John Adams

HOT WIRES

The Plug & Play Electronics Set!

Safety Information...

WARNING!

- Only for use by children aged 8 years and older. Not suitable for children under 3 years due to small parts which could cause a choking hazard.
- Contains electronic component blocks including photosensitive resistor, LED diode and sound modules. See manual for full listing.
- The kit contains wires with sharp points, which are necessary for the functioning of the kit and electronic components, which are detailed in the contents list.
- Use under the supervision of an adult and read all instructions, follow them and keep for future reference.
- Failure to comply with the safety precautions could result in injury to the user.
- Keep out of reach of young children.

Possible Hazards

- Connecting components incorrectly could cause short circuiting (causing an abnormally high current to flow between two electrical components, damaging the circuit) and causing damage to the product.
- Connecting components incorrectly could lead to overheating and damage to the batteries causing them to leak.
- Please do not attempt to increase or manipulate the current flow in the product as this will overheat the circuit and damage the product.
- Do not connect electrolytic capacitors in reverse polarity to prevent risk of explosion.

Safety Advice for Supervising Adults

- Read and follow the instructions, with particular reference to the information on the batteries (below) and the circuit building instructions (below & within the experiment pages).
- Hot Wires is for use by children above the age of 8 years.
- Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe (the instructions should enable supervising adults to establish the experiment's suitability for the child).
- Supervising adults should discuss the warnings and instructions with children before commencing the experiments.

BATTERIES

- 4 x AA (1.5 volt) batteries are required, which are not included in this kit.
- Only insert batteries once a circuit is complete and has been carefully checked for errors.
- Always remove the batteries before dismantling the circuit.
- Batteries must be replaced and inserted by an adult.
- Do not mix different types of old or new batteries.
- Only batteries of the same or equivalent type should be used.
- Batteries should be inserted with the correct polarity.
- Remove exhausted batteries from the product.
- DO NOT short circuit the battery holders.
- NEVER throw batteries into a fire, or attempt to open their casings.
- Batteries are harmful if swallowed, so keep away from young children and pets.
- Non rechargeable batteries are not to be recharged.
- Rechargeable batteries should only be used and charged under the supervision of an adult.
- Rechargeable batteries should be removed from the product before being charged.

HOT WIRES has been designed for children over eight years.
It should be kept out of reach of small children.

WARNING! This kit must only be used with 4 x AA Batteries (1.5 volt). Rechargeable batteries should not be used without adult supervision and this kit must not be connected to electricity directly or through a transformer.

There are 4 x AA batteries which will have an output of 6Volts DC.

Always make sure the batteries are disconnected when building a circuit. DO NOT connect the batteries until you have finished building your circuit and checked it against the relevant circuit diagram for any errors.

Always check the positive and negative terminals of the battery holders are connected correctly, according to the circuit diagrams. Failure to do so may result in a short circuit.

It is advisable to disconnect the battery holder(s) after use to save the batteries.

General advice for circuit building

Before building a circuit, prepare and lay out the parts that you will need. Make sure all parts marked with a + or - are connected correctly. Follow the circuit diagrams carefully and work slowly, making sure you are using the correct components and placing them in the right place.

John Adams

HOT WIRES

Hot Wires is designed to teach the principles of electronics to children of all ages from 8 years upwards.

The easy-to-handle components snap together to create a huge number of different circuits on the base board. All wires are secured within the components so the kit is entirely safe and amazingly simple to operate. The circuits are activated by touch, water, light and sound, resulting in flashing bulbs, a motorised fan and flying disc, and many brilliant sound effects.

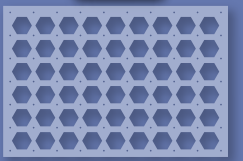
Children aged from 8 years upwards will rapidly learn how to set up the circuits and will be entranced by the results of their experiments. Instructions must always be followed exactly in order to avoid short circuiting.

An understanding of electronics is a vital part of all children's scientific education. **Hot Wires** removes the frustrations of handling small and delicate components, replacing them with fail safe systems with guaranteed results.

HOT WIRES® Components...

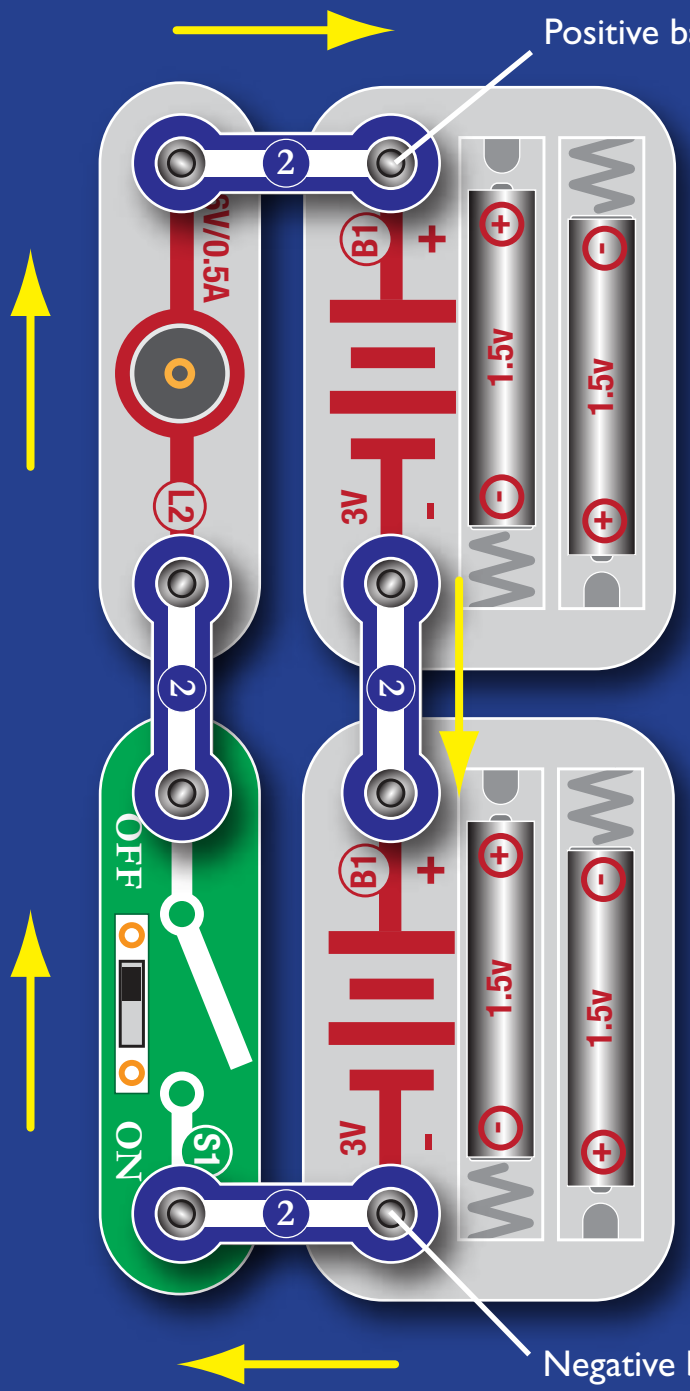
Number	Description	Item	Number	Description	Item
1	Washer with 1 connecting terminal	x7 washers are always shown with an arrow indicating where they fit in the circuit	PR	Photo Resistor	
2	Wire with 2 connecting terminals	 x11	D1	Red LED	
3	Wire with 3 connecting terminals	 x4	B1	Battery Unit	 x2
4	Wire with 4 connecting terminals	 x2	SP	Loudspeaker	
5	Wire with 5 connecting terminals		U1	Music IC Unit	
6	Wire with 6 connecting terminals		U2	Alarm IC Unit	
7	Wire with 7 connecting terminals		U3	Sound effects IC Unit	
BZ	Buzzer		M1	Motor Unit	
TP	Touch Plate		A1	Antenna Coil	
S2	Button Switch		D2	Green LED	
S1	Switch		L2	6V Lamp Unit	

HOT WIRES® Components...

Number	Description	Item	Number	Description	Item
X1	Microphone		C5	470µF Capacitor	
U4	Power Amp IC Unit		U5	High Frequency Amplifying IC Unit	
R1	100Ω Resistor		Q1	PNP Transistor	
R2	1K Resistor		Q2	NPN Transistor	
R3	5.1K Resistor		VR	Variable Resistor	
R4	10K Resistor		VC	Variable Capacitor	
R5	100K Resistor		FM	FM High Frequency IC Unit	
C1	0.02µF Capacitor		D3	Diode	
C2	0.1µF Capacitor		U6	Sound Recording IC Unit	
C3	10µF Capacitor		Others…	 6V Bulbs x2	 Plastic Spinner
C4	100µF Capacitor				 Base Board

HOT WIRES® Experiments...

HOT WIRES® Experiments...

