AGASTYA
INTERNATIONAL FOUNDATION
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Papertronics

Learn Invent Explore

Play with simple circuits and experiment with electronics.

Embark on an electrifying journey through Circuit Study with Nilu and Pilu. Explore circuits from basic components to complex designs.

Get hands-on with copper strips, LEDs, and switches, and create your own circuits using everyday materials. Dive into the world of electronics and discover how circuits power our daily lives.

Table of Contents

Nilu and Pilu, start their day early. The alarm clock buzzes at 7 AM, and Pilu turns off the lamp on the bedside. They get ready and head downstairs for breakfast.

Switching a lamp on or off is a simple circuit, lets build one to understand!

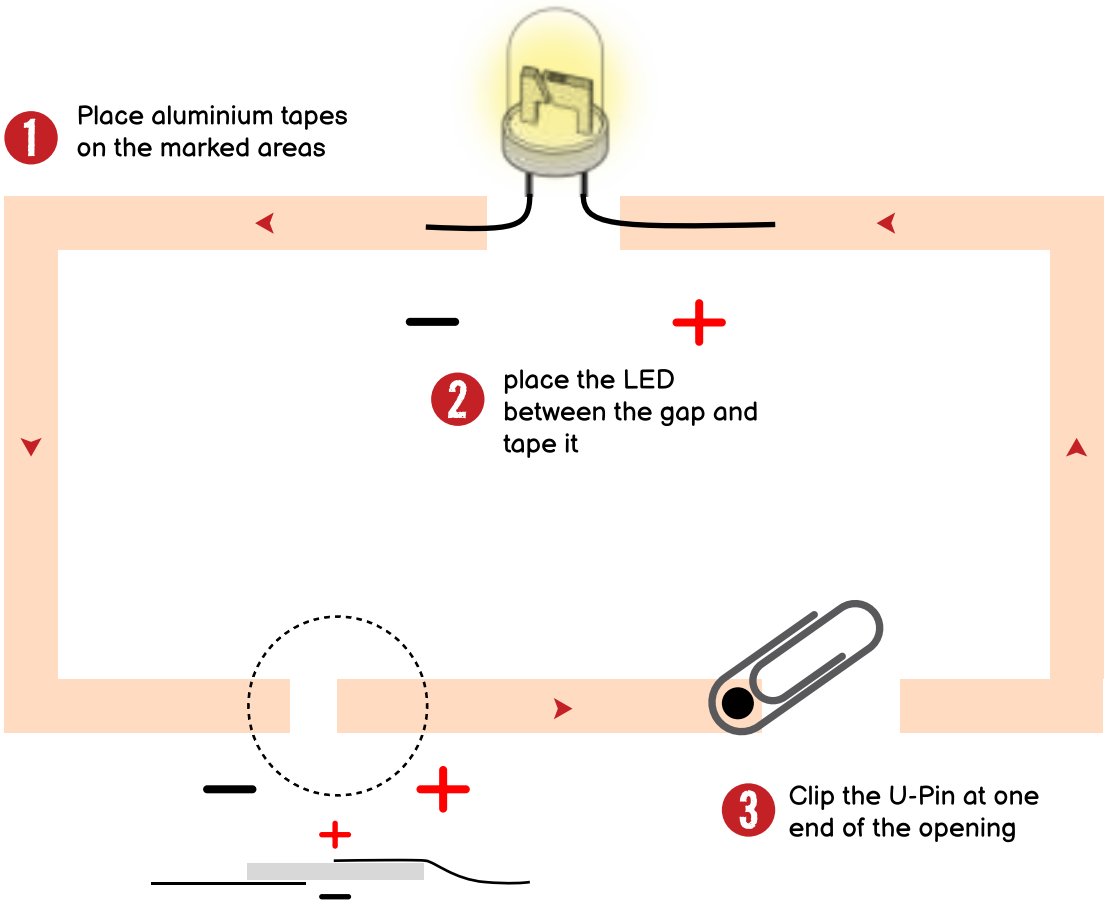
Did you Know?

Benjamin Franklin is credited with the discovery of electricity being natural occurrence in June 1752

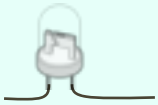
DIY

Can you create a simple flashlight using a battery, light bulb, and switch?

Simple Circuit



What you will need

 x 1

 x 1

x 1

About the circuit

A simple electrical circuit is a path through which electricity will flow. It is closed at each end making it a loop.

The fairly lights around their desks create a warm and cozy atmosphere. "These lights make studying more fun," Pilu remarks.

But how does this series circuit work?

Let's create our own series circuit !

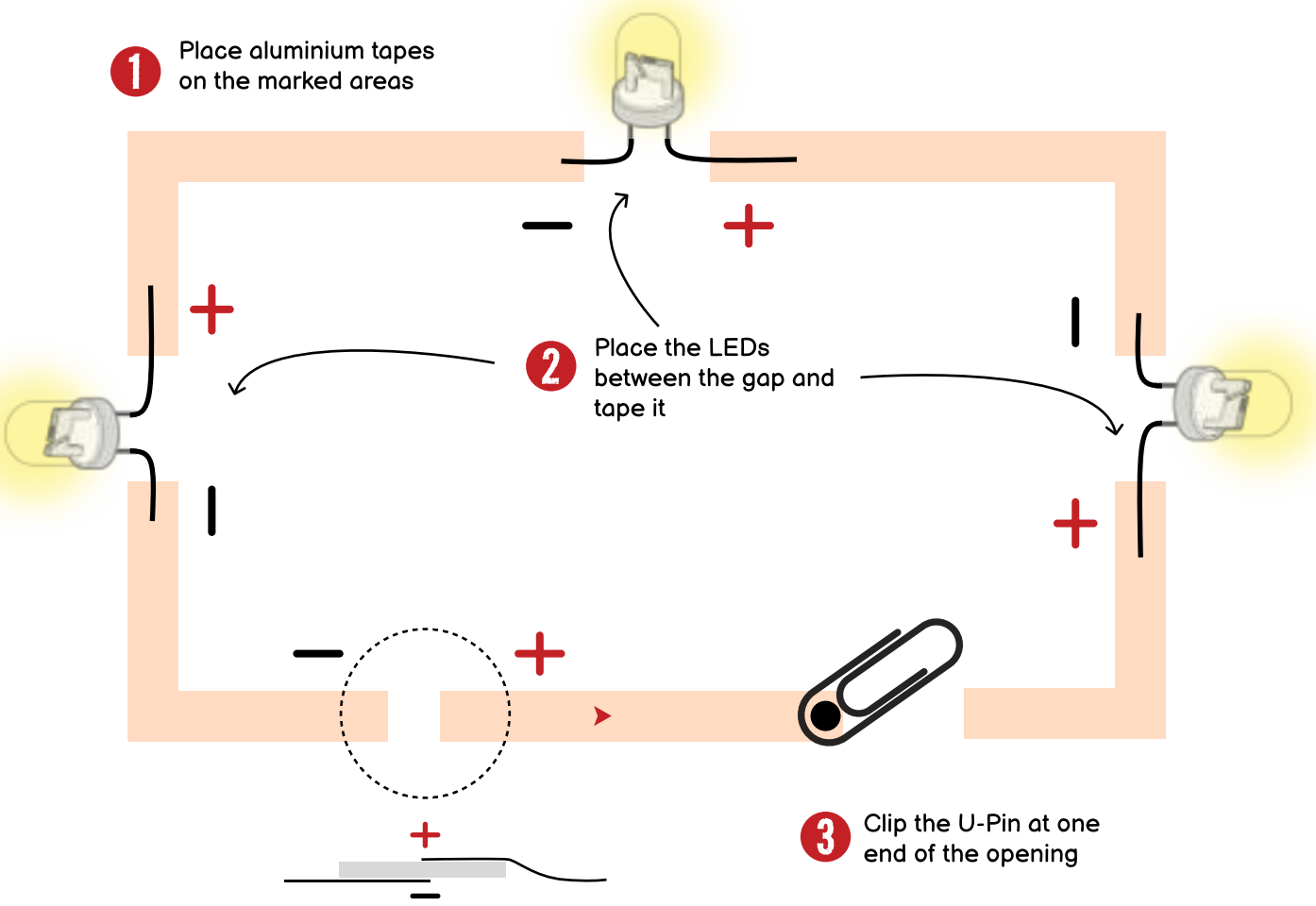
Can you make a circuit that lights up a bulb and makes a sound at the same time?

Try this ?!

Did you Know?

Electrified trees can occur naturally during thunderstorms when lightning strikes the ground, it follows through the roots of trees.

Series Circuit



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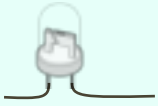
 x 3

 x 1

x 1

About the circuit

A series circuit is a type of electrical circuit where all components are connected end-to-end in a single path, so the same current flows through each one, and if one component stops working, the entire circuit stops working because there's only one path for the current to travel.

After breakfast, they sit at their desks in the study room, which have a common connection port for their electronic devices. Pilu plugs in his laptop while Nilu connects her computer.

But how do parallel circuits work?

Let's create our own Parallel circuit!

?!

Try this

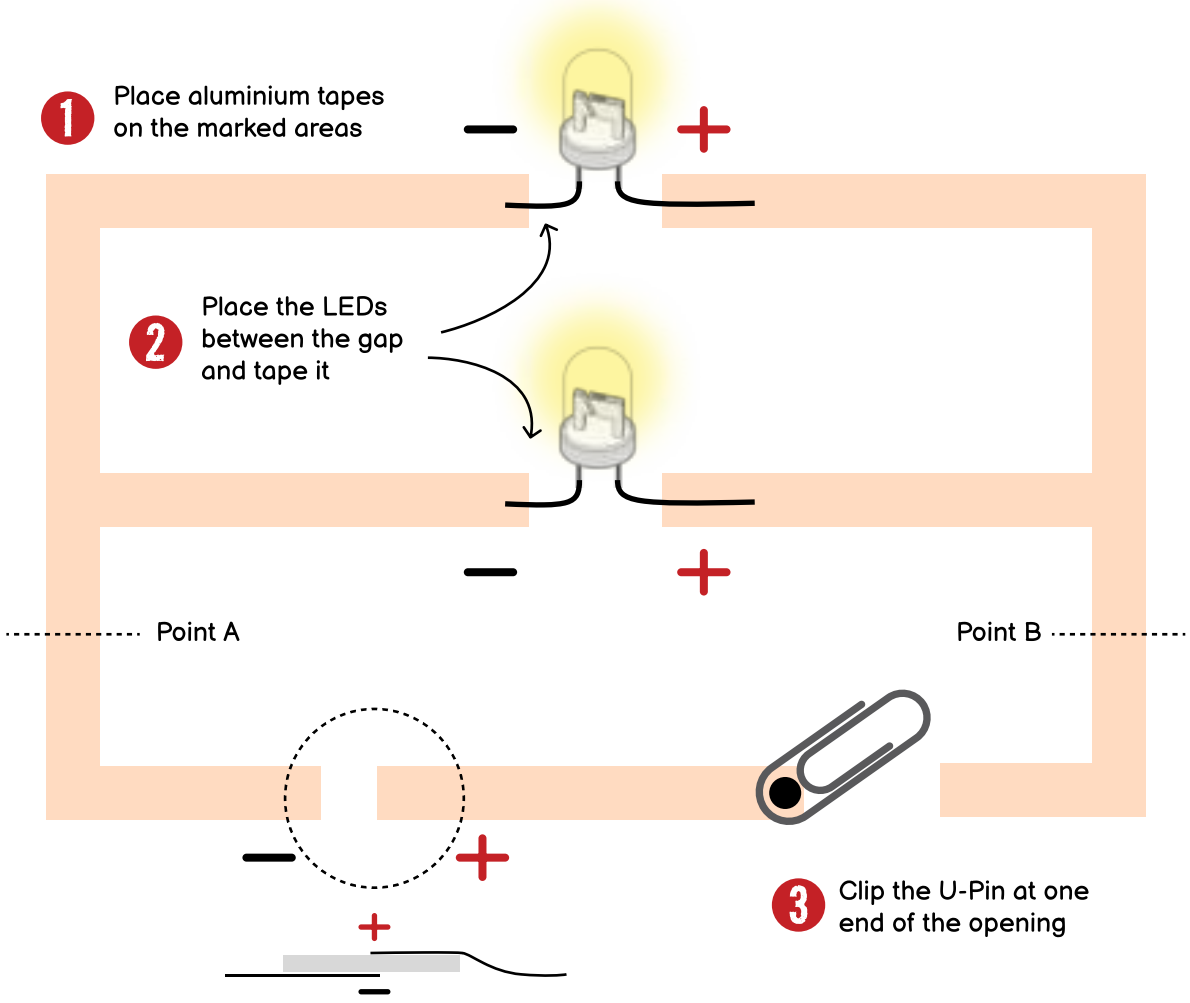
How many ways can you light up an LED using a battery and some wires?

OH!

Did you Know?

The human brain generates enough electricity to power a small light bulb. That's because our brains use electrical signals to send messages throughout our bodies.

Parallel Circuit



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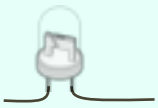
 x 2

 x 1

x 1

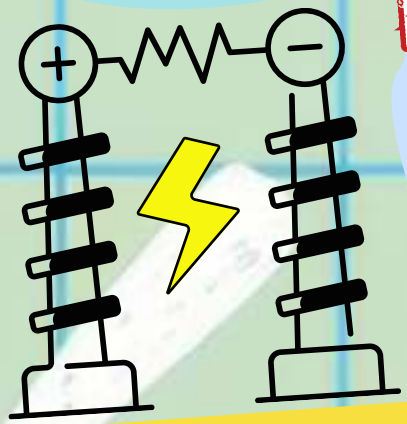
About the circuit

A parallel circuit is a type of electrical circuit where each component is connected to the same set of points (A and B) , so each one gets the full voltage, and if one part stops working, the others can still work because they have their own separate paths.

In the kitchen, their mom is busy preparing lunch. The kids observe the various kitchen appliances like the blender, microwave, and toaster. "It's fascinating how electricity powers all these gadgets," Nilu says.

But how does this multi-switch circuit work?

Let's create our own Multiple Switches circuit!



