More on Switches

Can you build a circuit so that each of these burrowing animals has a light (yes, Kingfishers, echidnas, spiders and snakes burrow too). When the switch is open, the Kingfisher and spider holes should light up, but the current cannot flow across the gap to extend the circuit to the snake and echidna. If, however, you close the switch by folding over the flap, the remaining two burrows should light up too!



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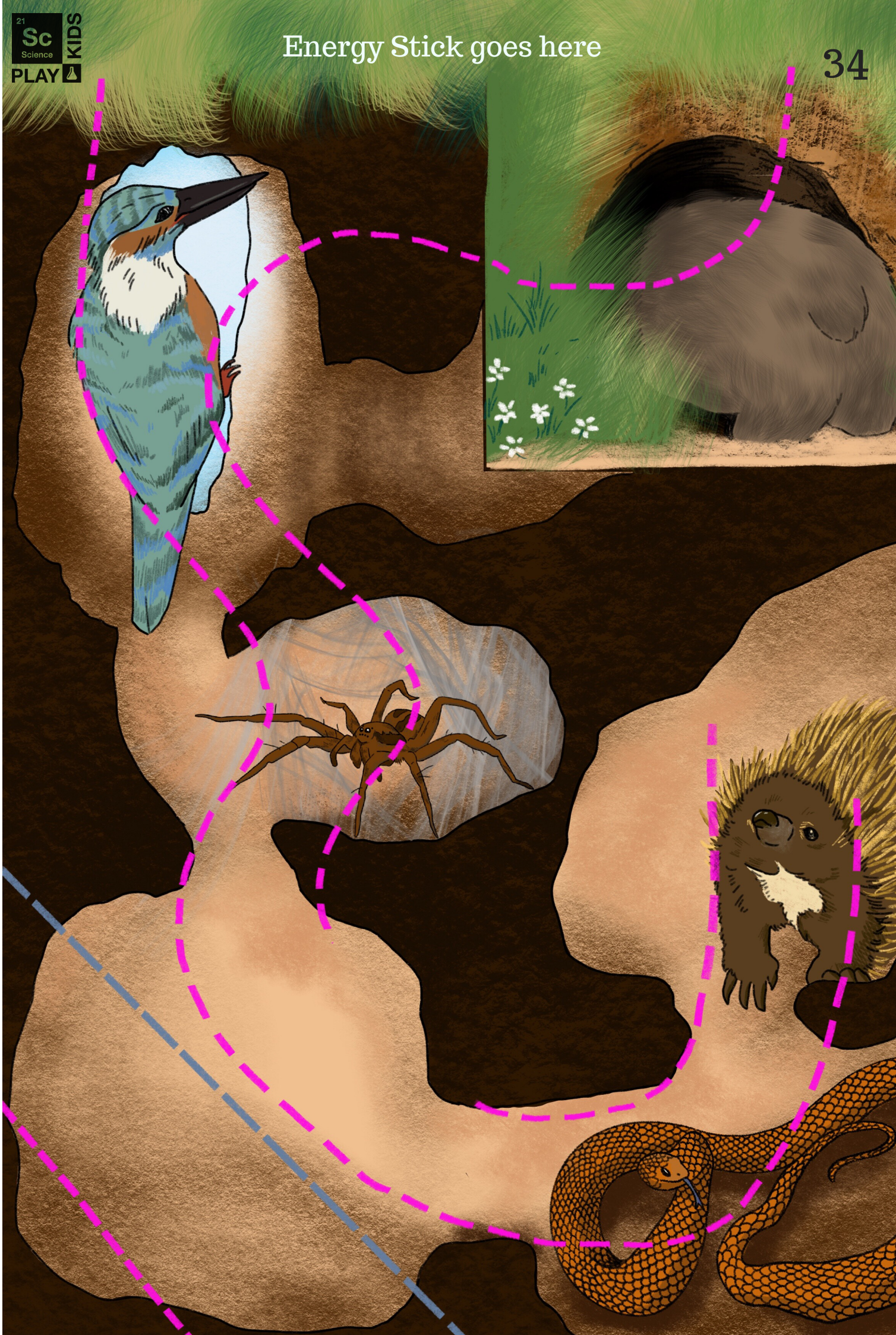