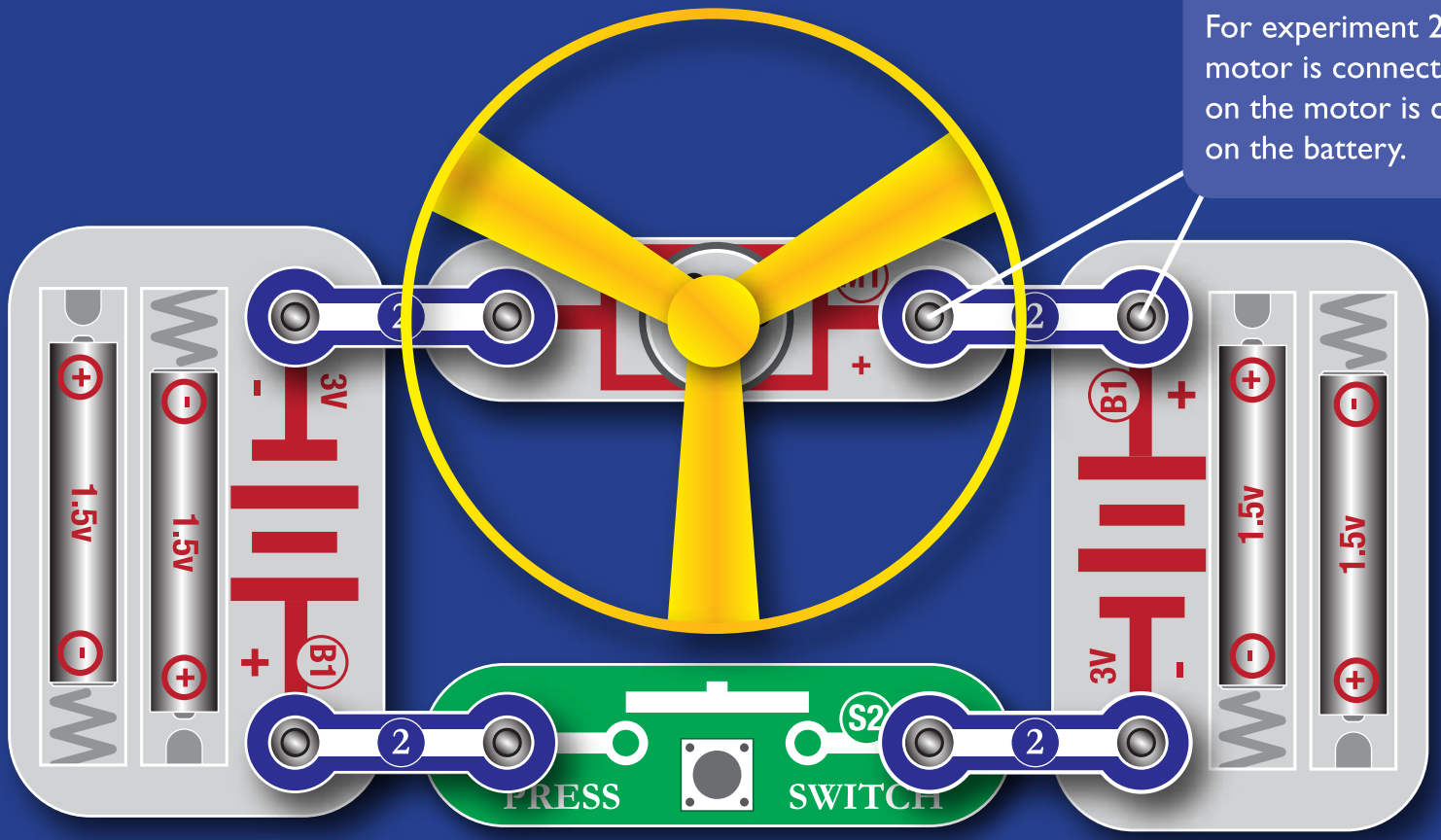


Experiment 1: Making a simple circuit.

Build the circuit as shown in the diagram, by carefully clipping the components to the base board. Ensure that one of the 6V bulbs is screwed into the 6V Lamp unit (L2), and that everything is assembled exactly as shown in the diagram before inserting the batteries into the battery holders.

When you operate the switch, you complete the circuit and the electricity can flow. The electricity flows from the negative (-) terminal of the batteries, through the closed switch, through the bulb (which lights as the electricity flows through it), and back to the positive terminals of the batteries. Electricity always flows from the negative to the positive.

NOTE:
For experiment 2, ensure that the motor is connected so that the + on the motor is connected to the + on the battery.

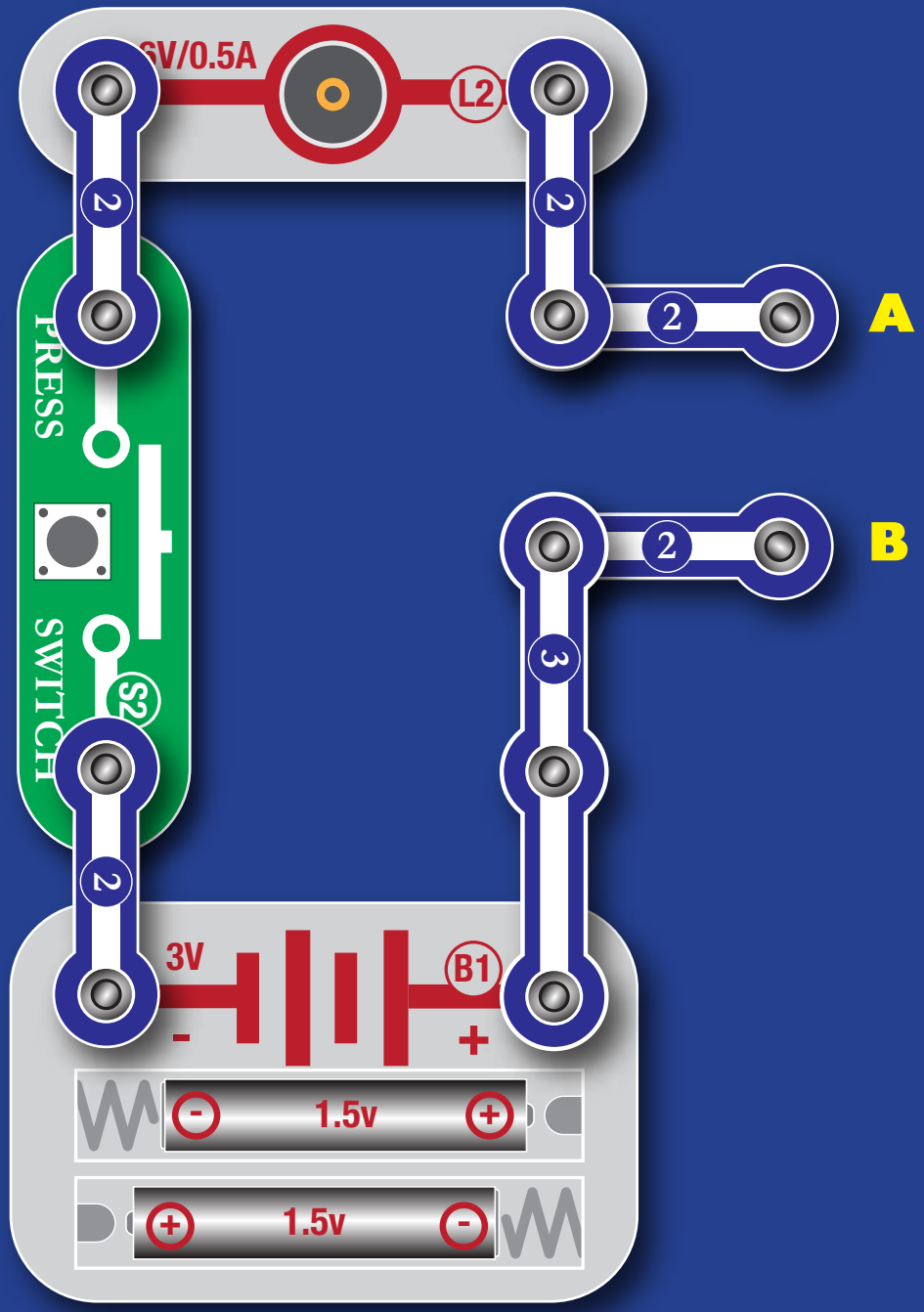


Experiment 2:
Powering the motor & fan.

Build the circuit as shown in the diagram, taking care to connect the motor the correct way, as illustrated. When you press down on the button switch, the circuit is complete and the electricity can flow, powering the motor to turn the fan at high speed!

Experiment 3:
Reversing the direction of the fan.

Disconnect the motor, and re-attach so that it is connected the opposite way round to the diagram. Make sure that you are not in the way of the fan, and press the button switch to complete the circuit. This time the motor spins in the opposite direction, and when it has enough speed, the yellow spinner launches into the air!
See how high you can make it go!