DIY

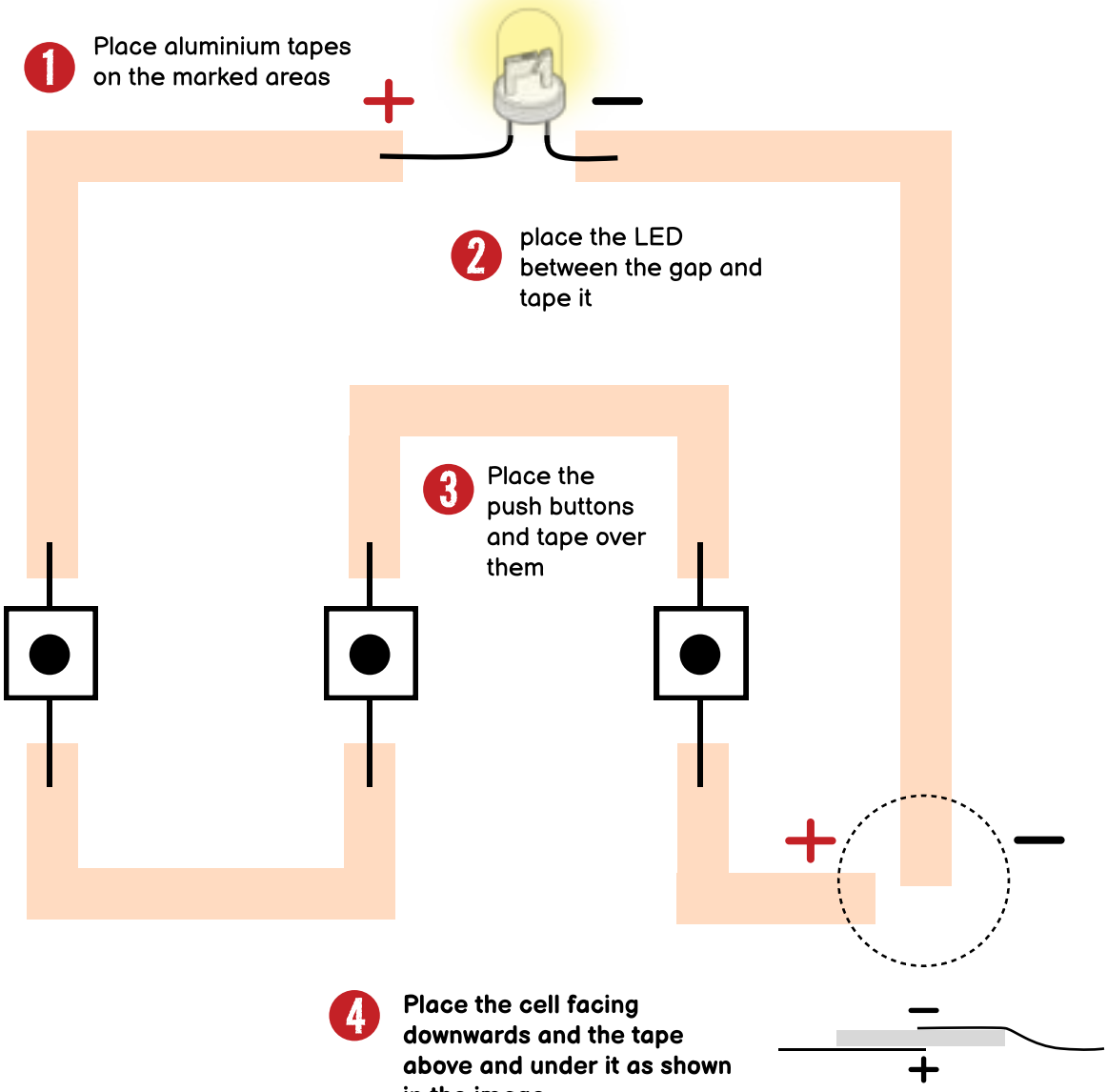
Can you create a circuit where one switch turns on a light, another switch turns on a buzzer, but a main switch controls both, turning them off together?

Did you Know?

Nikola Tesla experimented with wireless electricity transmission, envisioning a world where electricity could be transmitted through the air.

NIKOLA TESLA
1856- 1943

Multiple Switches



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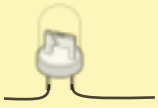
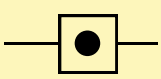
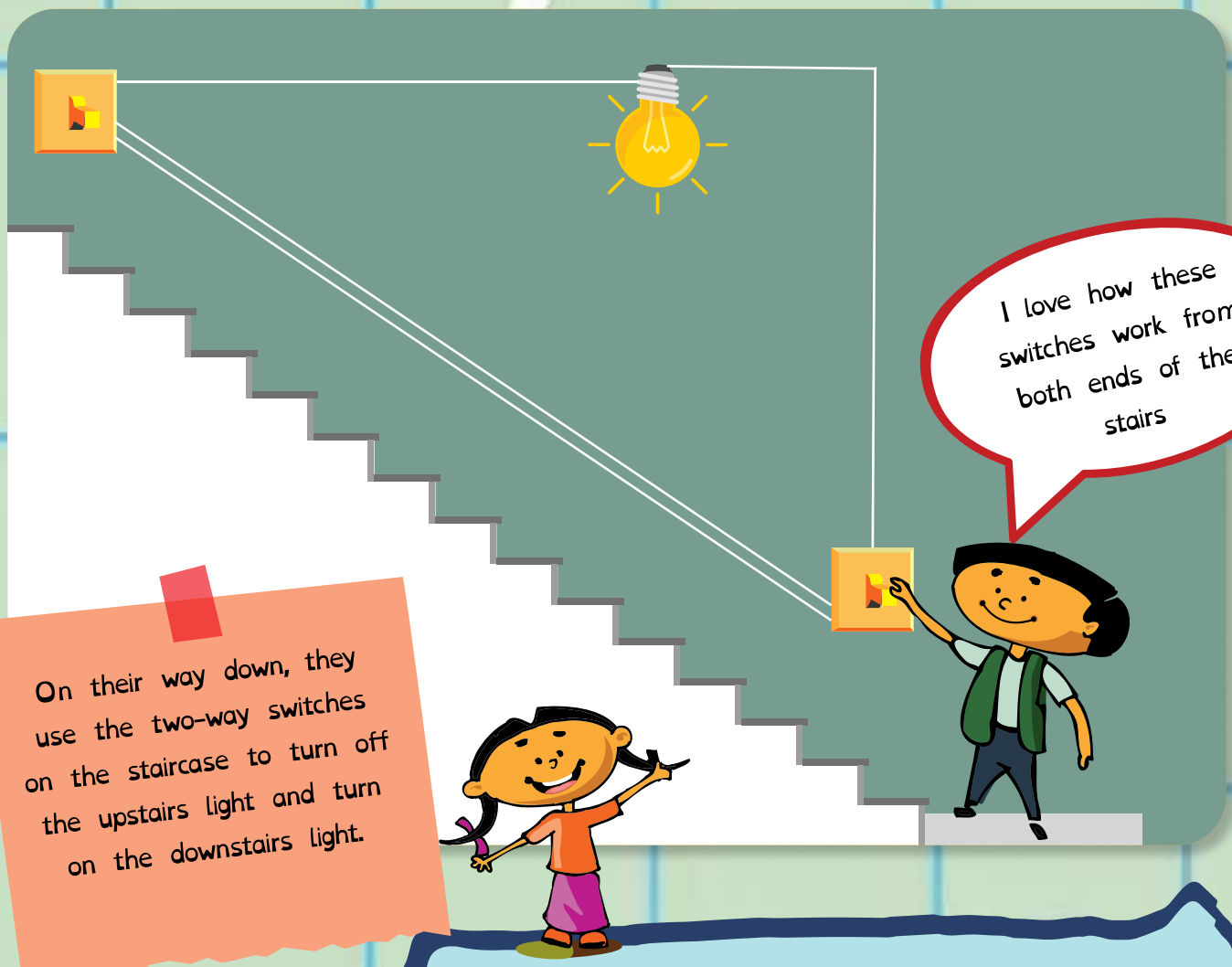
 x 1

 x 3

x 1

About the circuit

A multiple switch circuit allows you to have safety levels in your circuit. Only on passing each level the bulb lights up. This is really handy on dangerous equipment like a toaster.

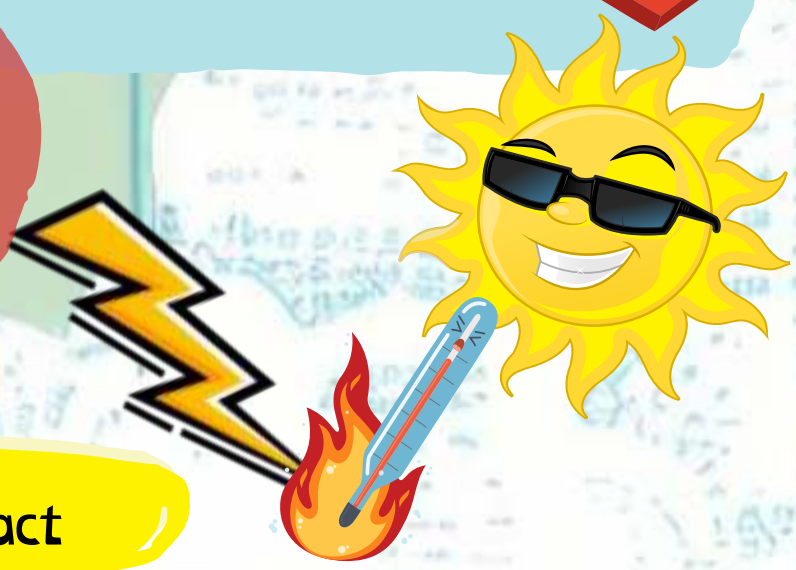


On their way down, they use the two-way switches on the staircase to turn off the upstairs light and turn on the downstairs light.

But how does this two-way switch work?
Let's create our own two-way circuit!

Try this

What will happen if you create a circuit with one battery, one light bulb, and two different paths for the current?

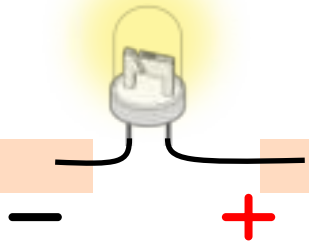


Fun Fact

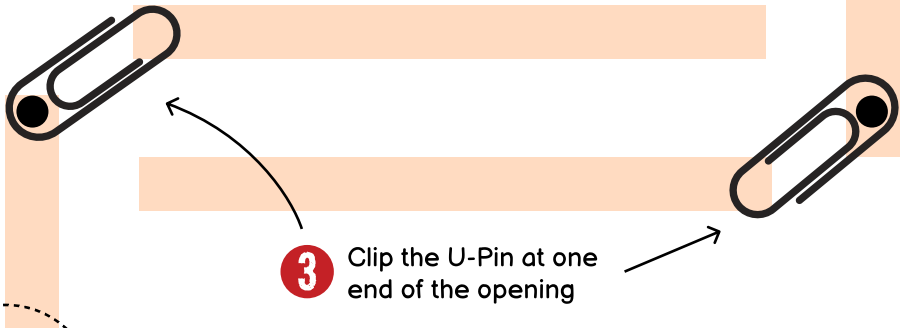
Lightning Bolts are hotter than the Sun!!!

Two-way Switches

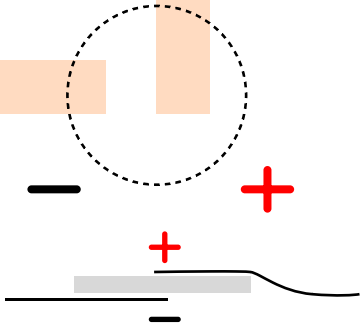
1. Place aluminium tapes on the marked areas



2. place the LED between the gap and tape it

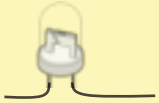


3. Clip the U-Pin at one end of the opening



4. Place the cell facing upward and the tape above and under it as shown in the image

What you will need



x 1

x 2

x 1

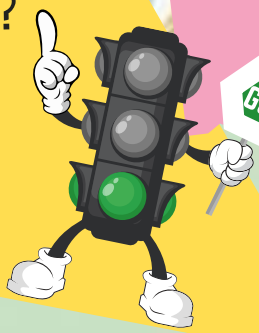
About the circuit

A two-way circuit allows you to control a light or ceiling fan from two different switches, like turning a hallway light on at one end and off at the other.

On their way to the park, they observe the traffic lights. "Red means stop, green means go, and yellow means slow down," Nilu explains. "It's like a signal system for cars."

want to know how traffic lights work?

Let's create our own simple traffic lights circuit !