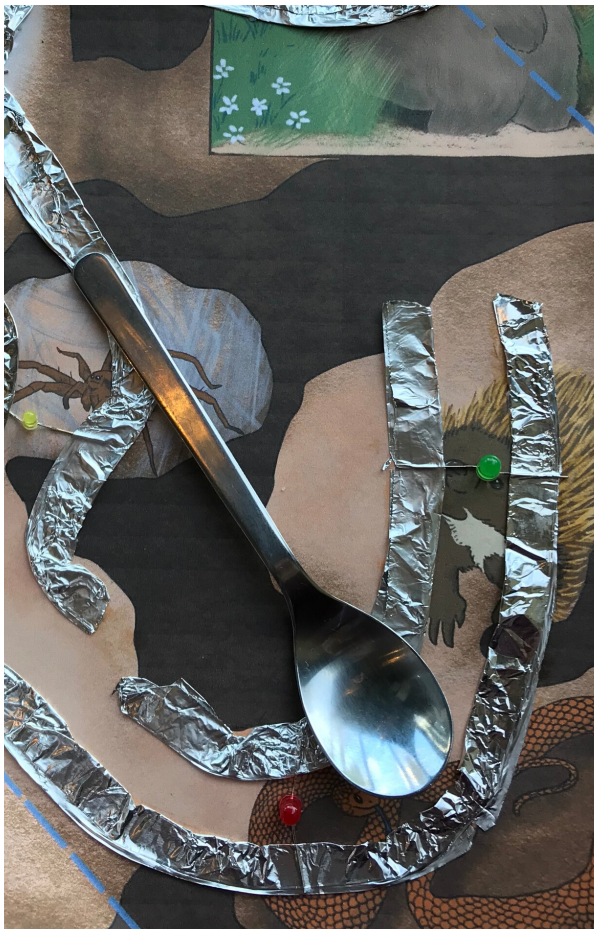
Energy Stick goes here

Closing the gap with other conductors

Remember in the first experiment you tested lots of different materials to see if they conduct electricity?

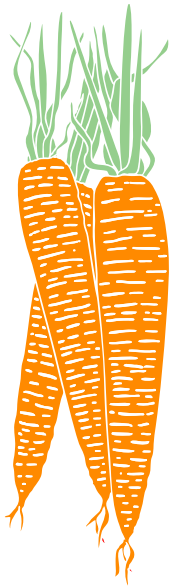
Let's experiment some more:
Instead of making your switches out of foil, could you use a different type of conductor to close the gap in the circuits you've already made? Think back to all the items you tested earlier, would any of them work?

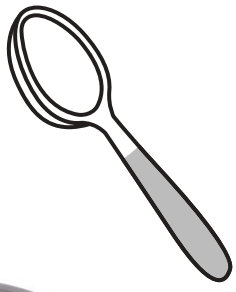
Instead of using foil to close the switch in this circuit, I used a spoon. Would a paperclip work? How about a carrot? See if you can add 'different' conductors to the circuits with gaps (police car, ambulance and fire truck) to close the gaps and let electrons flow.

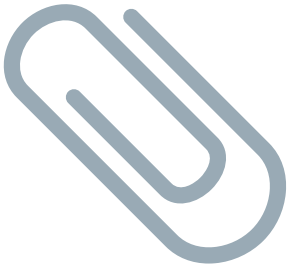


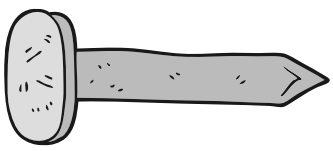
Some conductors will close the circuit and light up the Energy Stick but won't let through enough current to power the LEDs. Which types of conductors are these ones?

Here are some other items you could try:







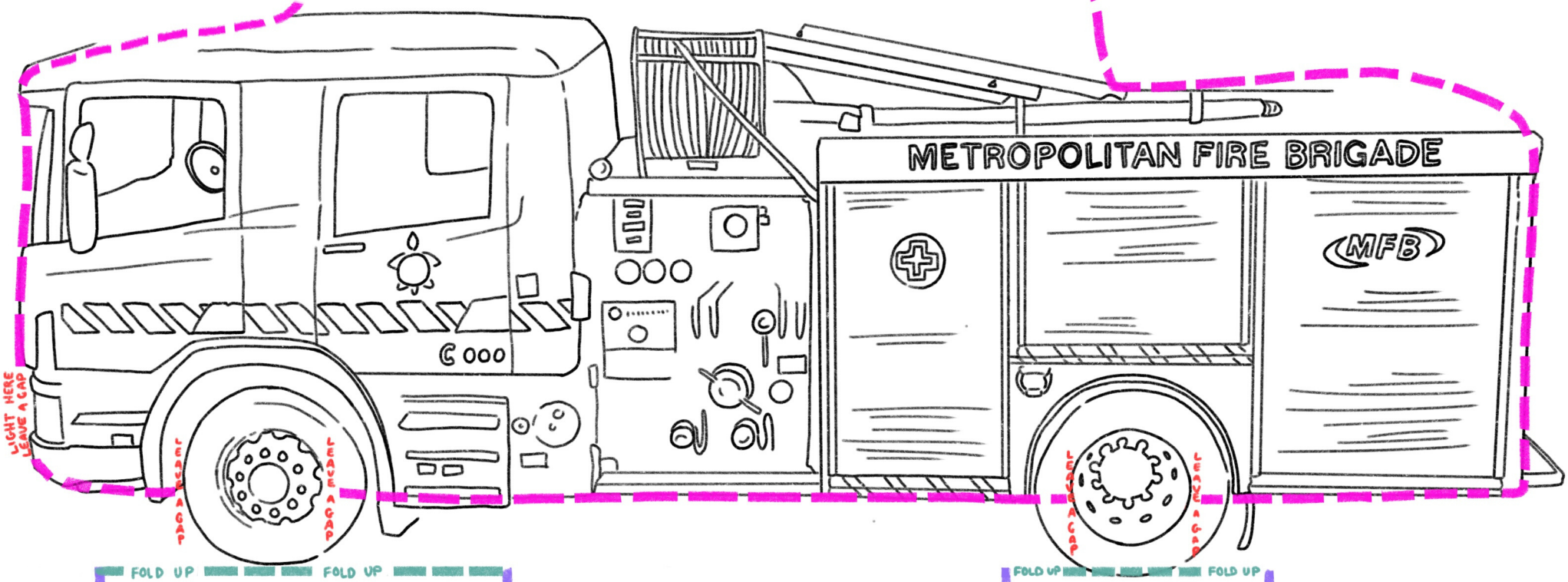


'AND' Switches

We can add more than one switch in a circuit. In the Fire Truck circuit, there are **TWO** gaps for a switch and **TWO** flaps with foil strips that can close the switches. For the circuit to be complete **BOTH** switches need to be closed at the same time. This is called a 'logical AND' switch because you have to press Switch 1 *AND* Switch 2 to get electrons to flow.