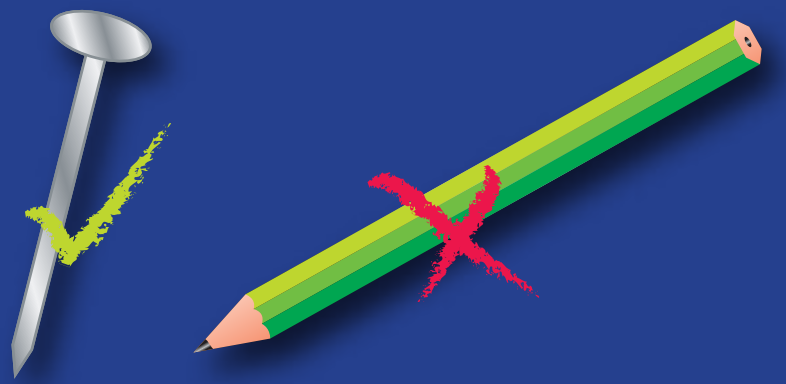
Experiment 4: Testing Electrical Conductivity.

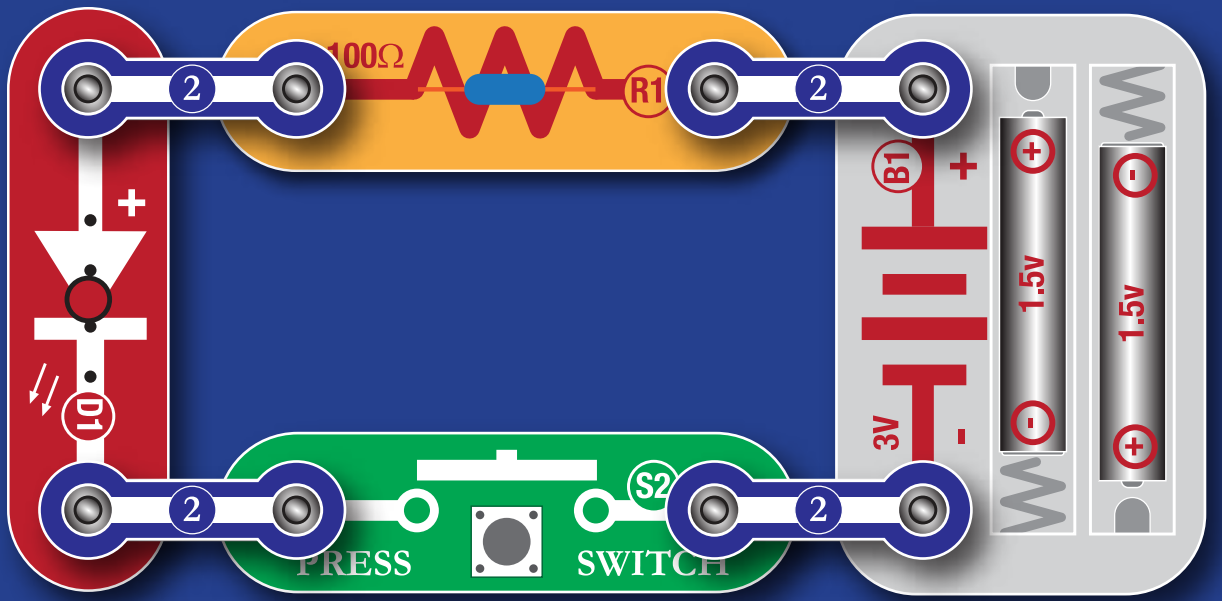
Some materials can conduct electricity (this means that electricity can pass through them), and other materials can't conduct electricity.

This circuit can test whether different materials are **conductors**, or **non-conductors**.

Build the circuit, then hold an object (for example: a teaspoon) across the two terminals **A** and **B**, then press the button switch. If the object can conduct electricity then the circuit will be complete and the bulb will light.

Try lots of different objects, and make a list of conductors and non-conductors!



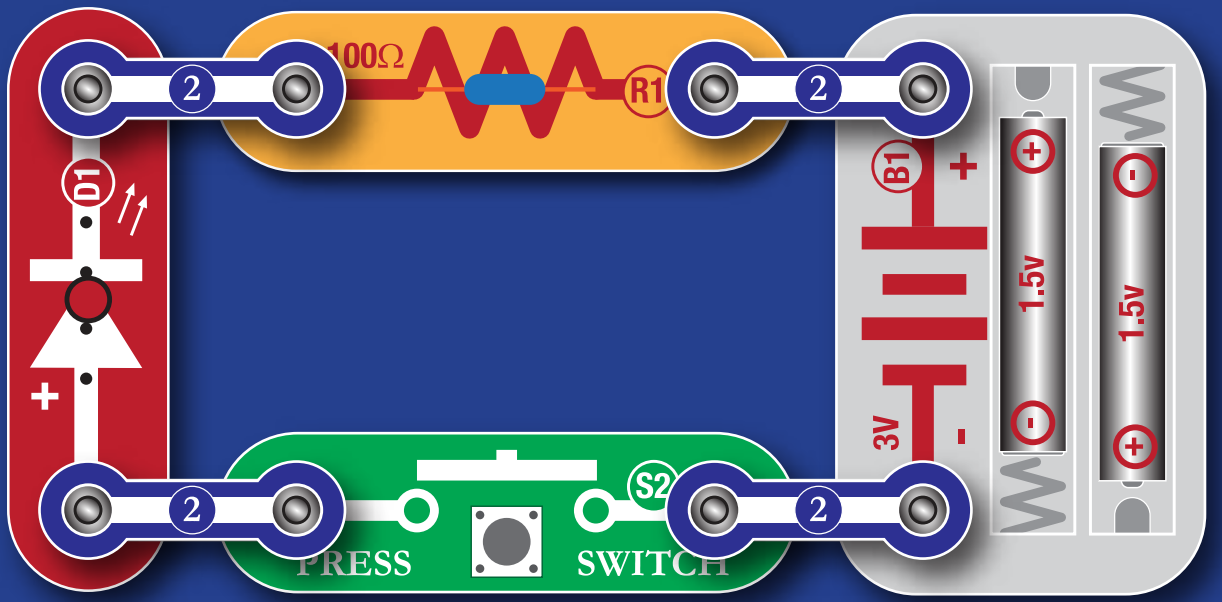


Experiment 5: Simple LED Circuit.

A diode is an electronic component that only allows electricity to flow through in one direction. LED stands for 'Light Emitting Diode', this is a special type of diode that lights up when the electricity flows through it.

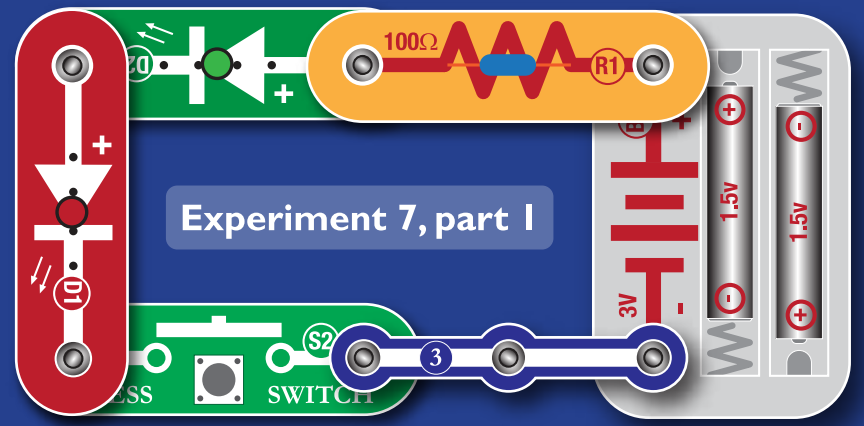
When you press the switch, the circuit is complete and the LED will light. The other component (R1) is a resistor, its purpose is to reduce the current of the electricity to prevent damage to the LED.

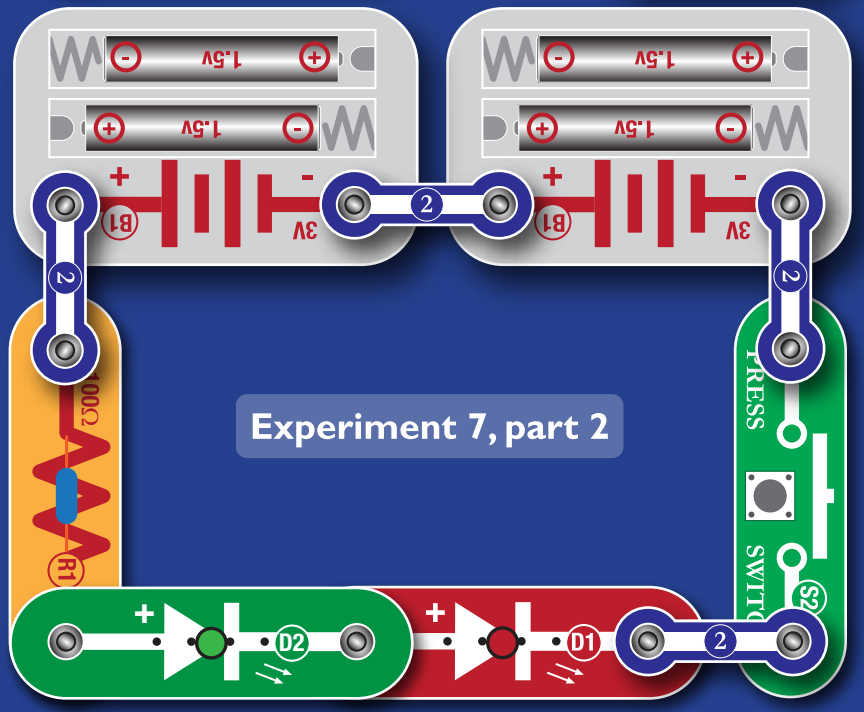
If you like, you can swap the red LED for the green LED (D2).