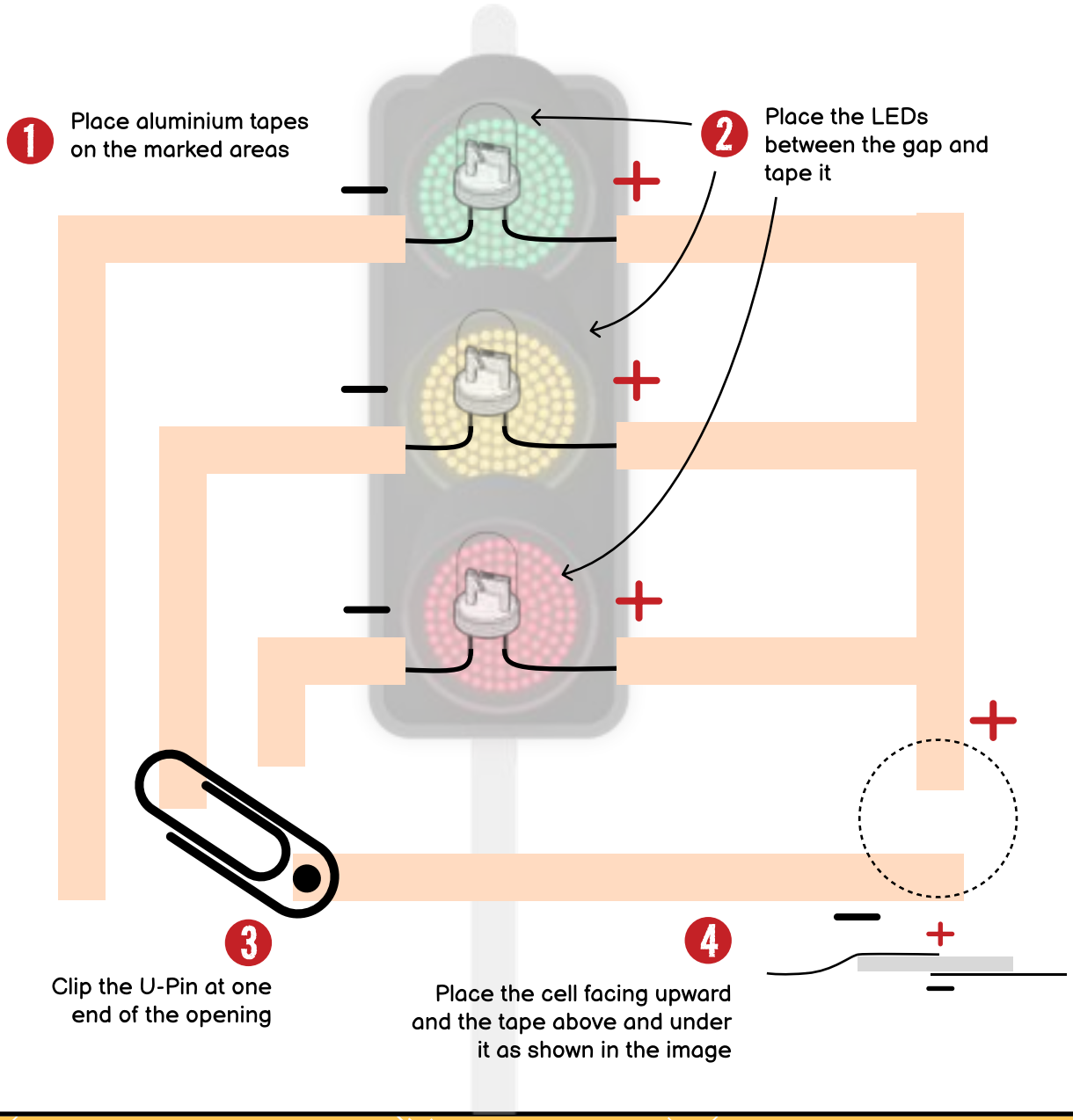
DIY

Can you create a circuit on a cross-road containing four traffic lights, how should they be controlled to ensure smooth traffic?

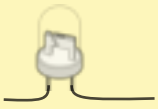
Did you Know?

Some animals, like pigeons, have been found to have tiny magnetic particles in their beaks that help them sense direction. They also rely on other senses

Traffic light



What you will need

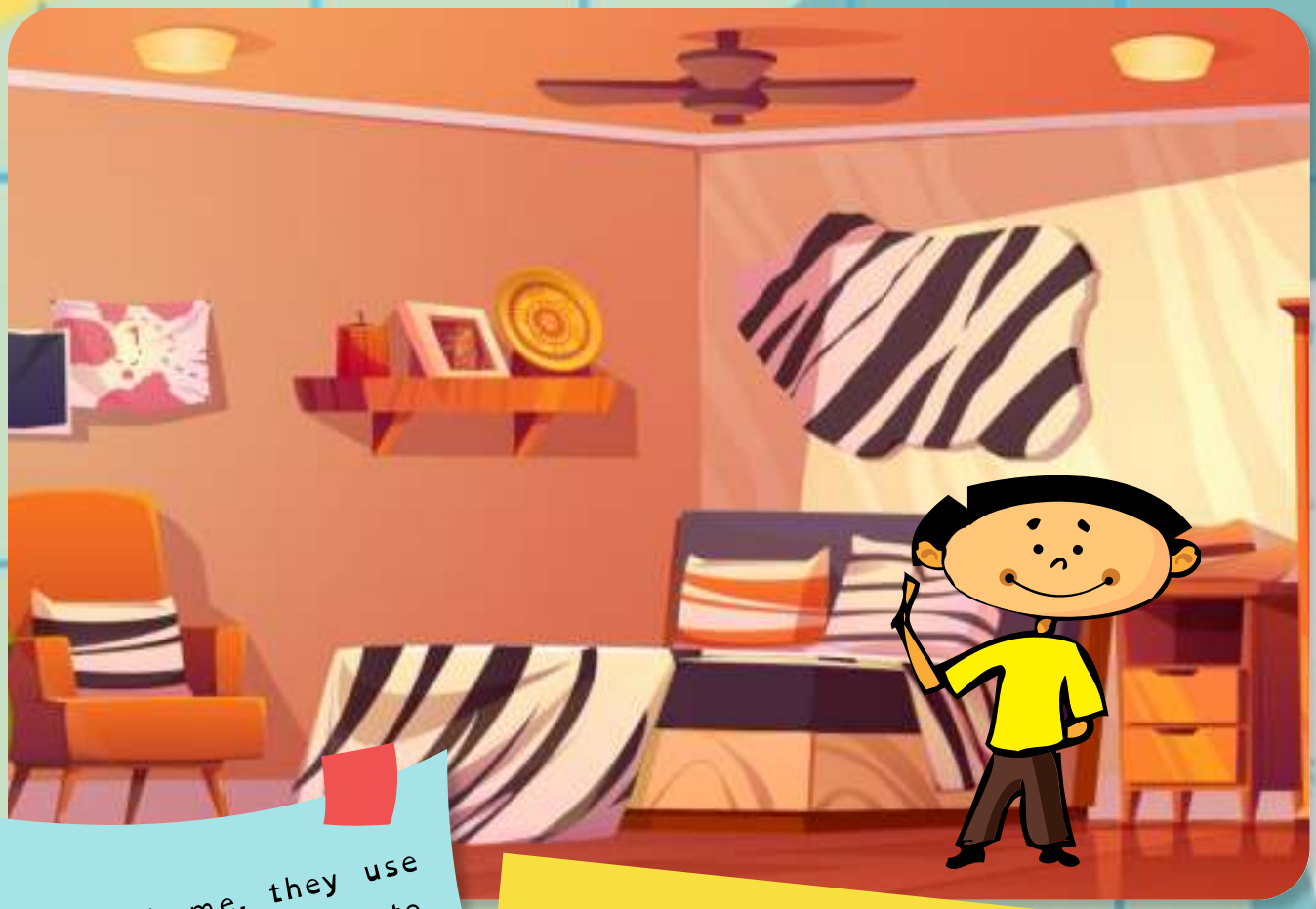
 x 3

 x 1

x 1

About the circuit

A simple traffic light circuit is a modified version of a simple circuit. Each colour has it's own circuit but only a single switch allowing to operate each light with it at a given time.



Back home, they use the fan regulator to adjust the fan speed in their room. "I like it at medium speed," Pilu says, turning the knob.

But how does the speed changes ?

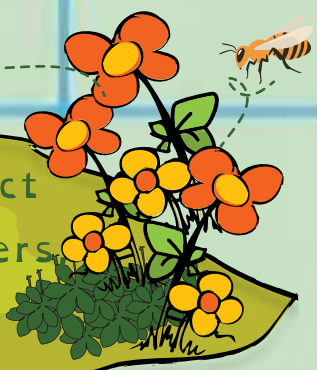
Let's create our own Potentiometer circuit!

Try this

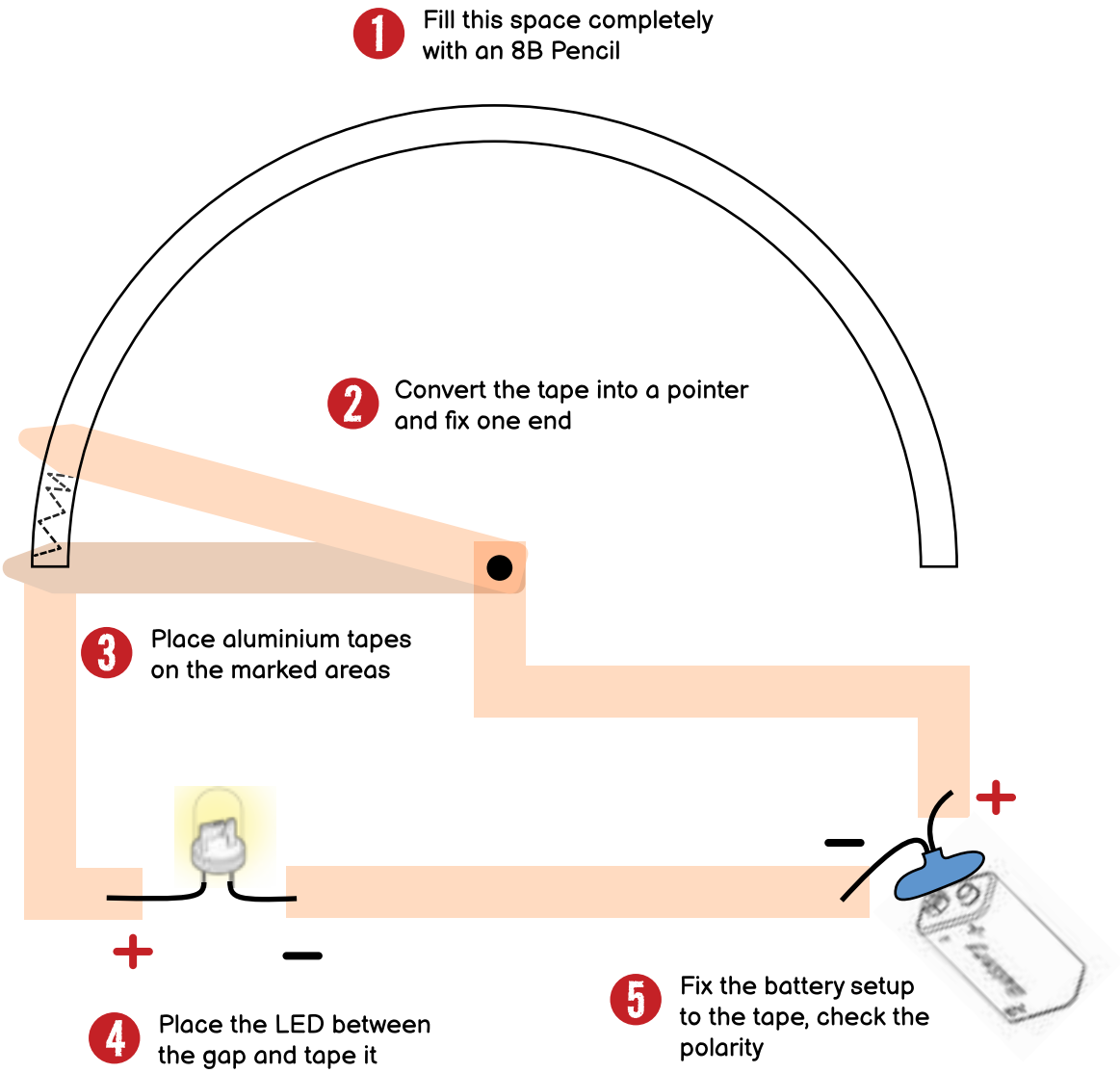
How can you design a circuit where turning a potentiometer changes the volume of a buzzer? What happens if there are 2 buzzers or 2 LEDs connected instead of one?

Did you Know?

Animals like bees and sharks can detect electric fields. Bees use it to find flowers and sharks use it to locate prey.



Potentiometer



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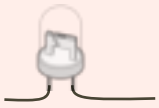

x 1


x 1


x 1

About the circuit

The circuit works on the principle of resistance. The more path that current has to travel through the more resistance it has hence a dimmer effect on the bulb.

In the living room, they experiment with the dimmer switch to control the brightness of the ceiling lights. "It's like magic," Pilu giggles as the light dims and brightens.

Let's check if we can make a flickering light?

Let's create our own Flickering Lights circuit!

Try this

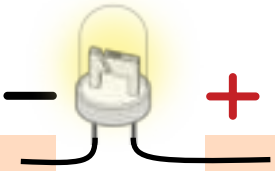
How can you make a greeting card that lights up when opened?

Did you Know?

Magnetic fields are prevalent in space, influencing the structure of galaxies and the behavior of cosmic rays.

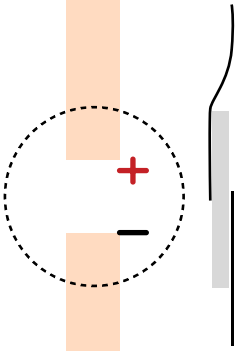
Simple Flickering Lamp

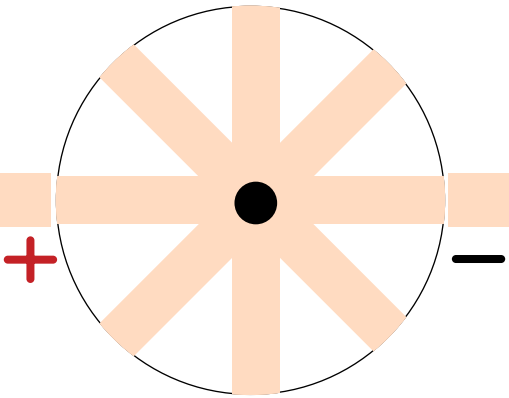
1. Place aluminium tapes on the marked areas



2. Place the LED between the gap and tape it

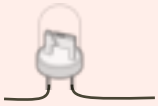
3. Place the cell facing upward and the tape above and under it as shown in the image





4. Cut a paper disk and stick the copper tape on the disc as marked and place it upside down using a split pin in the centre

What you will need



x 1

x 1

About the circuit

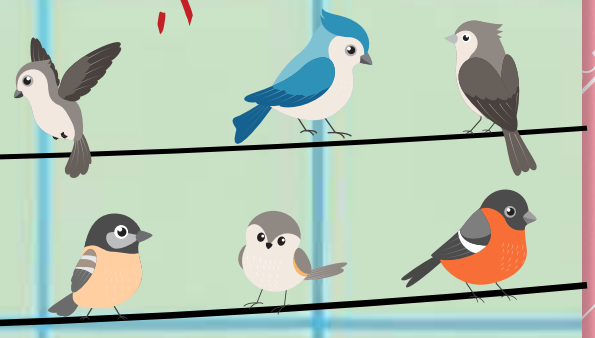
This circuit gives us an idea of how fast current flows around the circuit. Try rotating the circle as fast as you can and see of the current is still able to flow at that speed.