Make the circuit below and experiment with these switches. What do you hypothesise will happen if you only close the left switch? or the right switch? or both switches?

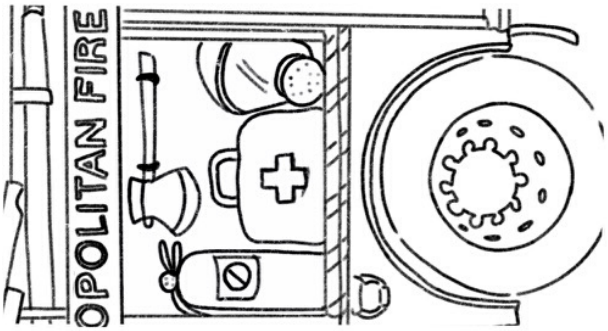
Energy Stick goes here

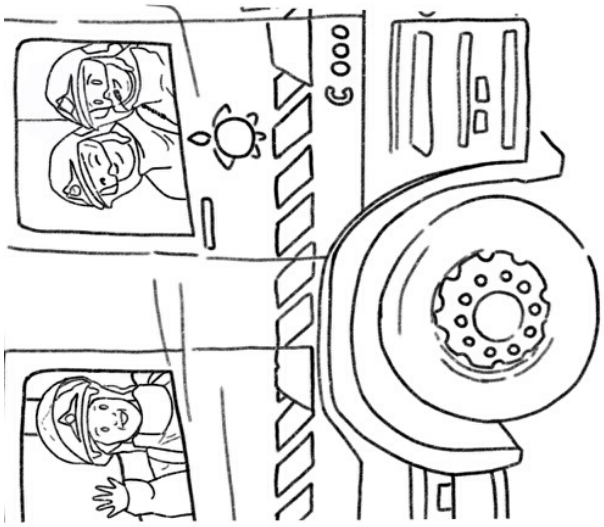


FOLD UP FOLD UP FOLD UP FOLD UP