Experiment 6: Reversing the LED.

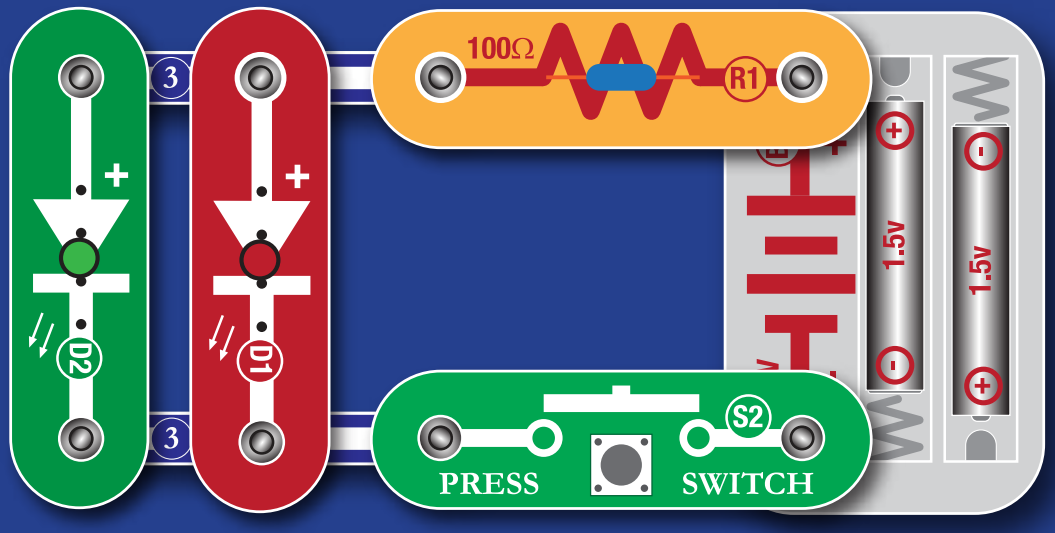
Try changing the polarity (direction) of the LED. When you press the switch the LED blocks the flow of electricity and does not light.





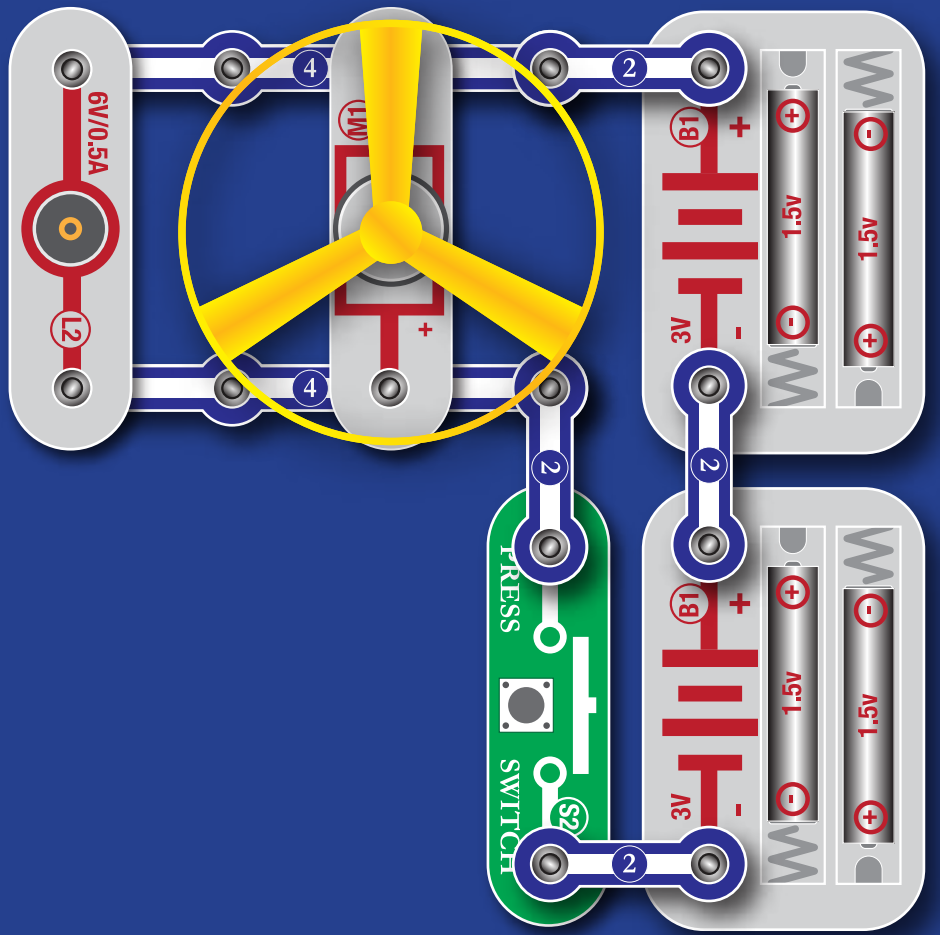
Experiment 7: LEDs in Series.

Build the first circuit and press the switch. Although the circuit is complete and the LEDs are connected correctly, they do not light. This is because they are both sharing the 3V battery, and receive 1.5V each, which is not enough to light them. Build the second circuit, where they are sharing 6V and they will light, as they each receive 3V.



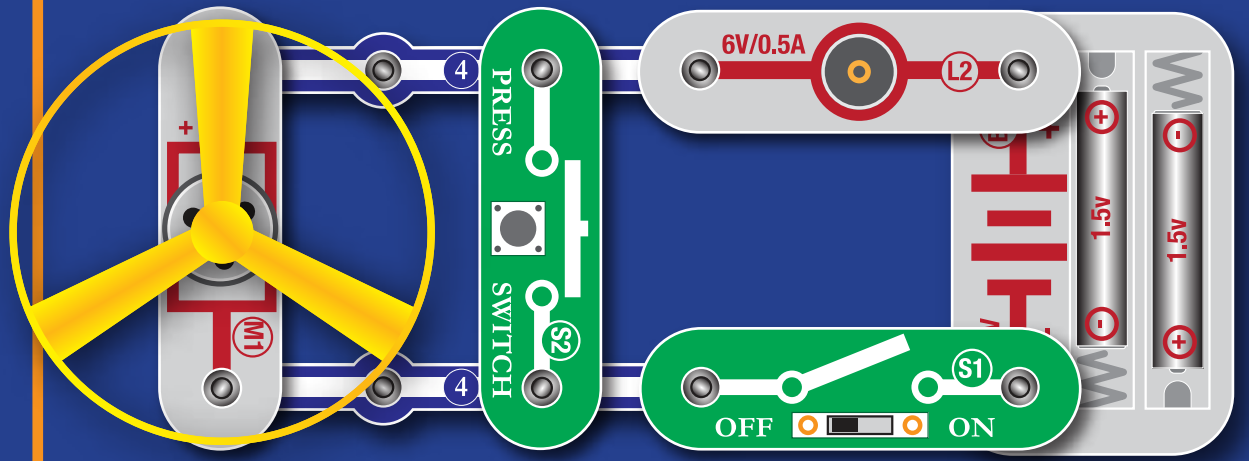
Experiment 8: LEDs in Parallel.

In the first circuit of Experiment 7, 3V was not enough to power both LEDs as they had to divide it equally between themselves. However, in a parallel circuit, both LEDs receive 3V each from the battery and they both light up. It seems as if you are getting more out of the batteries as only 3V is lighting both LEDs, but in reality the batteries will only last half as long as they would in the series circuit.