"Do you think all materials conduct electricity?" Pilu asks.
"No, only conductors like metals do. We should test different materials to see which ones conduct electricity," Nilu suggests.

Let's check which materials are conductors or not?
Let's create our own Multiple Materials circuit!

Did you Know?

- Birds can sit on power lines without getting shocked because they're not grounded.
- Electricity needs a path to the ground to flow through.

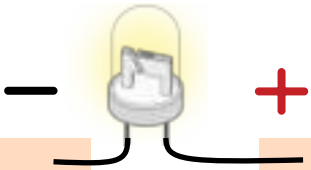


Try this ?!

Jot down on the basis of LED brightness which material is a good conductor or insulator. Try wood, paper, foil, pencil lead etc.

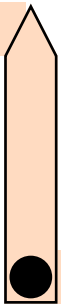
Conductors/Insulators - Solids

1. Place aluminium tapes on the marked areas



2. Place the LED between the gap and tape it

3. Place items in between these spaces to test

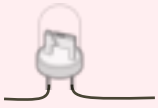


4. Convert the tape into a pointer and fix one of its end

Place the cell facing upward and the tape above and under it as shown in the image

5

What you will need



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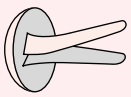


x 1

x 1

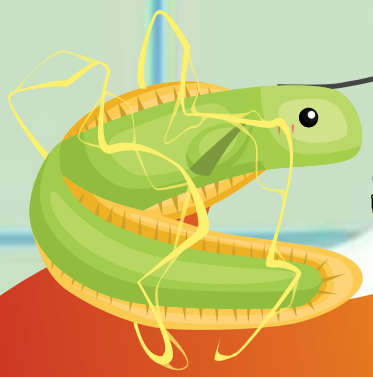
About the circuit

Conductors are materials that let electricity flow through them easily, like metal, while insulators are materials that block electricity, like rubber or plastic. This circuit lets us test and identify them.

"Remember not to touch electric plugs with wet hands," their mom reminds them as they help with washing the vegetables. Their curiosity about electricity extends to their science projects.

Why you shouldn't we touch electric switches with wet hands?

et create our own Water Switch circui



5x

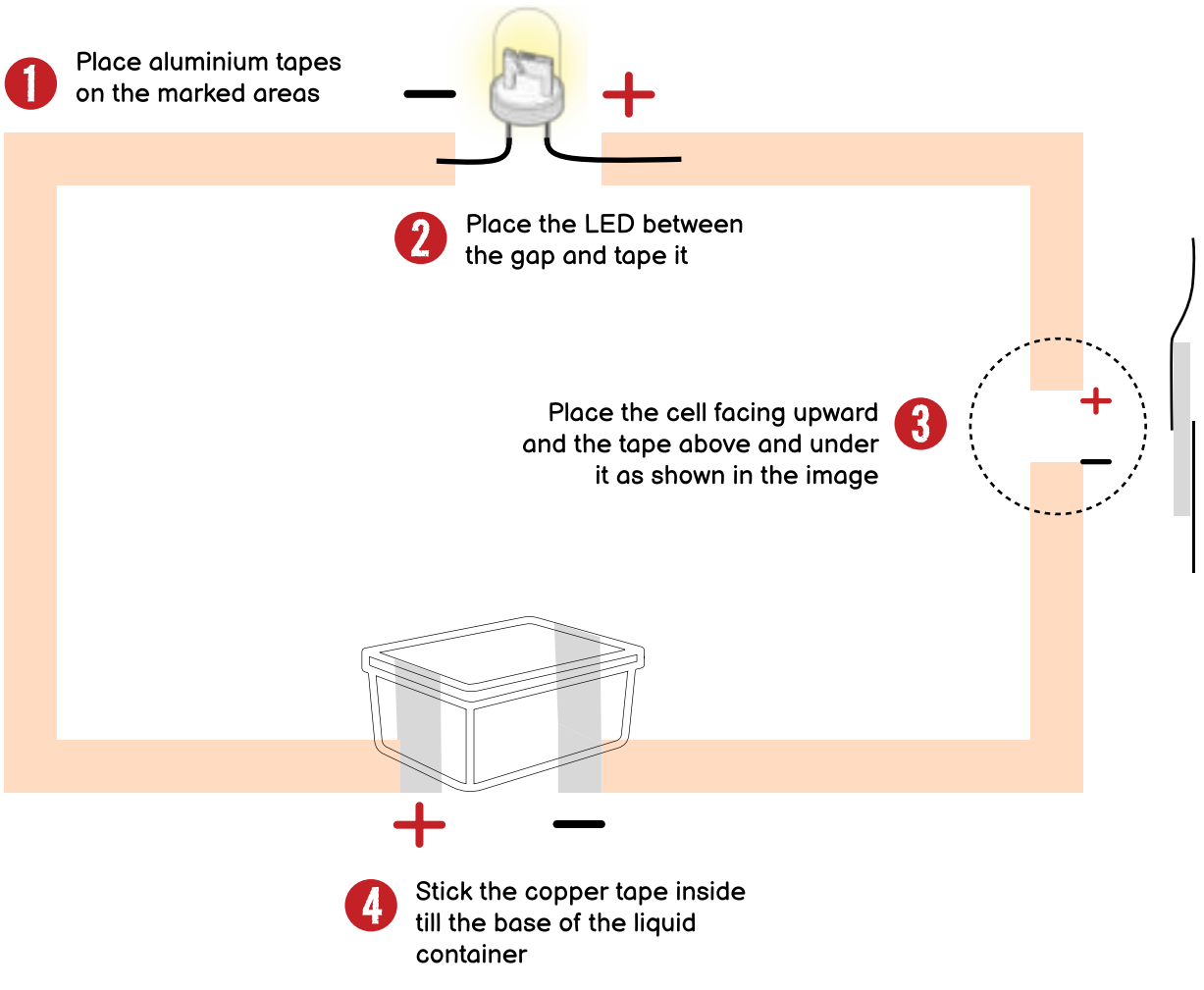
Electric eels can generate electric shocks of up to 600 volts. That's five times more powerful than the standard wall socket

Did you Know?

What happens when you change the size of the box containing liquid, or have 2 boxes connected instead of one?

Try this ?!

Water Switch



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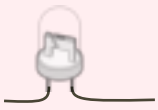
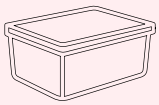
 x 1

 x 1

x 1

About the circuit

Electricity can flow through certain fluids, like saltwater, because the tiny particles in the fluid, transfer the electric charge from one place to another.

Fun Side Activity #1 that Nilu and Pilu come across in the Papertronics book they read

Let's see if you can paint the way out to light the beacon

Let's Paint your Own circuit!

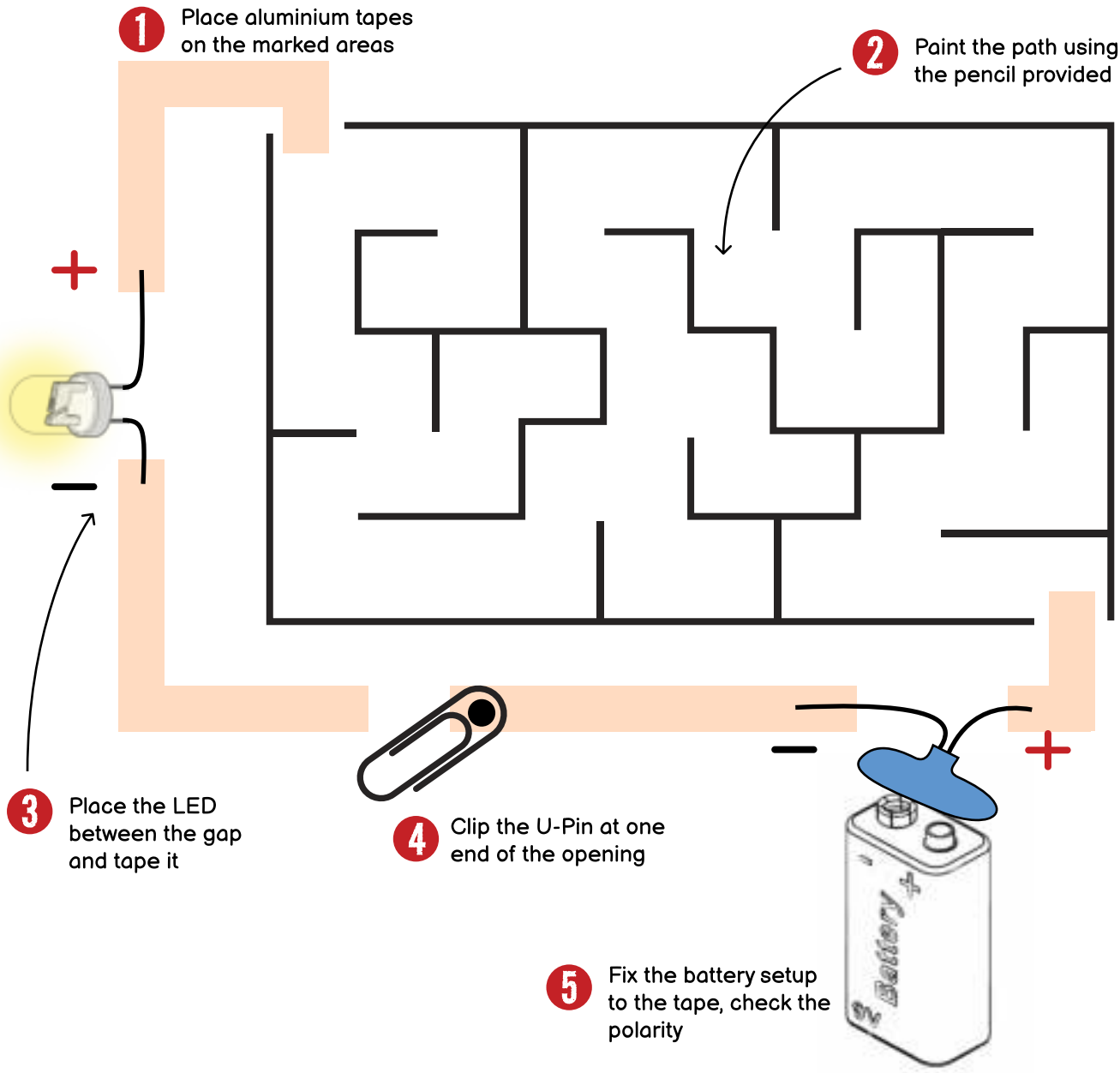
Try this ?!

Can you make a simple game using a circuit where a light turns on when you find the correct answer?

Did you Know?

Electricity can flow through certain fluids, like saltwater, because it has tiny charged particles called ions, from the salt. When we connect a battery, these ions transfer charge, creating electricity to flow.

Paint your Own Circuit



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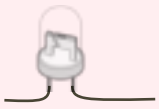 x 1

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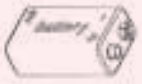
 x 1

 x 1

About the circuit

A fun activity based on a simple circuit. Find your way through the maze, mark it with the special paint provided. The bulb will light up only if you solve the maze.

While they were indulged in painting they hear the doorbell ring. "That's Dad! He's back from work," Pilu says, running to open the door.

Do you know how does a house bell work?

Let's learn !

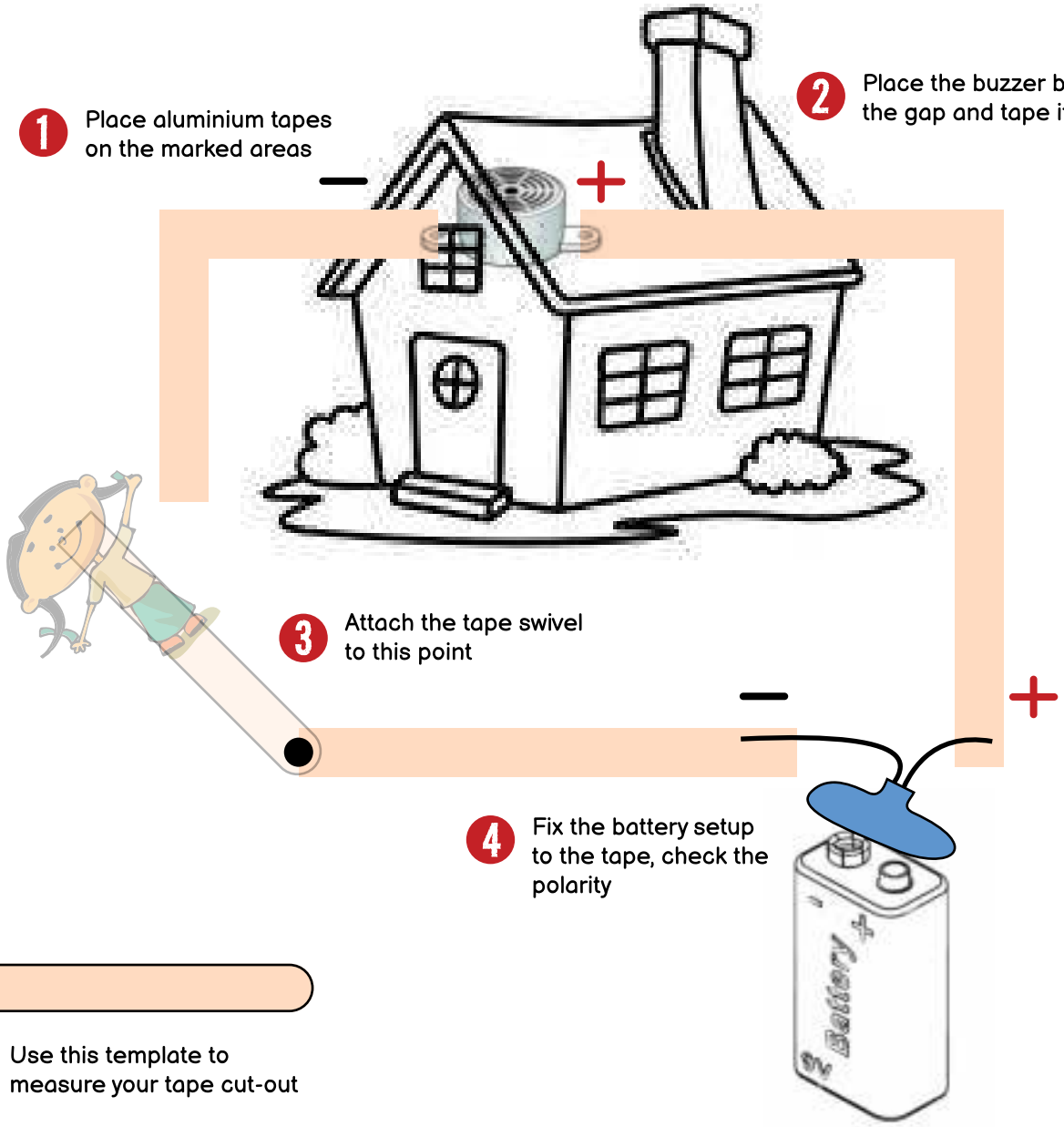
Imagine the house has 2 doors and we have to create 2 doorbell circuits which will ring the same bell? Can it work with just 1 battery?