CUT CUT CUT CUT CUT CUT

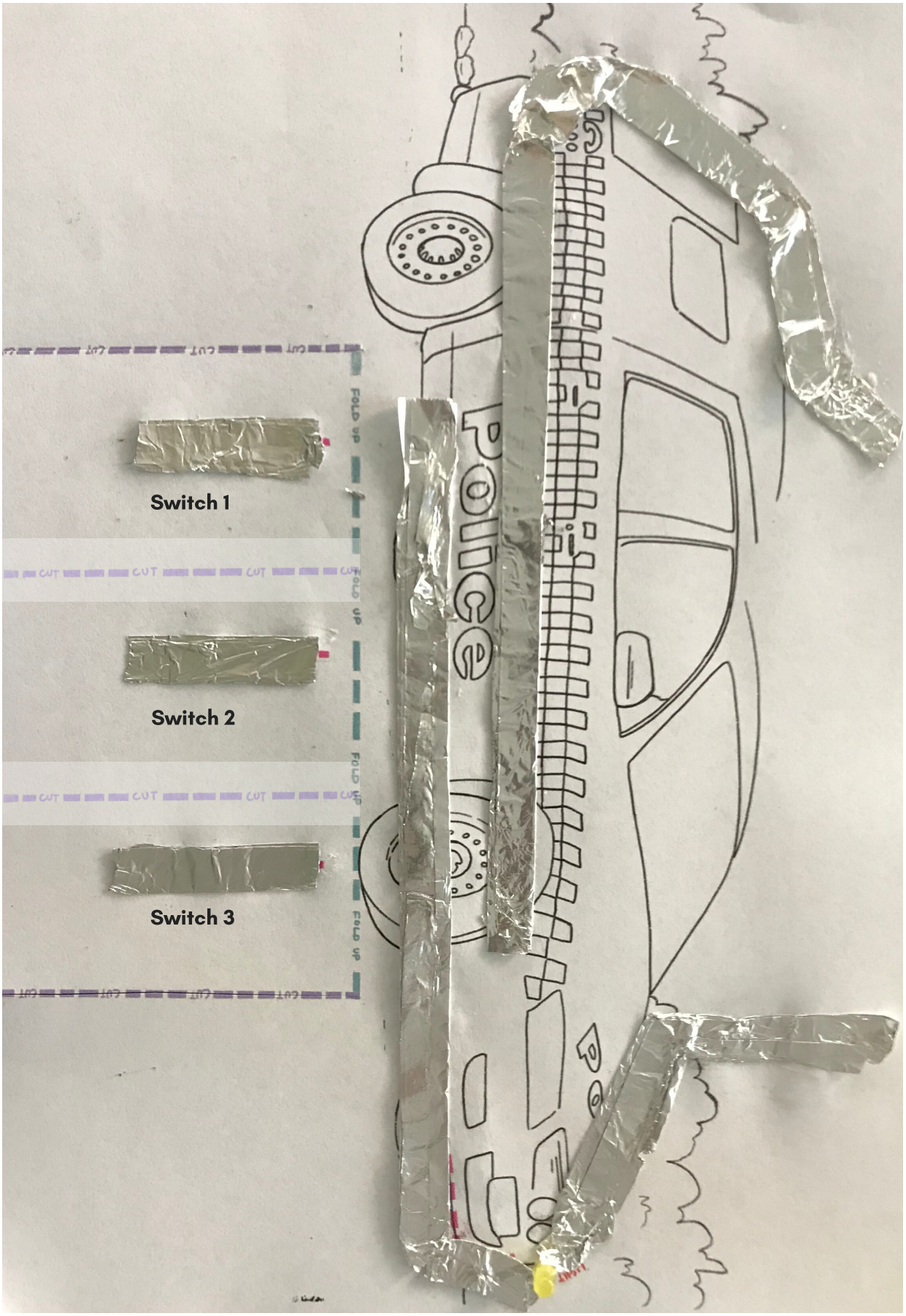
PLAY Sc 21 Science KIDS


OPOLITAN FIRE



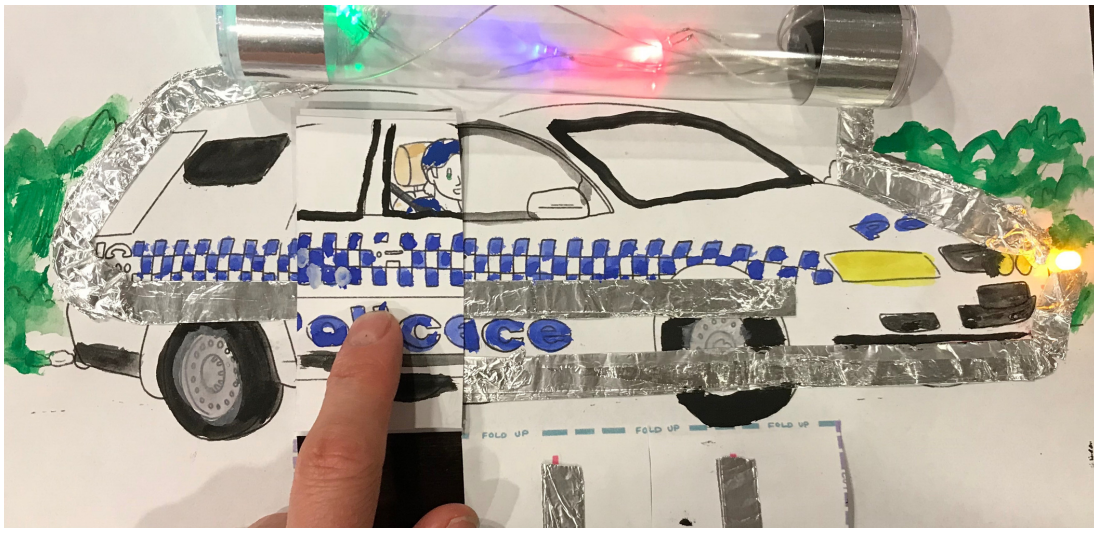
OR switches:

A circuit can also be designed so that it has more than one switch but so that only switch one OR switch two need to be closed for the circuit to be closed.