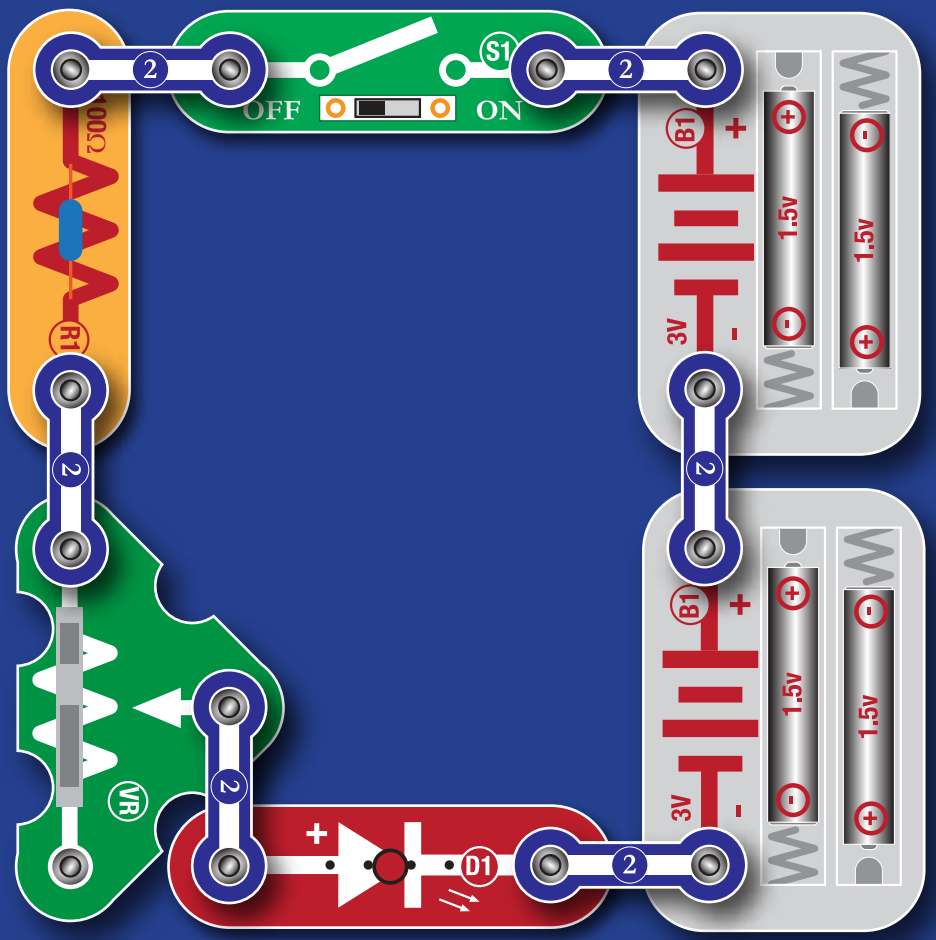
Experiment 9: Batteries in Series.

In this circuit, the batteries are connected in series, and combined together produce 6V. The bulb and the motor are both connected in parallel, so they both receive the full 6V instead of sharing. The result is that the bulb will light, and the motor will be strong enough to launch the flying spinner. (Note which way the motor is connected to launch the spinner).



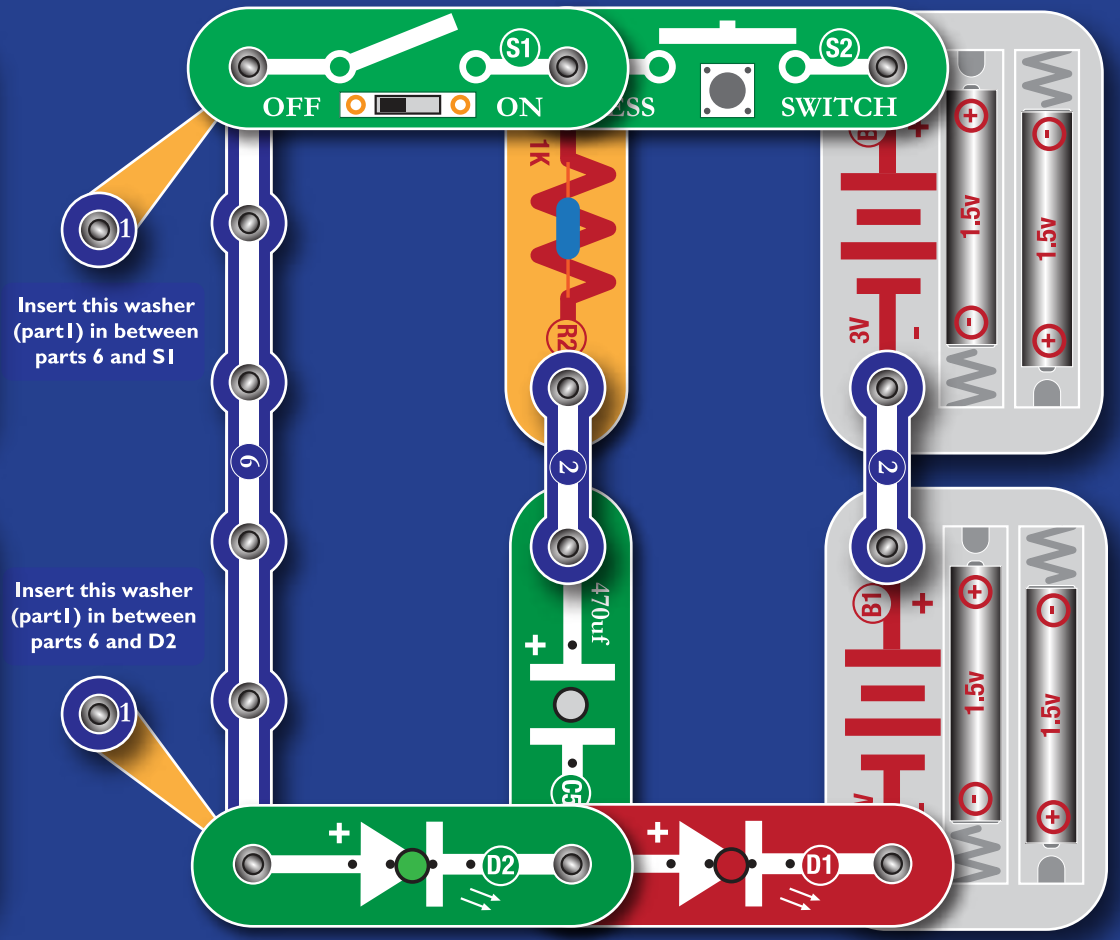
Experiment 10: Increased Current.

Close the switch (S1), the bulb lights dimly and the fan rotates. Press the button switch (S2), the brightness of the bulb will change and the fan will stop rotating. This is because the current bypasses the fan and all 3V goes through the bulb instead of sharing it with the fan.



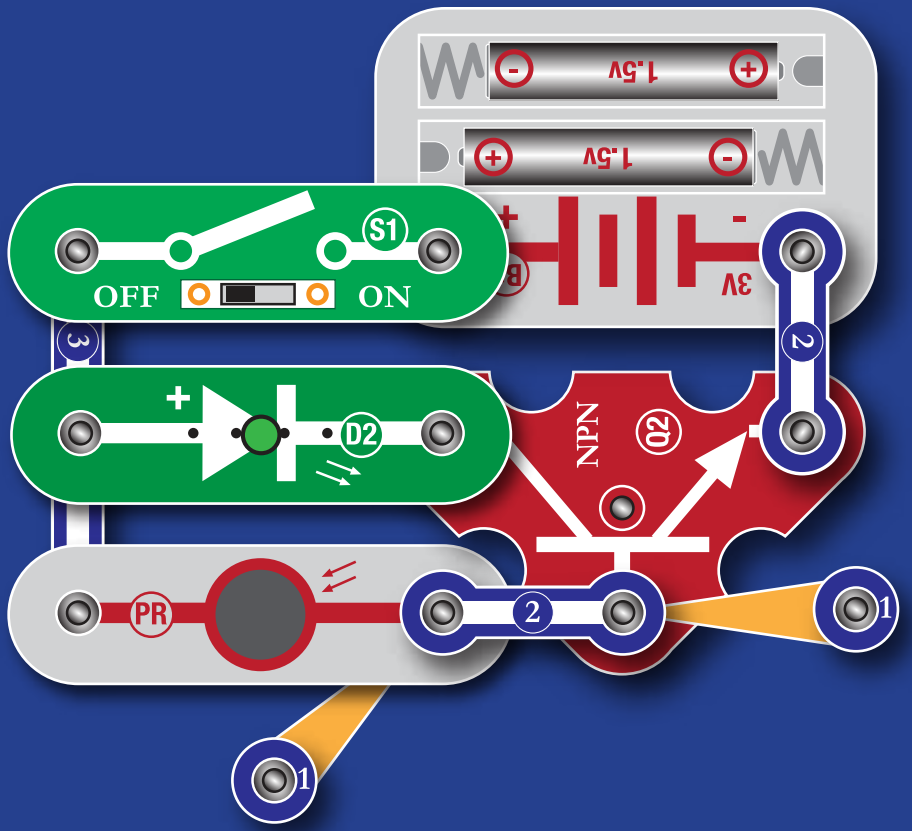
Experiment 11: Variable Brightness LED.

A resistor is an electronic component that resists the flow of electrical current. There are several resistors in this kit, each with a different value of resistance, as well as a variable resistor (VR). When you build the circuit and close the switch, the LED will light. As you move the slider on the variable resistor, the brightness of the LED will vary as the resistance increases and decreases.



Experiment 12: Charging a Capacitor.