Try this ?!

Did you Know?

Humans have made electromagnets that are 1,000,000,000 times stronger than the Earth's magnetic field

House Bell



What you will need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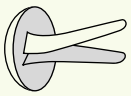
x 1


x 1

About the circuit

A simple circuit where electric bulb is replaced by buzzer which rings when bell is pressed as it completes the circuit.

After learning about the house bell they wondered what else has electro magnets in them. Turned out they are everywhere, but what are electromagnets they wondered.

How are electricity and magnetism connected?

Let's create a electromagnetism circuit!

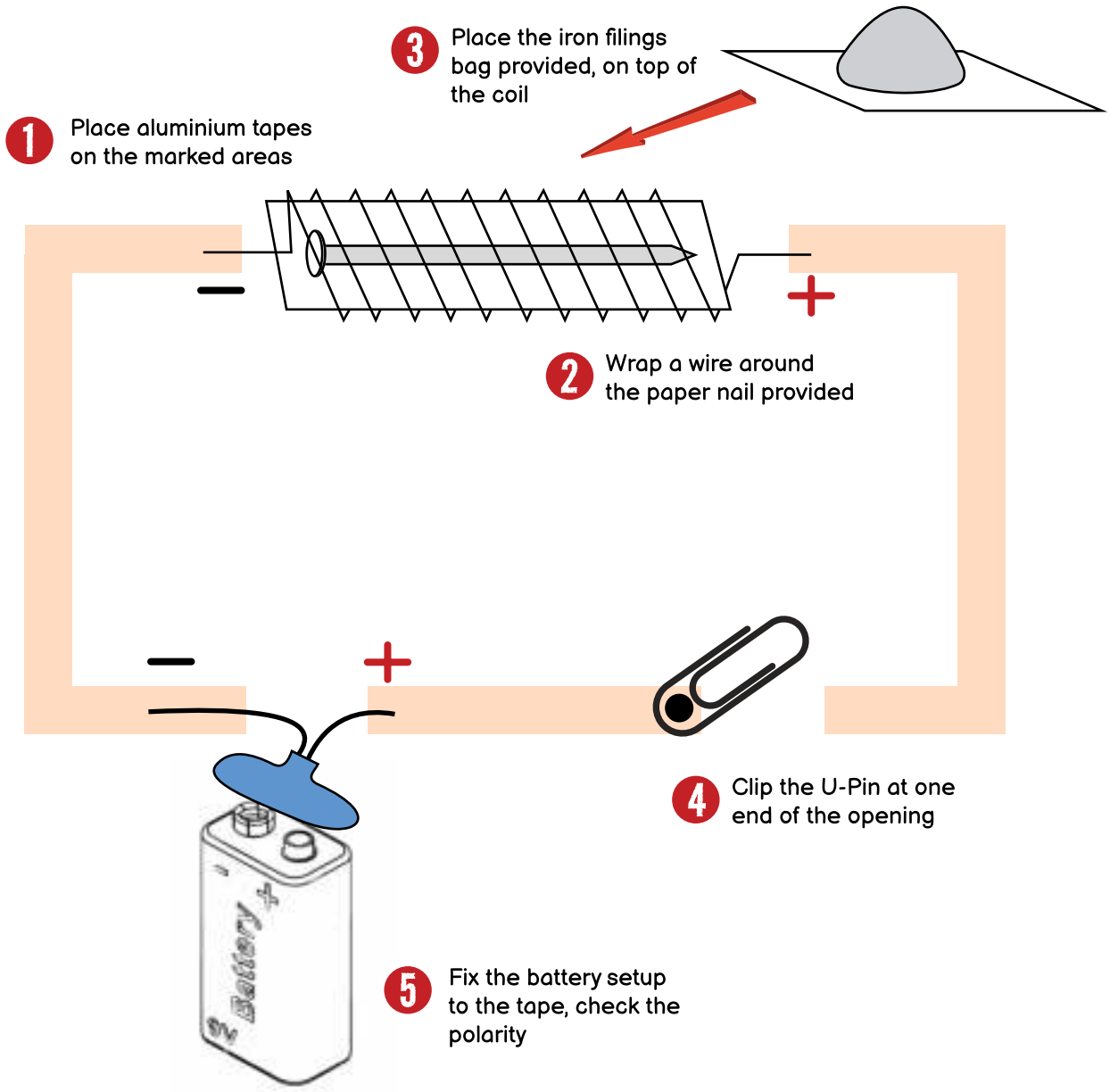
Try this ?!

How can you make a compass move using an electric circuit?

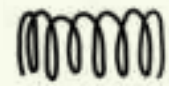
Did you Know?

Radio waves, which carry the signals for your favorite radio stations, are a form of electromagnetic energy.

Electromagnetism



What you will need

 x 1

 x 1

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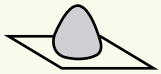
 x 1

About the circuit

Electricity and Magnets are very closely related to one another. As the current travels through the coil it starts behaving like a magnet. It stops as soon as you break the circuit.

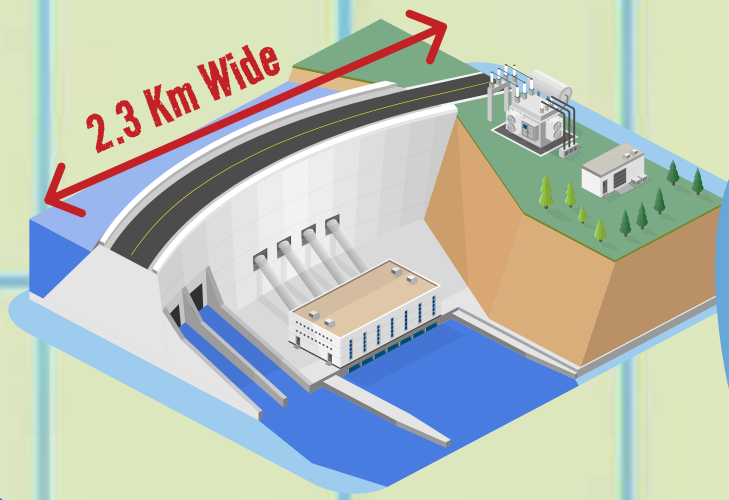
While entering a mall, Nilu and Pilu encounter automatic doors. Both wave their hands in front of it and see it open. Nilu wonders how can the door sense them. Pilu says it must be their waving which is causing this.

How can circuits be used in detecting motion?

Let's make a motion activated circuit to find out!

Try this ?!

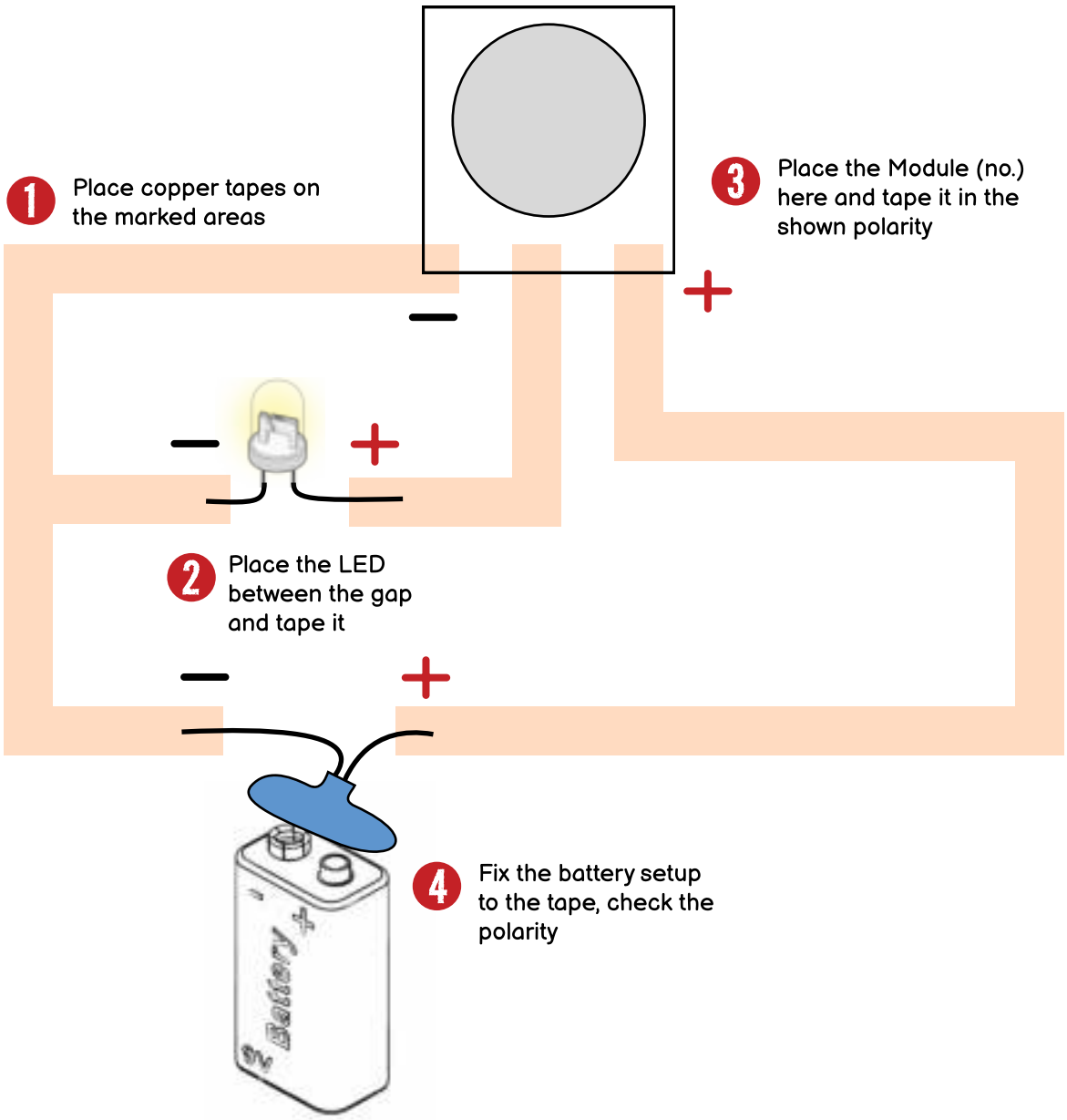
Can you create a circuit that turns on a light when it gets dark?



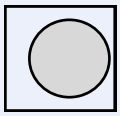
Did you Know?

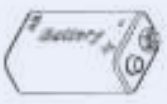
The largest electricity generator in the world is the Three Gorges Dam in China. It can produce enough electricity to power 60 million homes.

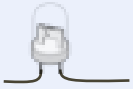
Motion Activated L.E.D



What you will need


x 1


x 1


x 1

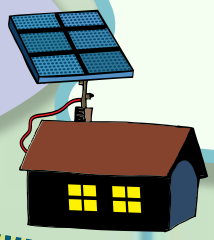
About the circuit

A motion detector actually detects changes in infrared radiation (a type of electromagnetic wave that all of us also emit) levels in front of it.

At the mall's energy exhibit, they learn about solar panels. "Solar panels use sunlight to generate electricity. It's a renewable energy source," Nilu reads from a display.

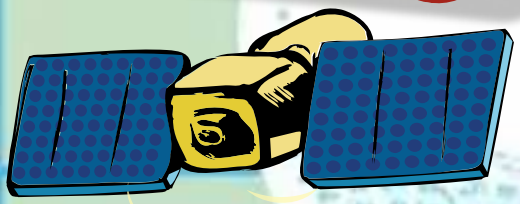
How does electricity get generated from sunlight?

Let's make a solar circuit!



Try this ?!