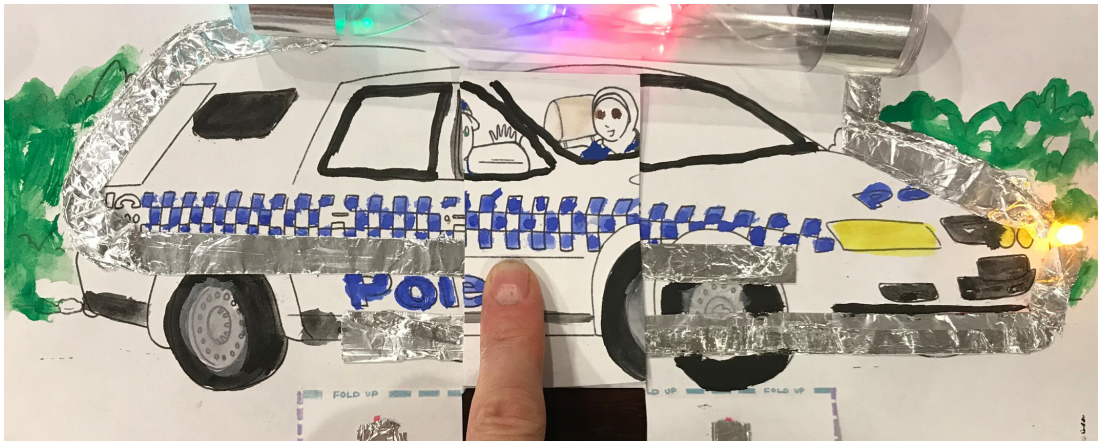


OR Switches continued

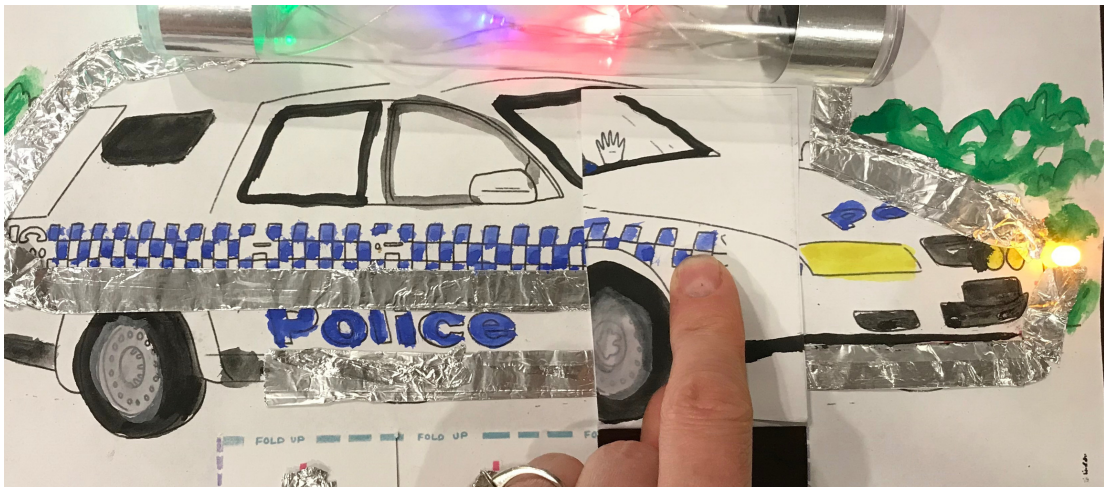
Now, let's test your circuit to see which switch, when closed, makes your LEDs light up:
Does closing Switch 1 let the electrons flow?



Does closing Switch 2 let the electrons flow?



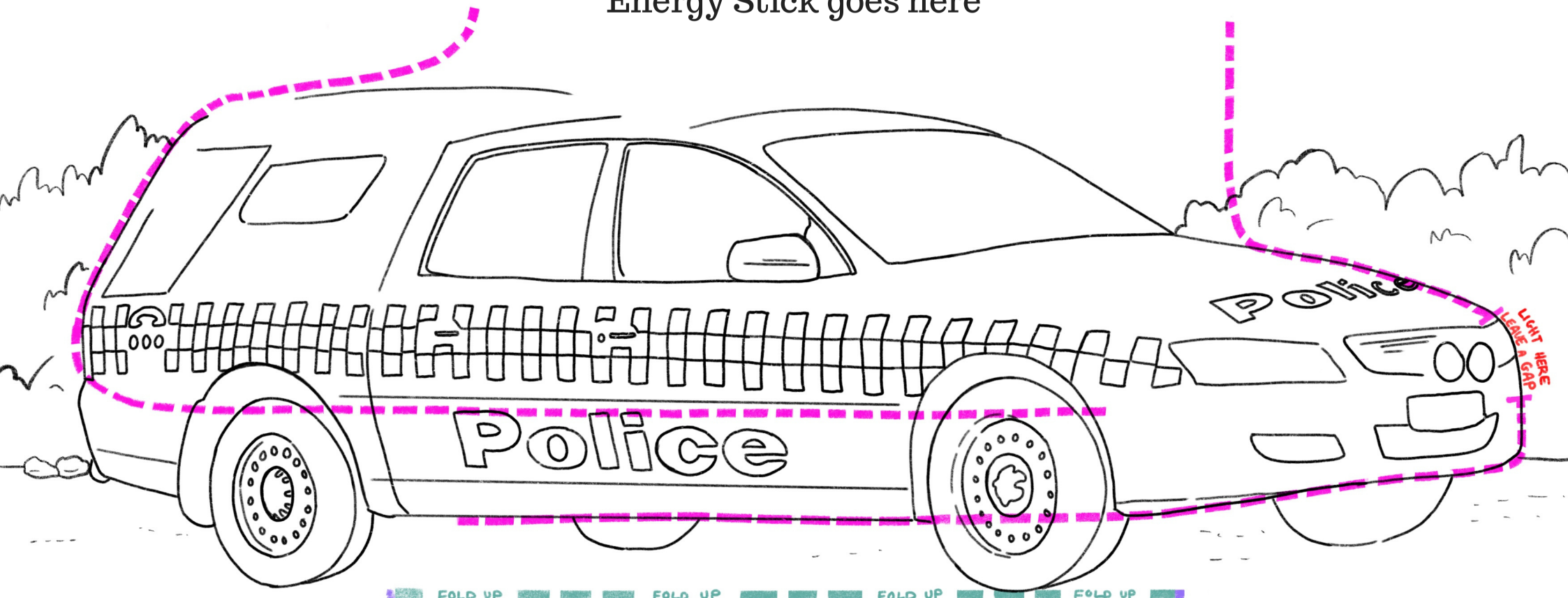
Does closing Switch 3 let the electrons flow?