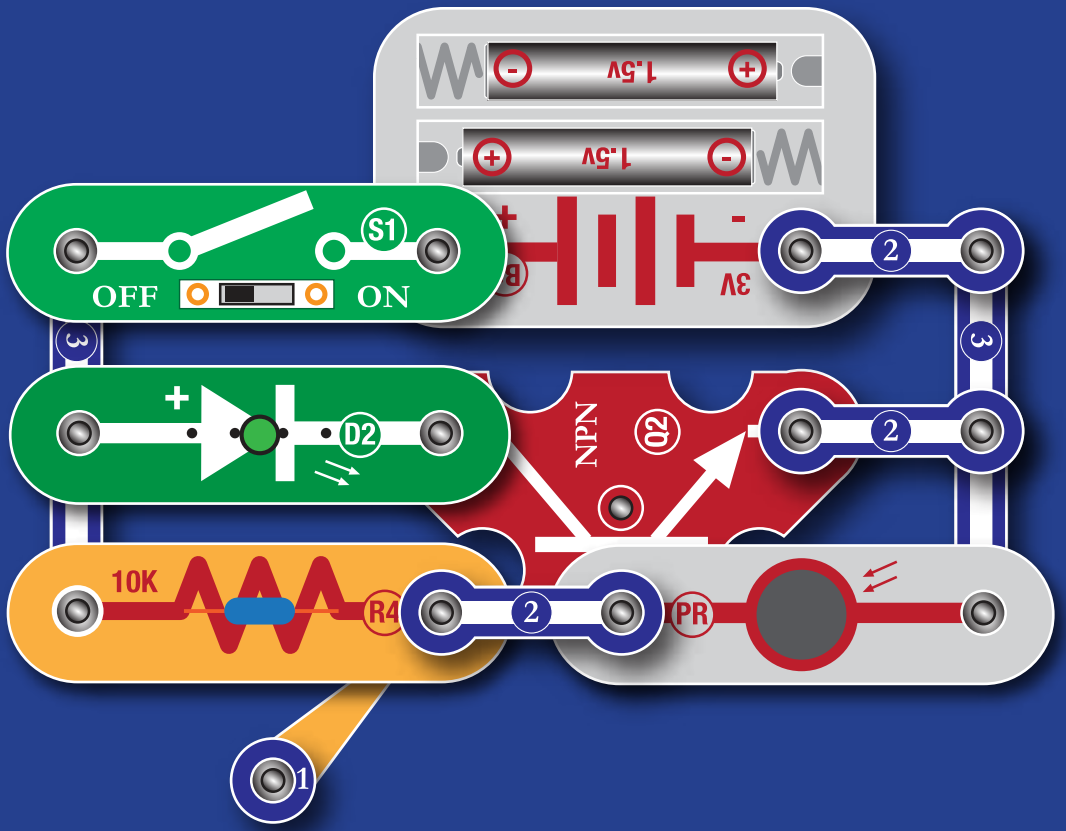
A capacitor is an electronic component that can store electrical energy, and release it when needed. Build the circuit shown in the diagram and leave the Switch (S1) open. Press down on the Button Switch (S2) and the electricity will flow through the capacitor (C5) and the Red LED. As the capacitor becomes fully charged, the red LED dies out. Once the capacitor is charged, release the button switch, then close the other switch. The stored charge is released and flows around the second half of the circuit lighting the green LED until it is exhausted.



Experiment 13: Light Sensitive LED with NPN Transistor.

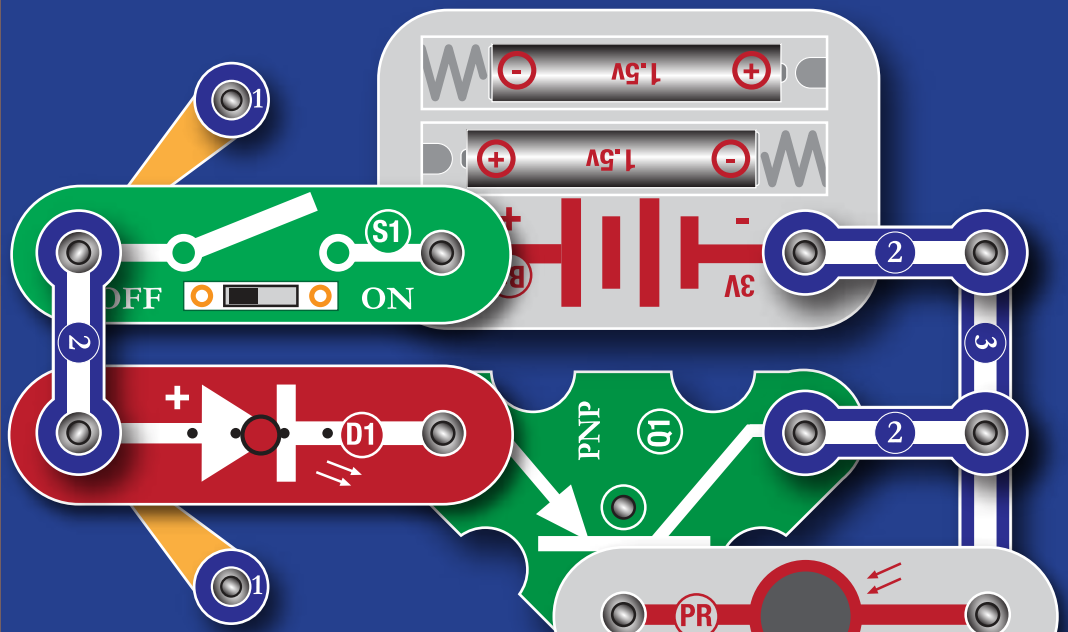
The next 4 experiments introduce 2 new components: the Photo Sensitive Resistor (PR) and Transistors (Q1 & Q2). The Photo Sensitive Resistor changes its resistance depending on how light or dark it is, and the Transistor acts like a switch. Depending on the resistance from the Photo Sensitive Resistor, it either switches on or off, to allow electricity to flow through the LED and light it.

In this circuit, the LED is lit when light falls on the Photo Sensitive Resistor. However, if you shade it with your hand, the LED will go out!



Experiment 14: Dark Sensitive LED with NPN Transistor.

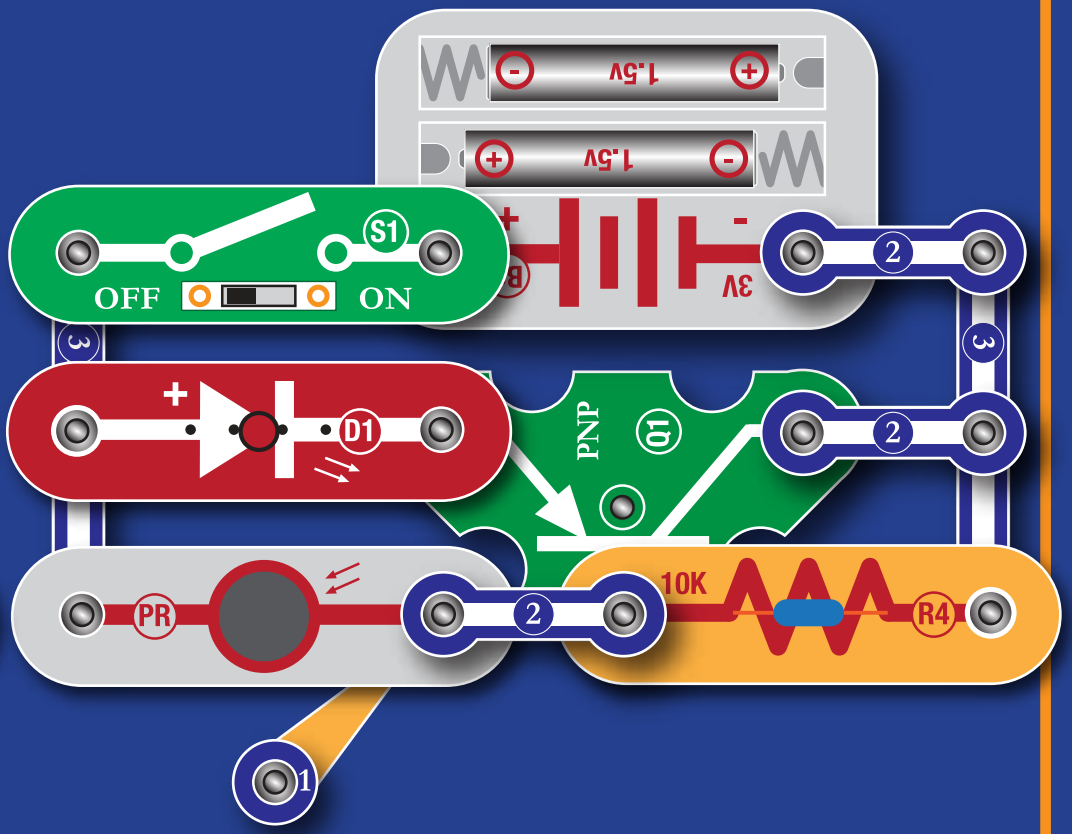
In this circuit, the LED is connected to the other side of the Transistor, and the circuit works in the opposite way. The LED will remain lit in the dark, but when strong light falls on the Photo Sensitive Resistor, the LED will die out.