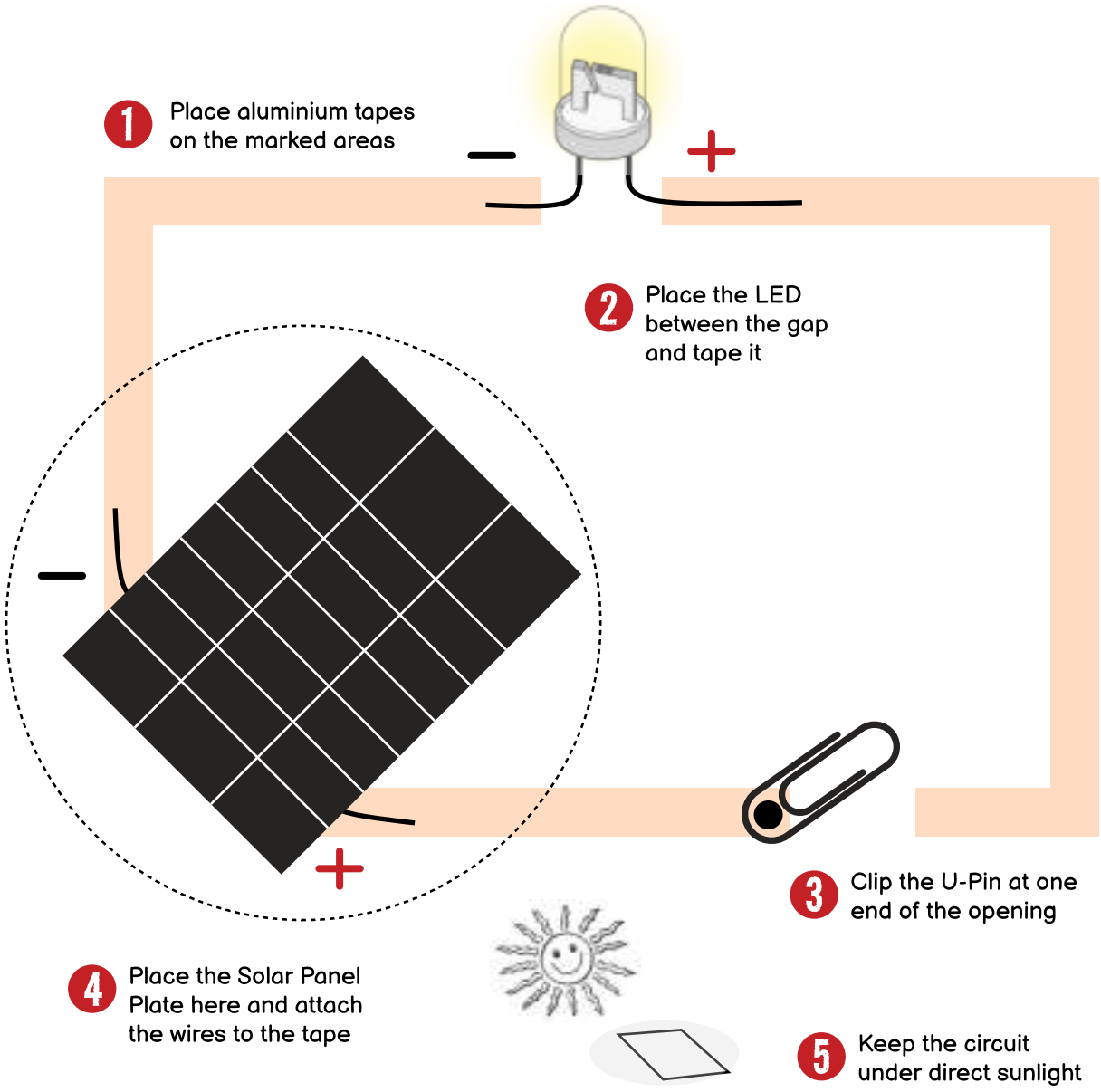
How can you build a circuit using a lemon, copper, and zinc to power a small LED or buzzer, and how many lemons do you need to make it work?



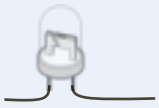
Did you Know?

The International Space Station uses solar panels to generate electricity. These panels are so large they can cover a football field.

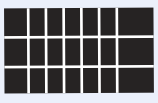
Solar Circuit



What you will need

 x 1

 x 1

 x 1

About the circuit

This circuit shows the conversion of solar energy into electrical energy with the help of solar cells present in it.

While strolling inside the mall, they find a fire alarm. "What happens if we press it?" Pilu wonders.
"Don't touch it unless there's a real fire. It's for emergencies," their dad explains.

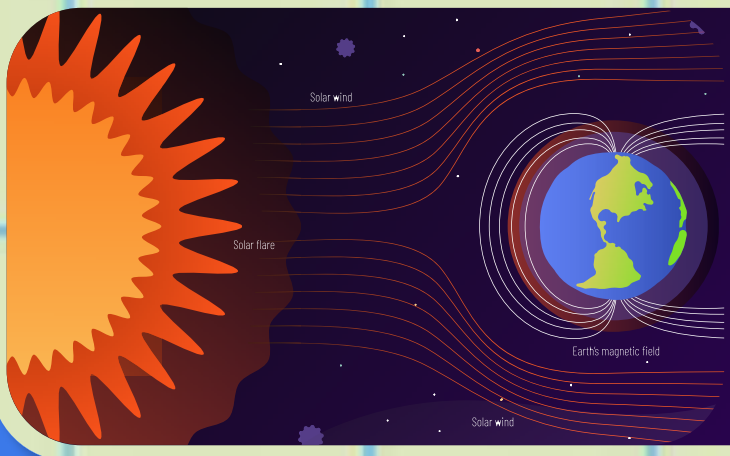
How do fire alarms work?

Let's create our own temperature sensor circuit!

Try this ?!

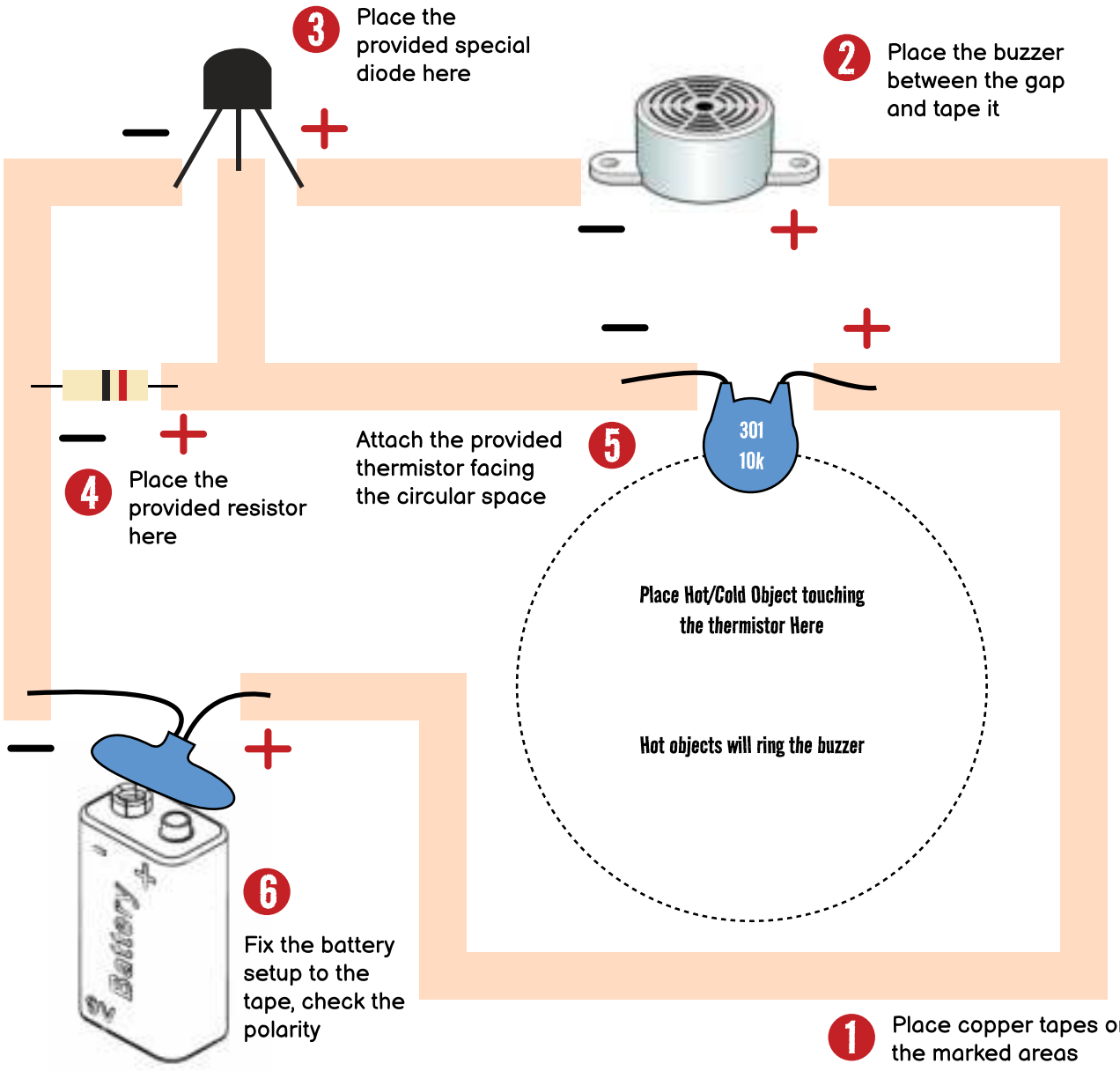
Can you create a circuit which makes sound when exposed to sunlight?

Did you Know?



The sun is a giant ball of hot, electrically charged gas called plasma.
The sun's electricity creates solar wind and sunspots.

Temperature Sensor



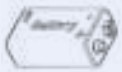
What you will need

 x1

 x1

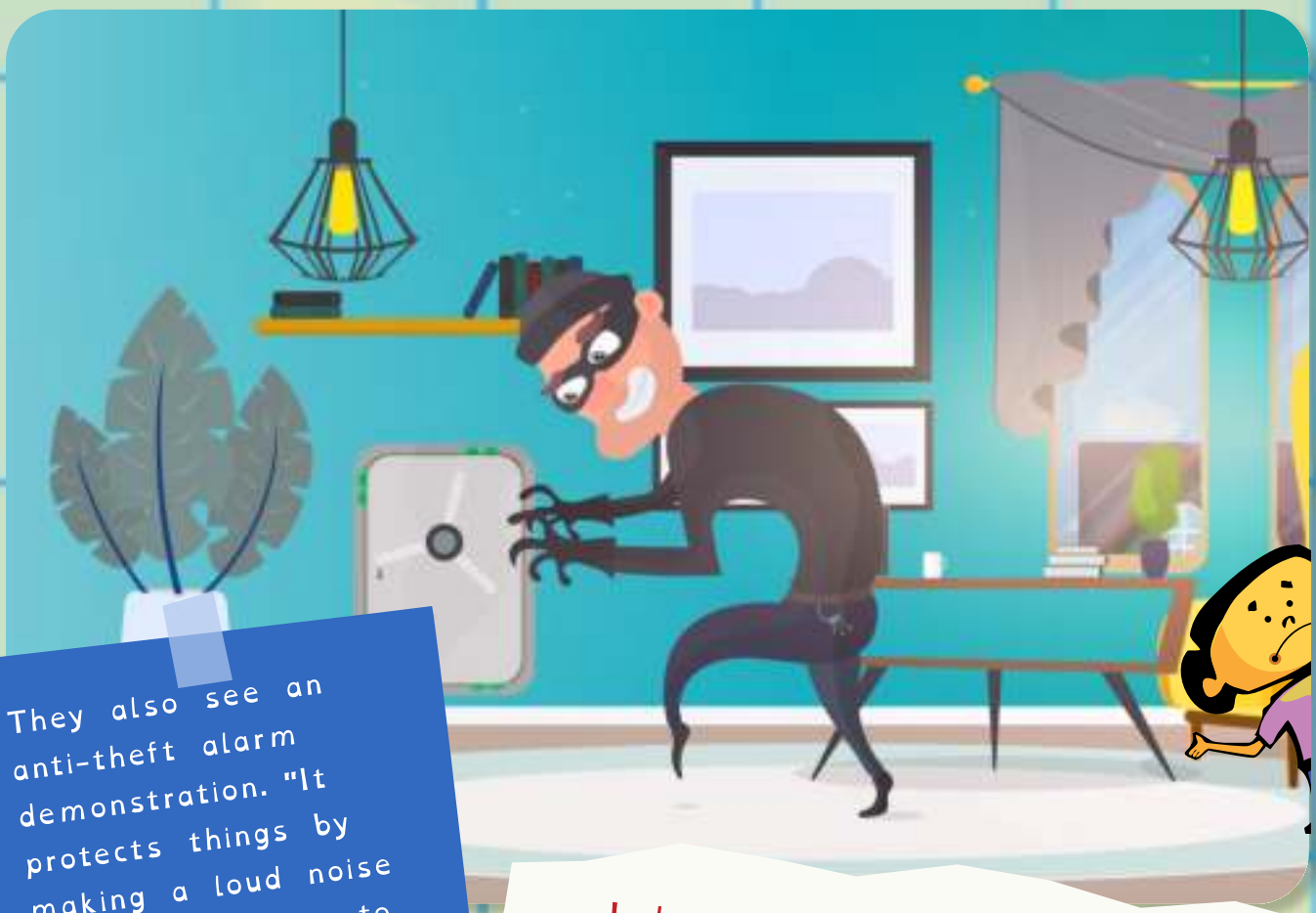
 x1

 x1

 x1

About the circuit

This circuit helps us identify hot and cold objects using a thermistor. These things change their behaviour in hot/cold temperatures. This property is showcased in the circuit.



They also see an anti-theft alarm demonstration. "It protects things by making a loud noise if someone tries to steal them," their mom explains.

I don't want my things stolen can circuits help me in protecting them?

Let's make a Thief Locker circuit!

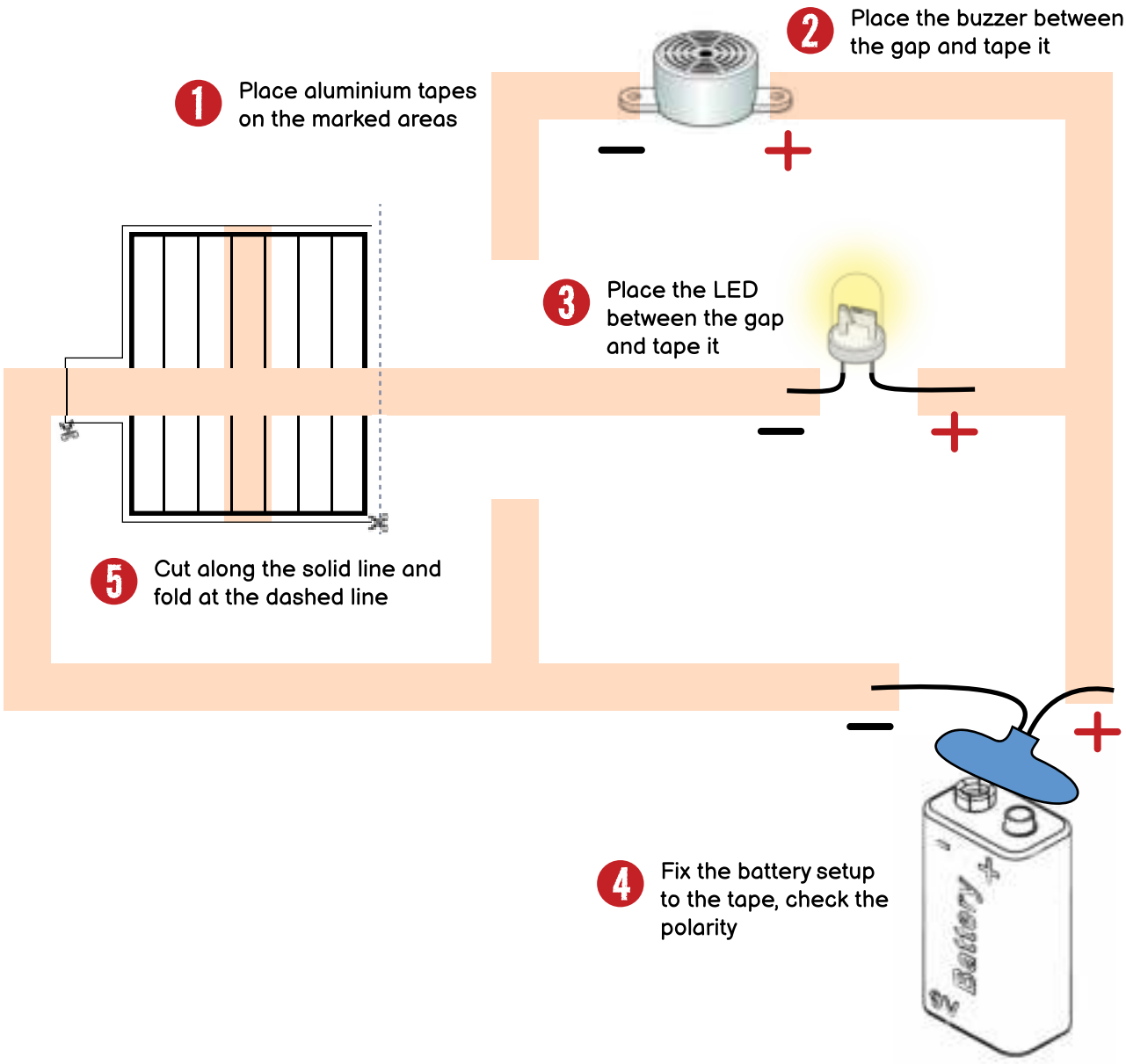
Can you create a circuit that acts like a burglar alarm, making a noise when someone enters a room?