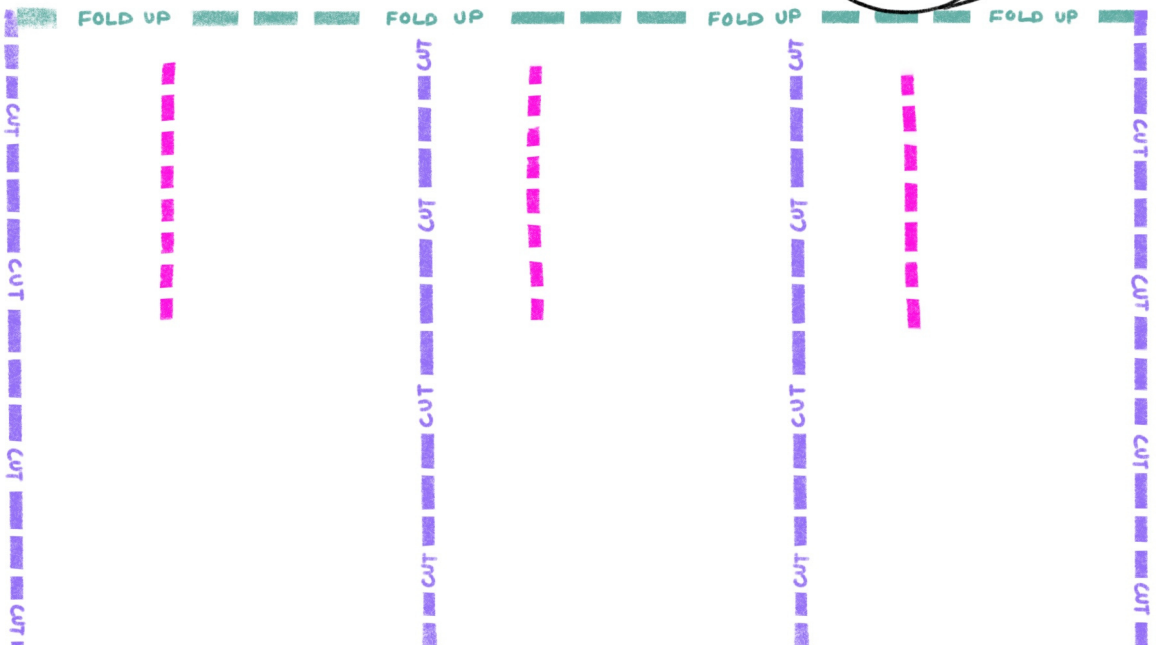


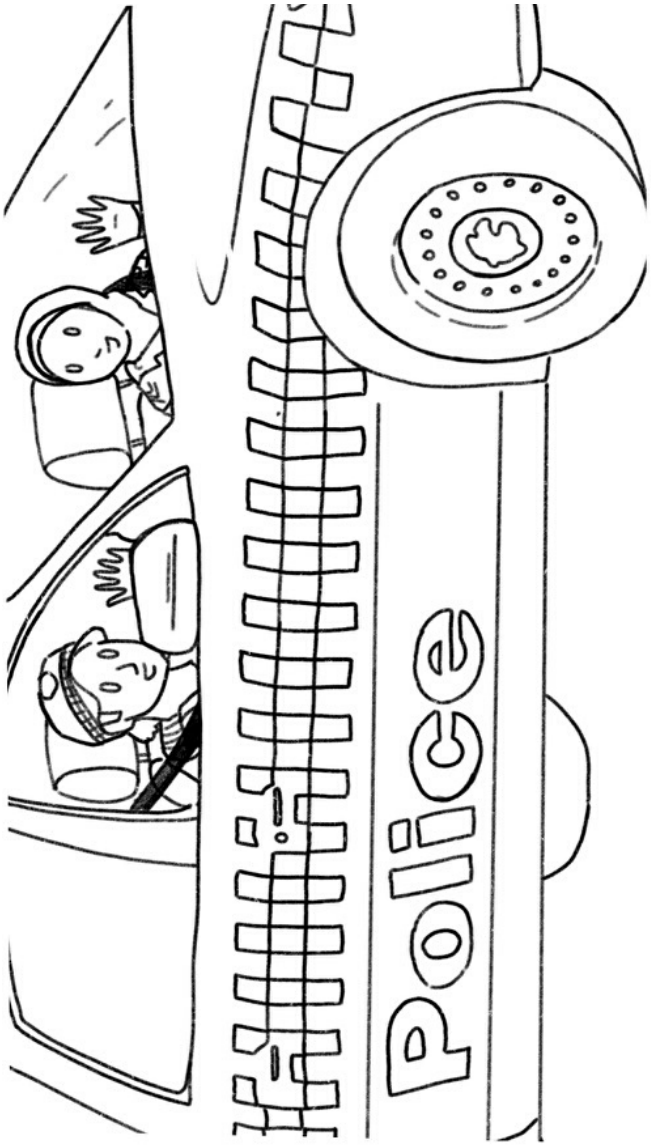
YES, yes and yes - so this type of switch is a 'logic OR' switch because closing Switch 1 **OR** Switch 2 **OR** Switch 3 completes the circuit.

What else could you use as a switch to close the circuit? Something that conducts electricity..... (test some items from the first experiment, like a metal spoon or metal lid).

Energy Stick goes here






Police

Let's dance!