Experiment 15: Light Sensitive LED with PNP Transistor.

In this kit, there are two different types of Transistor. These are called NPN and PNP. NPN stands for Negative-Positive-Negative, and refers to the three terminals of the Transistor. PNP stands for Positive-Negative-Positive. These two circuits perform the same function of the previous two experiments, but they use a PNP Transistor, instead of an NPN Transistor.

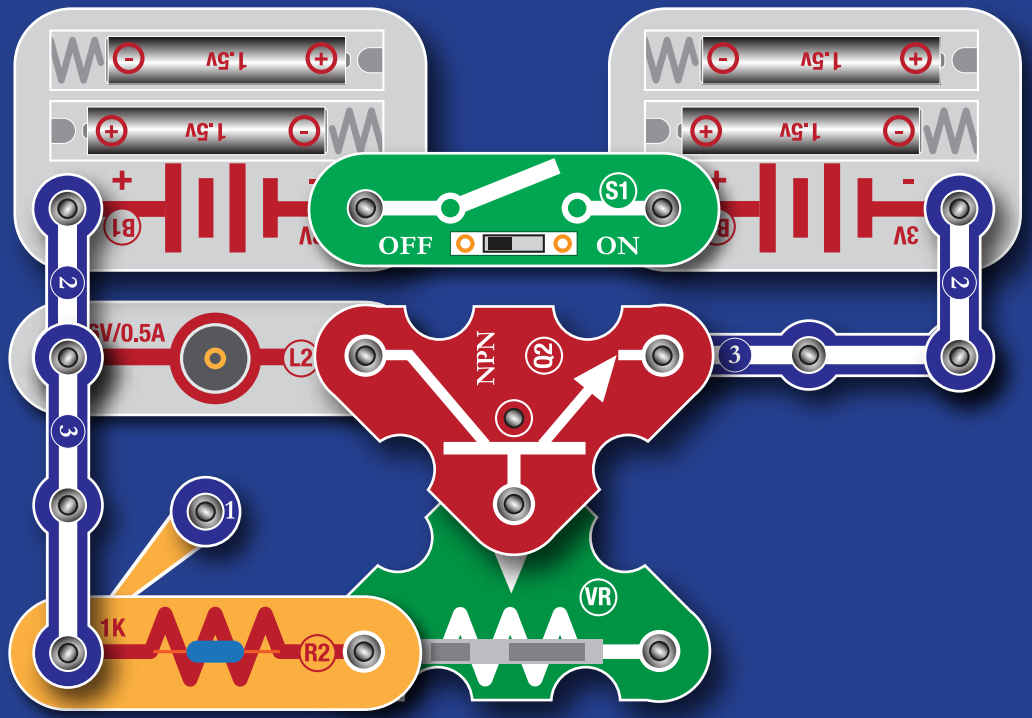
In this circuit, the LED is lit when light falls onto the Photo Sensitive Resistor, and dies out when you shade it.



Experiment 16: Dark Sensitive LED with PNP Transistor.

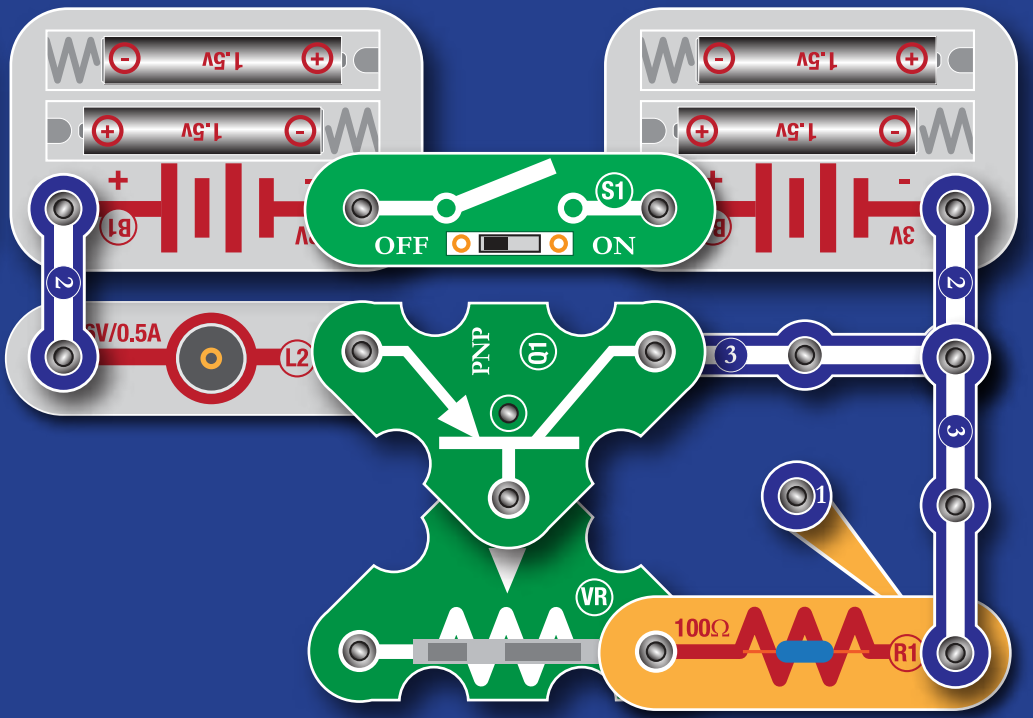
This experiment is similar to Experiment 14, but it substitutes a PNP Transistor for the NPN Transistor. Can you see how this has altered the layout of the circuit?

The LED will remain lit in the dark, or low light, but when strong light falls on the Photo Sensitive Resistor, the LED dies out.



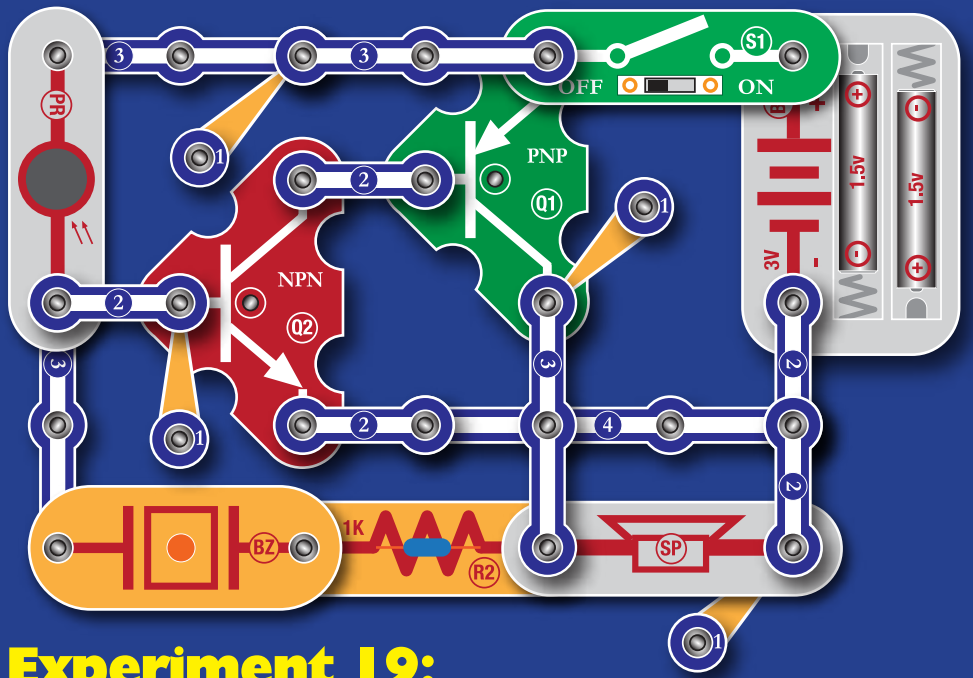
Experiment 17: Variable Lamp with NPN Transistor.

In this circuit, the Variable Resistor and NPN Transistor are used to control the amount of electricity flowing through the 6V Bulb. By moving the slider on the Variable Resistor, you can control the brightness of the bulb.



Experiment 18: Variable Lamp with PNP Transistor.

In this circuit, the Variable Resistor and PNP Transistor are used to control the brightness of the 6V Bulb. Once again, moving the slider controls the brightness. Can you see how this circuit differs from the circuit in experiment 17?