Try this ?!

Did you Know?

Alarms have the capability of causing a fight-or-flight response in humans, a person under this mindset panics causing them to ignore rational thought.

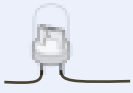
Thief Locker Trap



What you will need

 x 1

 x 1

 x 1

About the circuit

Simple circuits can be used to create a variety of applications. For instance this simple thief alarm.

Nilu and Pilu are fascinated by the RGB lights on display. "RGB stands for red, green, and blue. These lights can create any color by mixing these three," Nilu explains.

All the devices around us show pretty colours, but how do they do that?

Let's make a R.G.B circuit!

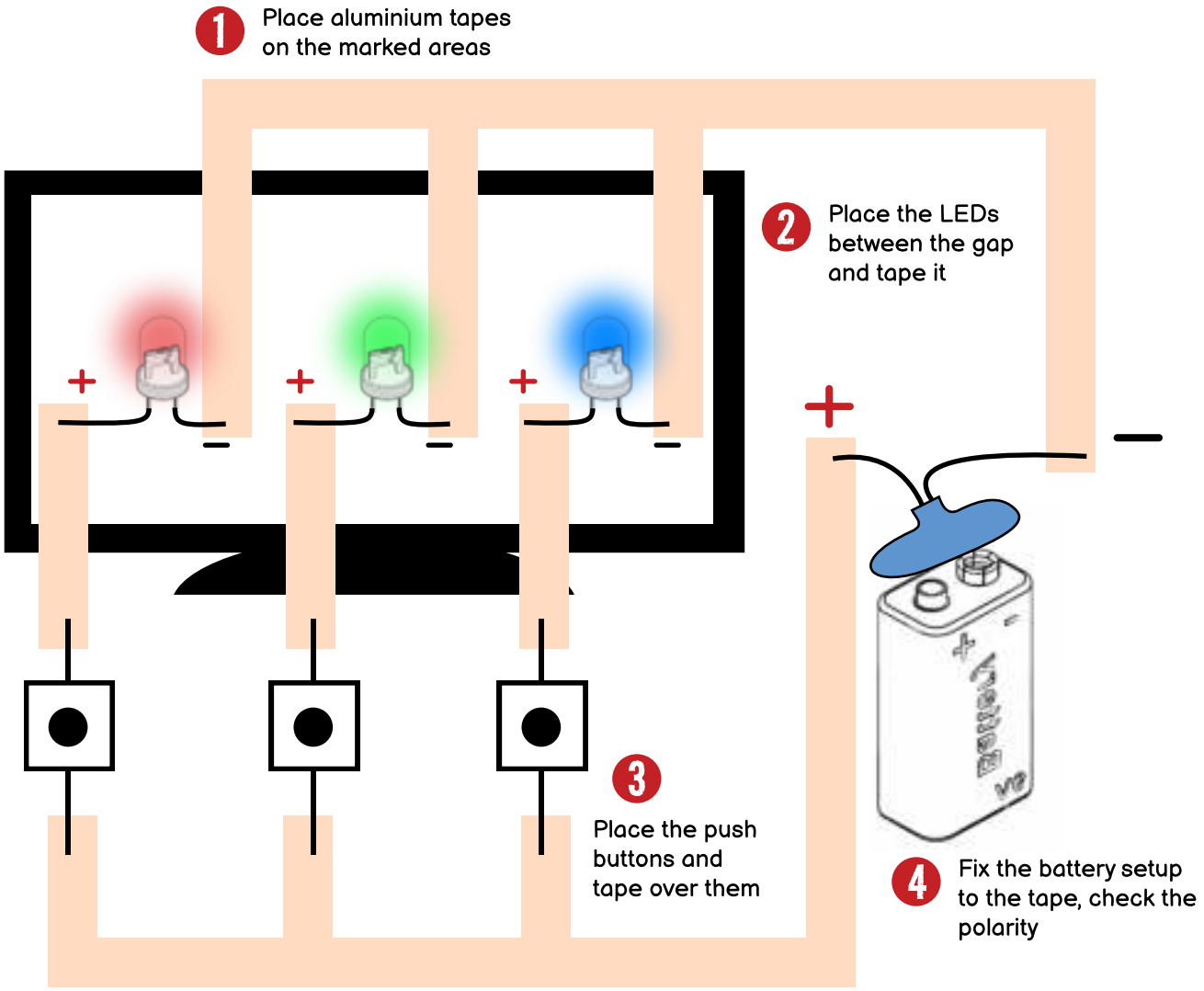
Try This ?!

What happens if you use two different types of light bulbs in the same circuit—do they both light up the same way?

Did you Know?

Auroras (Northern and Southern Lights) are caused by solar wind interacting with Earth's magnetic field, creating beautiful light displays.

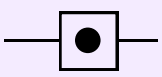
RGB Lighting



What you will need

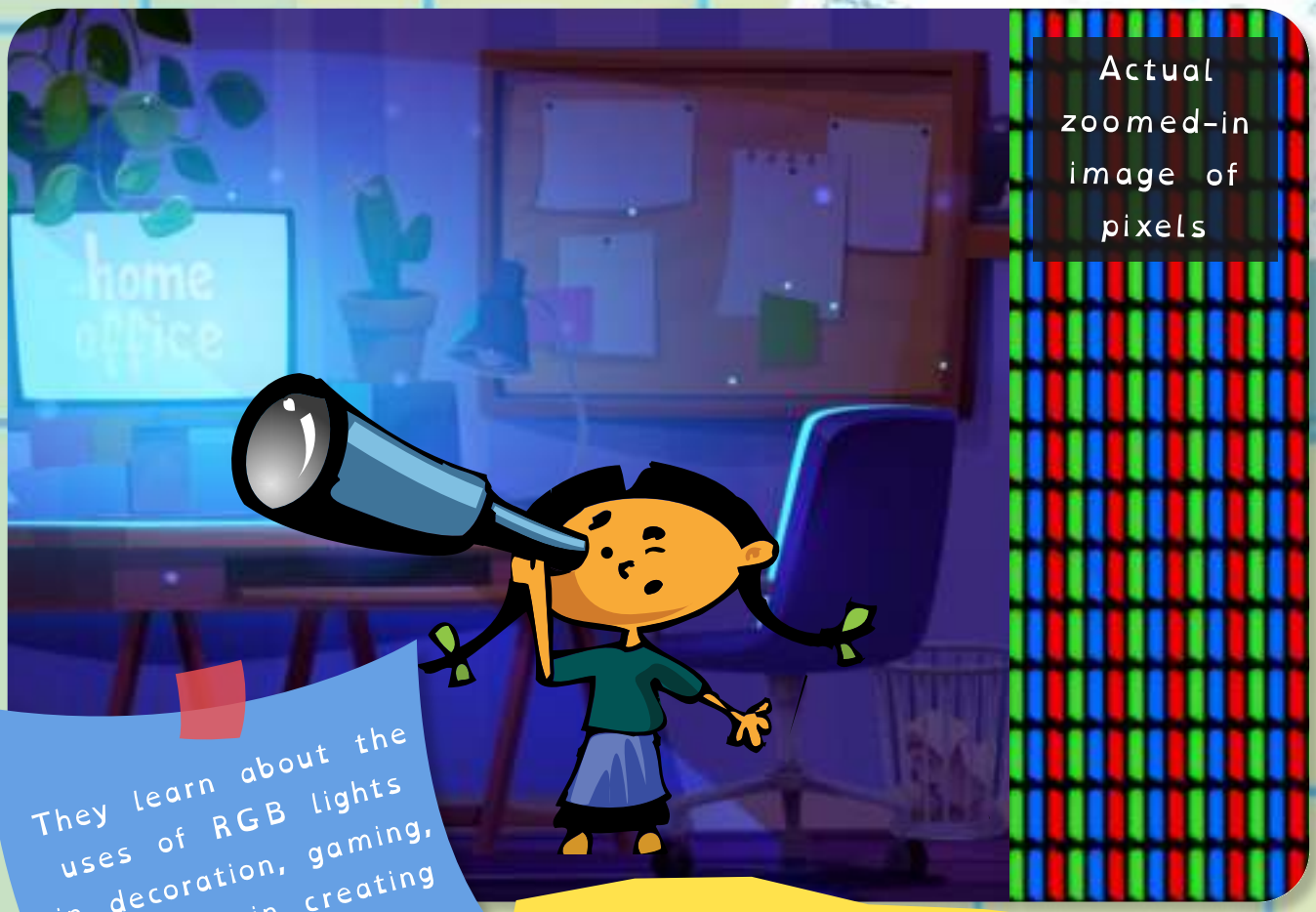
x 3


x 1


x 3

About the circuit

Your TV, laptop and your phones most likely have a pixel based screen. This circuit is a representation of a single pixel.



Actual zoomed-in image of pixels

They learn about the uses of RGB lights in decoration, gaming, and even in creating special effects for movies.

Now we know what's in our devices but how are the colours formed?

Let's make a colour mixing circuit!

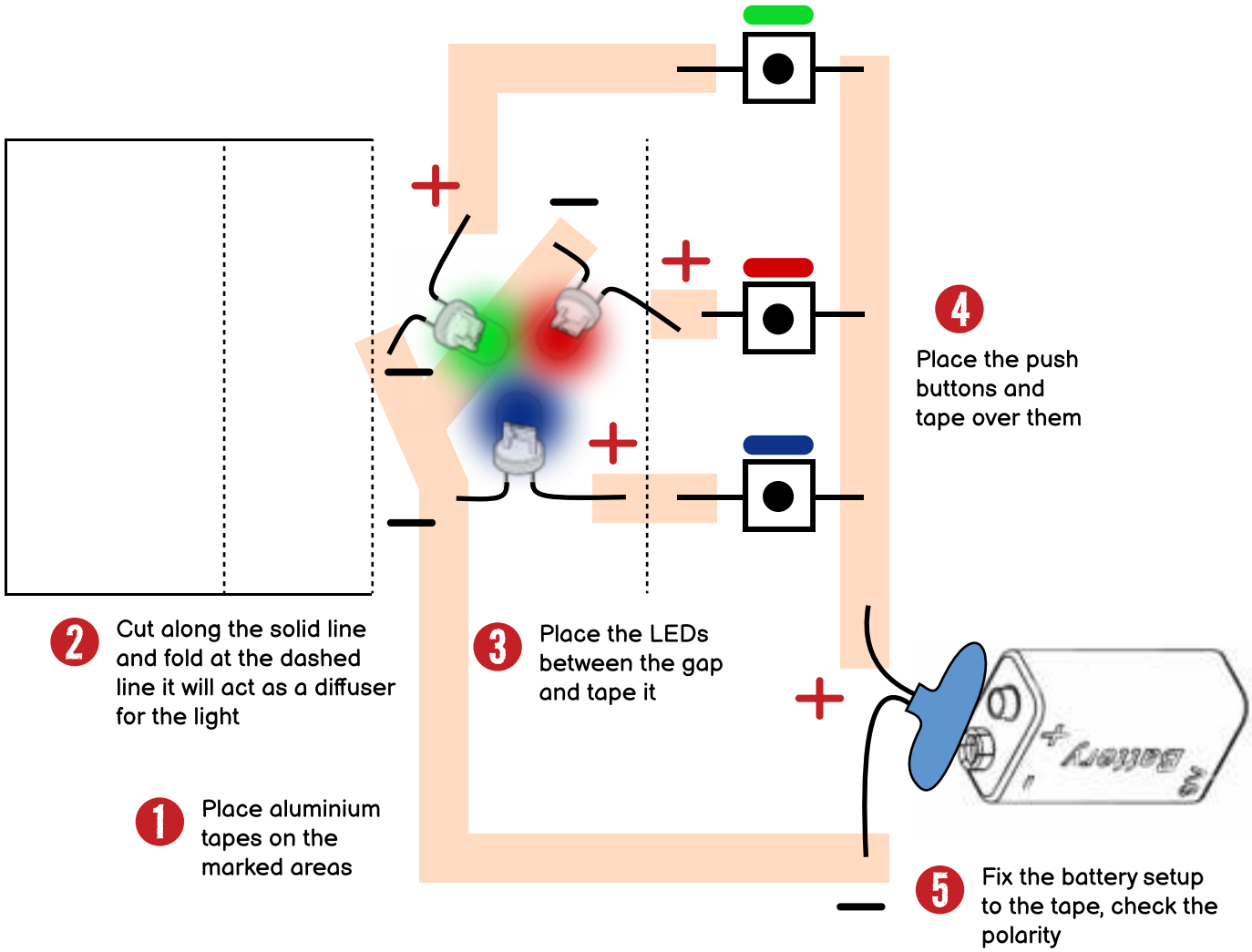
DIY

How can you use a potentiometer to control the brightness of each color in an RGB LED, mixing them to find the perfect shade?