This circuit has no LEDs, just 'OR' switches that will allow the Energy Stick to light up. Make each child dance to light up the Energy Stick:

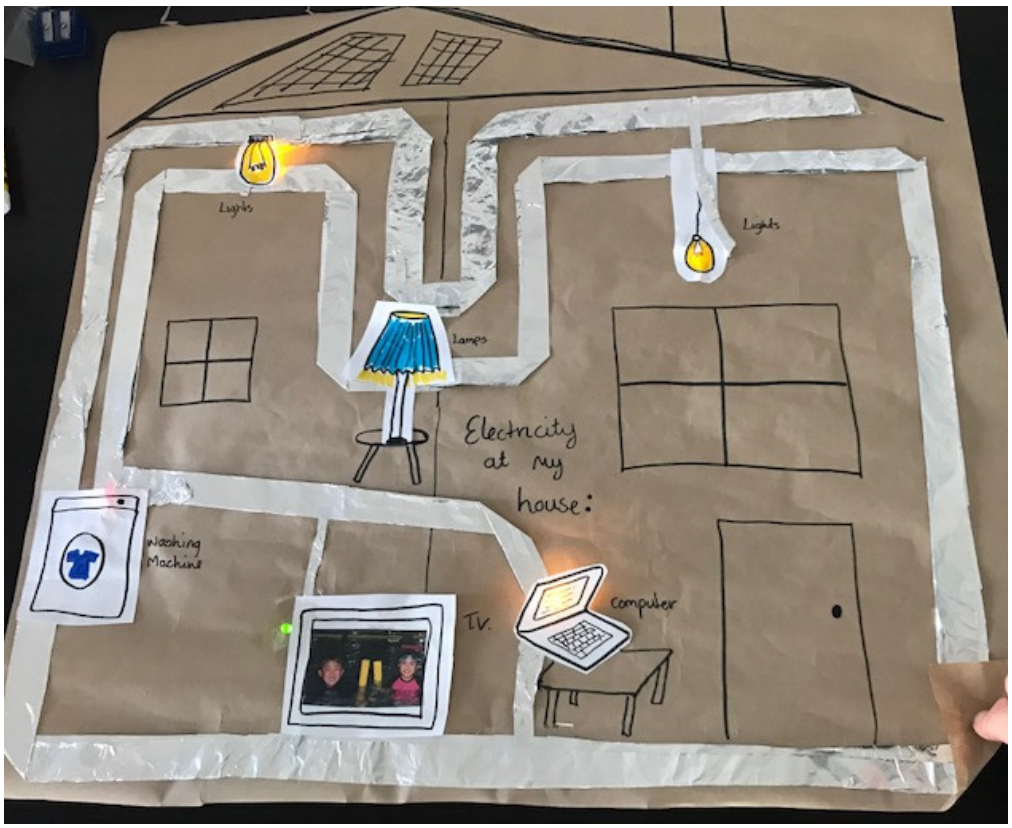
FOLD UP FOLD UP FOLD UP FOLD UP FOLD UP FOLD UP FOLD UP FOLD UP

CUT CUT CUT CUT CUT CUT CUT CUT

Some ideas to explore further:

Don't stop at the experiments listed in this booklet, make your own.

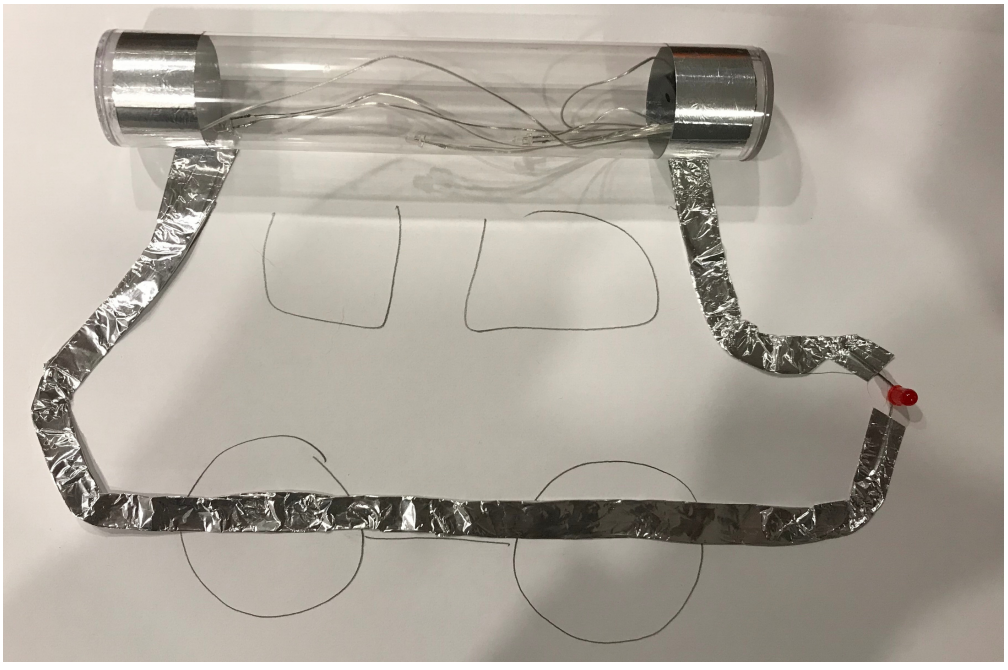
Can you draw a house and create a circuit that connects all the things in the house that conduct electricity?



Or design and draw your own machine/robot?

Glue on a circuit and add in some lights. How many lights can you put in the circuit?

How long are the foil 'traces'?



Light up badges

Materials:

- Round badge backs
- Glue stick
- Scissors
- Small LED light
- Badge you have chosen to cut out from opposite page
- 3V batteries (you need to supply these **PLEASE** only use if you have **no** small children in the house.
- Good quality tape (gaffa etc)

Method:

1. Cut out the badge from the opposite page and glue it to the front of the wooden badge.

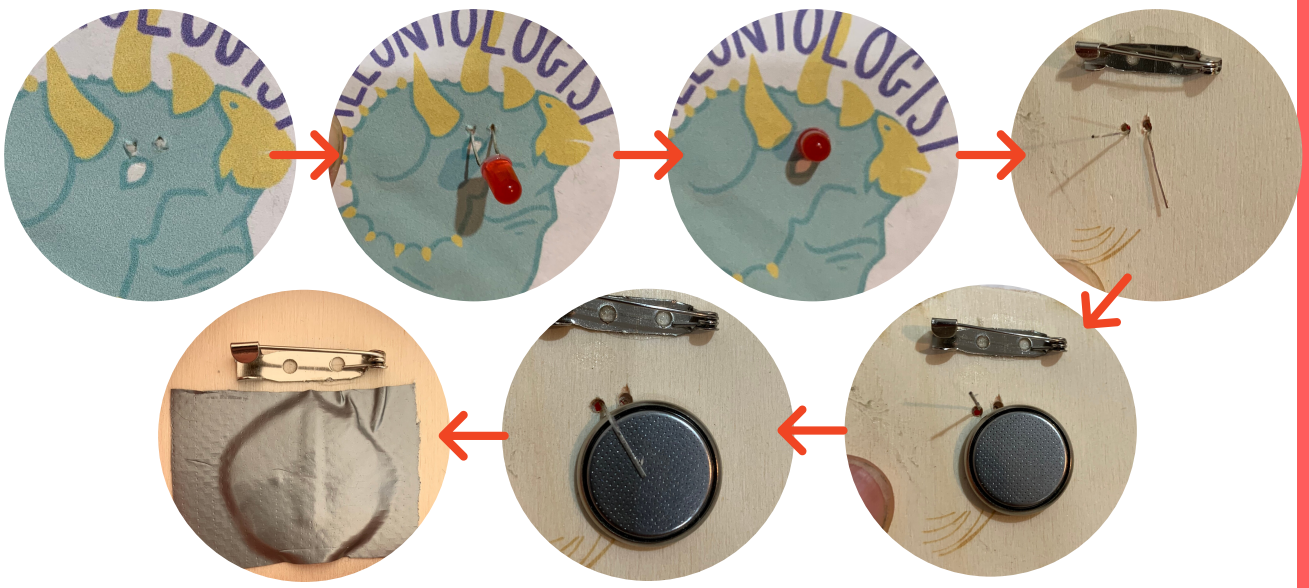
2. Turn badge over and poke holes through the paper where the holes in the wood are. Turn the badge back over and poke the prongs of the LED through to the back.

3. Flatten the longest of the prongs down, place the 3V battery on top, '+ve' side down, and then flatten the other prong (the shorter one) onto the side of the 3V battery that is facing up (should be the '-ve'.

4. Secure the battery and legs in place by sticking a big, strong bit of tape on top.

5. The LED will stay on as there are no switches in our circuit. To turn it off, take the tape off and place the button battery in a SAFE place (away from reach of any small children). When you are planning to wear your badge again, pop the battery back between the LEDs prongs and tape it securely.

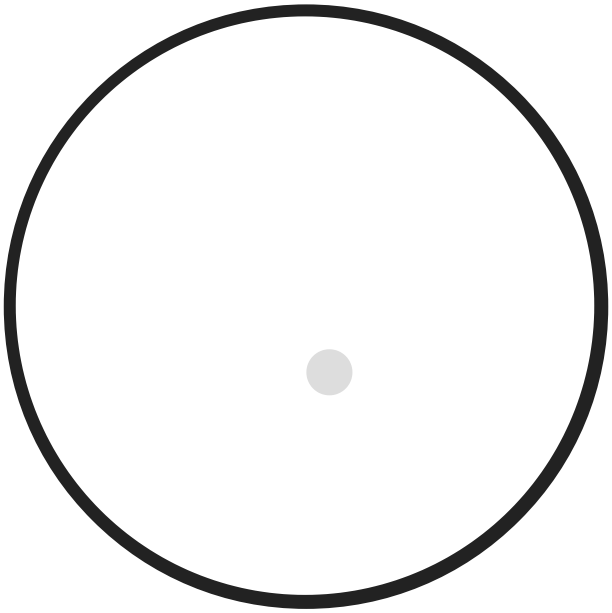
PLEASE NOTE: You must tape the back down very securely when wearing the badge. If the battery accidentally falls out it may land on the floor and become a VERY dangerous choking (and death) hazard for small children.



Light up badges

If your child is responsible enough to use a 3V battery without eating it, and you have no small children crawling around the floor picking up small objects that have fallen, then you can conduct these experiments. You will need to purchase a 3V battery, size DL2032/CR2032 (or similar) to do so.

Below are some coloured badges you can use, or you can draw your own design too.



_____'s Lab Book

Conductor – electricity flows thro

Insulator – NO flow of electricity