Did you Know?

Earth's magnetic north pole is constantly moving and can shift by as much as 40 kilometers per year.

Colour Mixing Lights



2 Cut along the solid line and fold at the dashed line it will act as a diffuser for the light

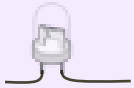
1 Place aluminium tapes on the marked areas

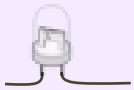
3 Place the LEDs between the gap and tape it

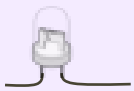
4 Place the push buttons and tape over them

5 Fix the battery setup to the tape, check the polarity

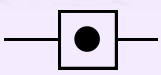
What you will need


Red x 1


Green x 1


Blue x 1


x 1


x 3

About the circuit

Let's use the same single pixel unit to see how different colours are made. Use different combinations to see which colour is made.

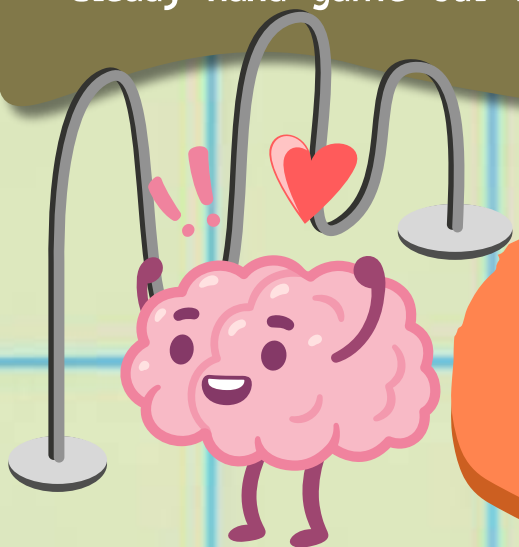
Fun Side Activity #2 that Nilu and Pilu come across in the Papertronics book they read

Let's have a fun competition about who has the most steady hand?

Let's make a steady hand game circuit!

Try this

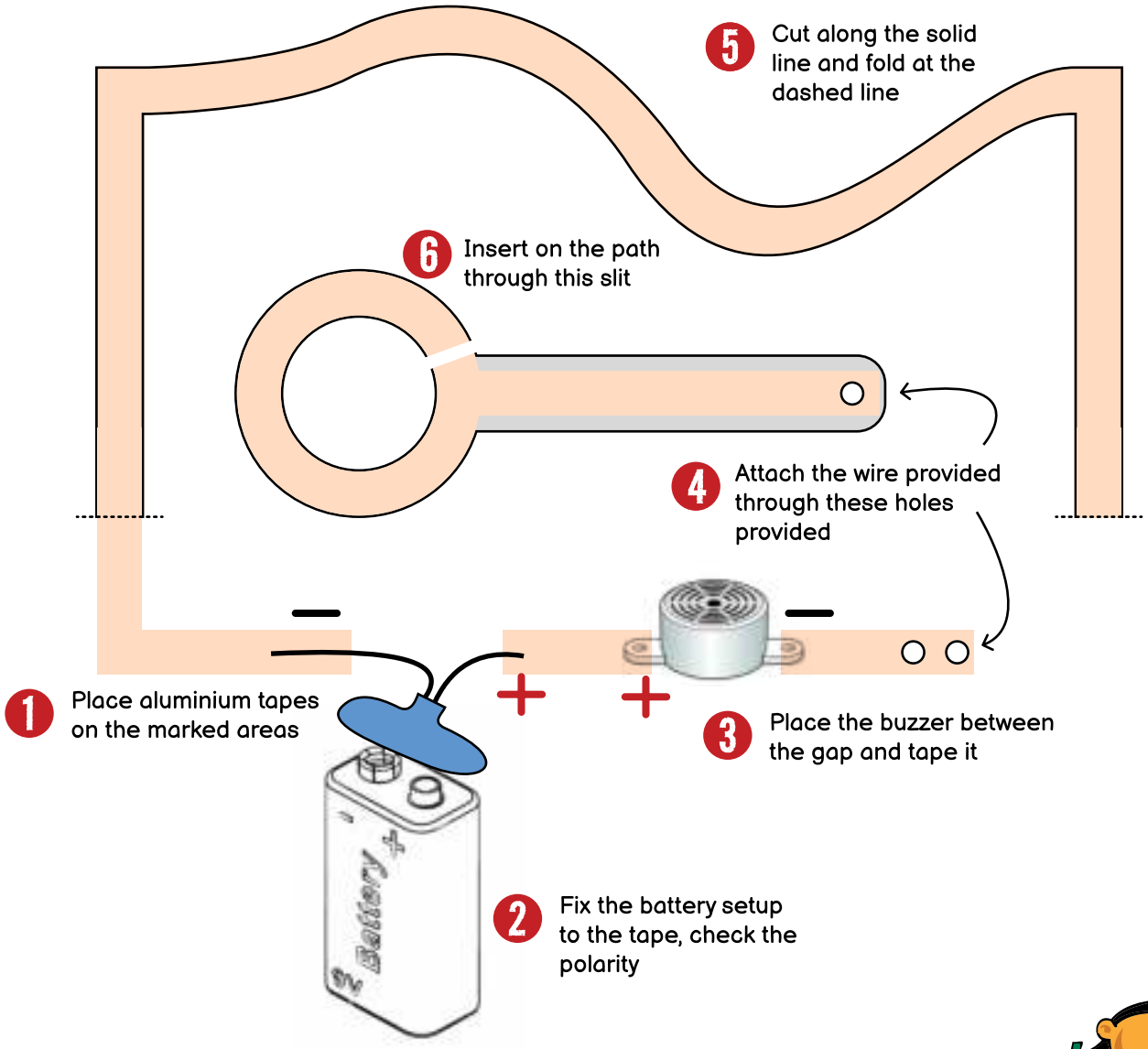
Can you create a similar but Big and complex steady hand game but with thick Wire instead of paper and copper tape



Did you Know?

The steady hand electric game was originally used as a therapeutic device in the early 20th century.

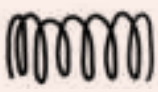
Steady Hand Game



What you will need

 x 1

 x 1

 x 1

About the circuit

Try your skill at the steady hand game. This is also a variation of a simple circuit. Try to move the loop from one end to another, if you touch the loop to the circuit closes you lose.

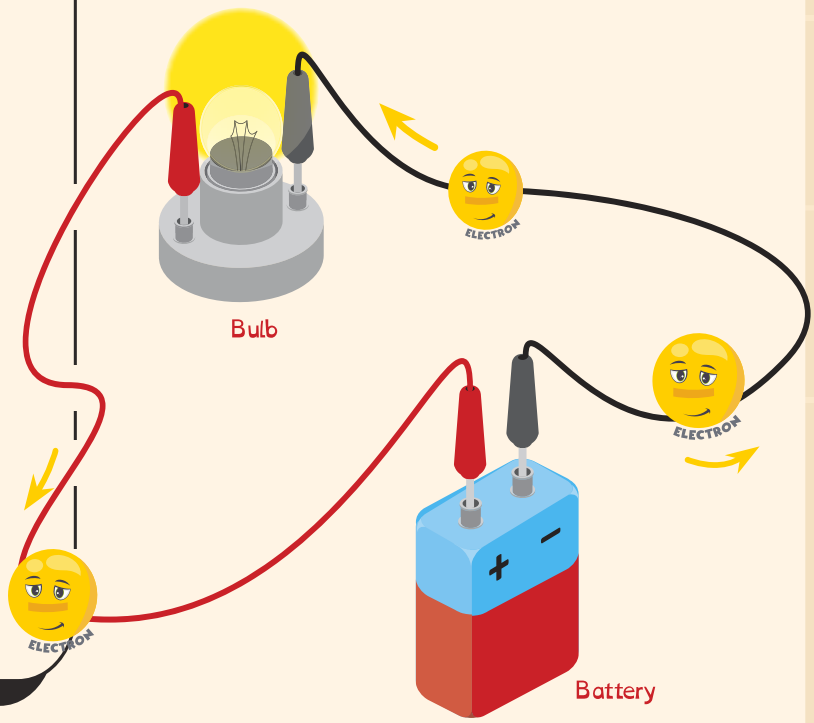
Glossary

1. Electric Circuit

An electric circuit is a path through which electricity flows. It needs a power source (like a battery) and something to use the electricity, like a light bulb, to make it work.

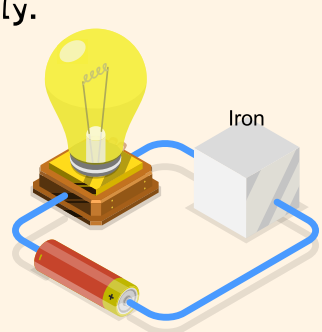
2. Electric Current

Electric current is the flow of tiny particles called electrons through a wire, kind of like water flowing through a hose.

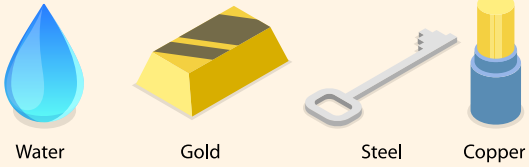


3. Conductor

Material that lets electricity flow through it easily. Metals like copper, steel are good conductors because they let electricity travel through them quickly.

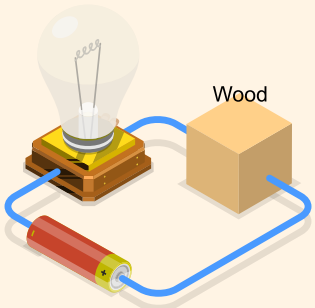


Material that allows the flow of electrical current

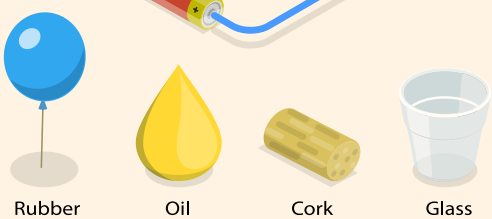


4. Insulator

Material that makes it difficult or resists electricity from flowing through it. Plastic, rubber, and wood are good insulators.



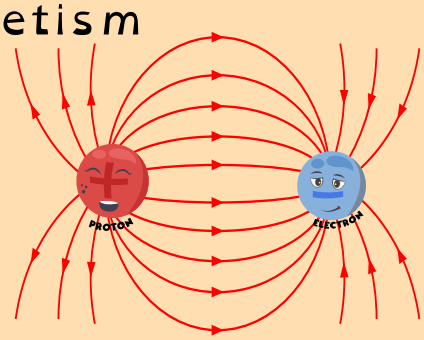
Electric current does not flow freely



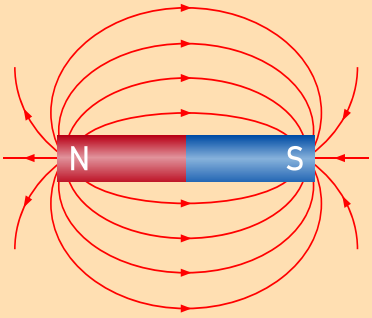
Glossary

5. Electro magnetism

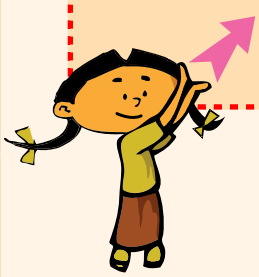
It is the interaction between electric charges and magnetic field, where an electric current creates a magnetic field.

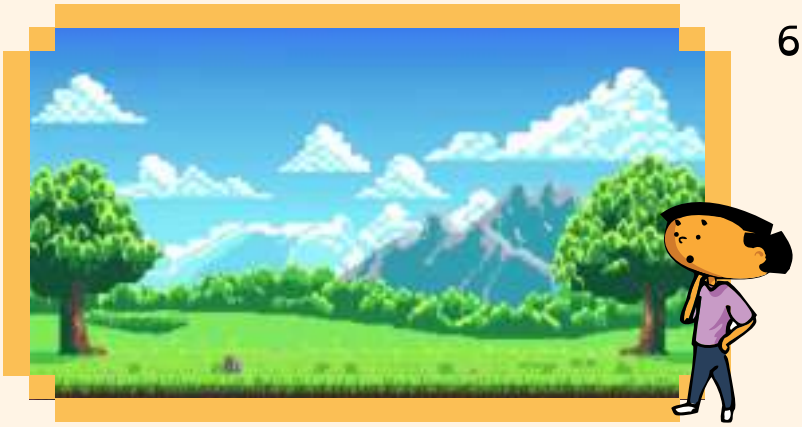


Electric charges



Magnetic field



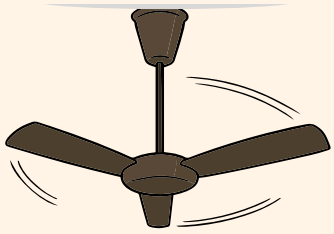


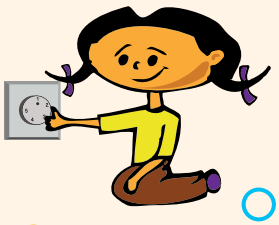
6. Pixels

A pixel is the tiny dot of color that makes up an image on a screen, like a building block for pictures. When many pixels are combined, they form the on phones

7. Potentiometer

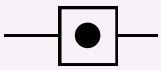
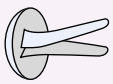
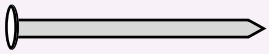
A potentiometer is a device with variable resistance that controls the flow of electrical current. Resistance can be controlled usually with a knob.





Material List

1. Yellow LED x5 
2. Red LED x3 
3. Green LED x3 
4. Blue LED x2 
5. U-Pin x1 
6. Coin cell x1 

7. Push Button Switch x3 
8. 9V battery x1 
9. 9V battery connector x1 
10. 8B lead pencil x1 
11. Split Pin x13 
12. Buzzer x1 
13. Diode x1 
14. Nail x1 
15. Iron filings 
16. Light sensor x1 
17. Wire x1 

Notes

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