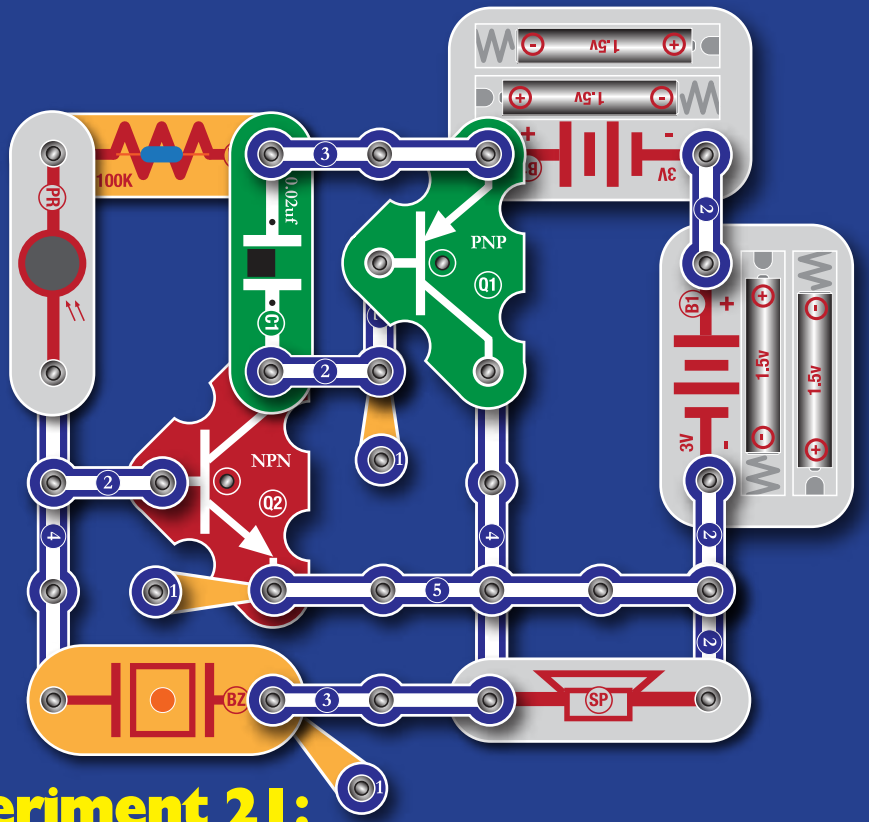


Experiment 19: Light Controlled Sound Generator.

When this circuit is placed in a light area and the switch is closed, nothing happens, but as you bring your hand closer to the Photo Sensitive Resistor it begins to produce a high pitched tone. As you move your hand closer to the Photo Sensitive Resistor, the note produced becomes lower and lower.

Experiment 20: Touch Controlled Sound Generator.

Replace the Photo Sensitive Resistor (PR) for the Touch Plate (TP). When you close the switch, the circuit is silent, but when you touch the Touch Plate gently, a low note is produced. The harder you press, the higher the note goes. The Touch Plate and the surface of your finger act as a resistor. Try wetting your finger and touching the Touch Plate.

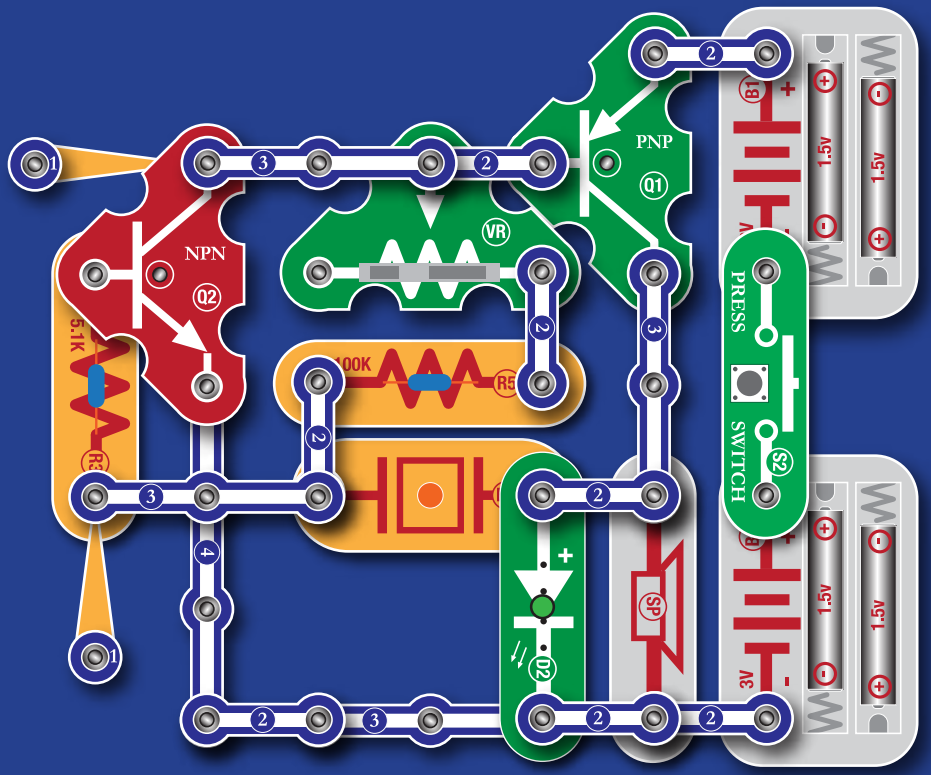


Experiment 21: Light Controlled Oscillator.

This circuit produces a high pitched oscillating sound. As you shade the Photo Sensitive Resistor, the pitch drops lower and lower. Try replacing the Capacitor (C1) for one of the other capacitors in your kit (C2, C3, C4 & C5). For numbers C3, C4 & C5, make sure that the + end of the capacitor is not the end connected to the NPN Transistor.

Experiments 22: Touch Controlled Oscillator.

Replace the Photo Sensitive Resistor for the Touch Plate and use touch to control the circuit.

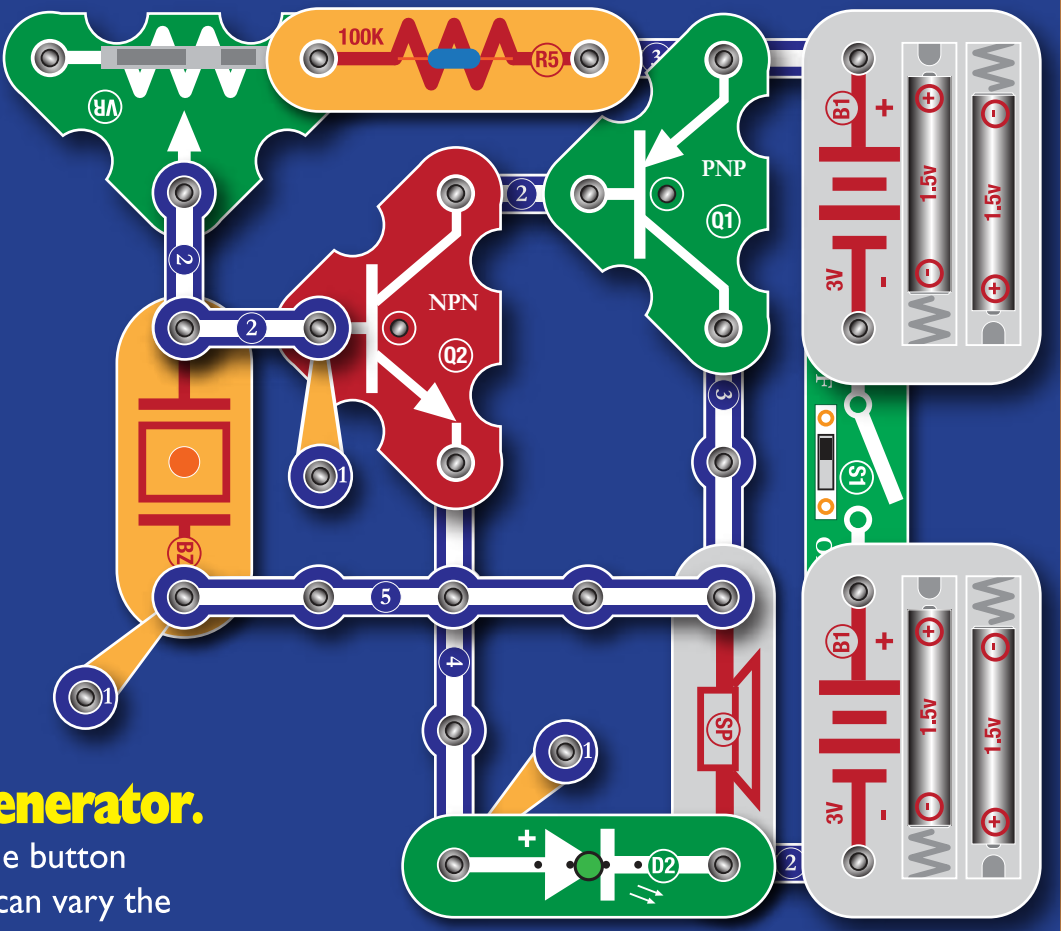


Experiment 23: Variable Tone Morse Code Generator.

With this circuit you can produce messages in Morse Code! Tap on the button switch to produce short and long notes (called dots and dashes). You can vary the pitch on the notes by altering the position of the slider on the Variable Resistor.

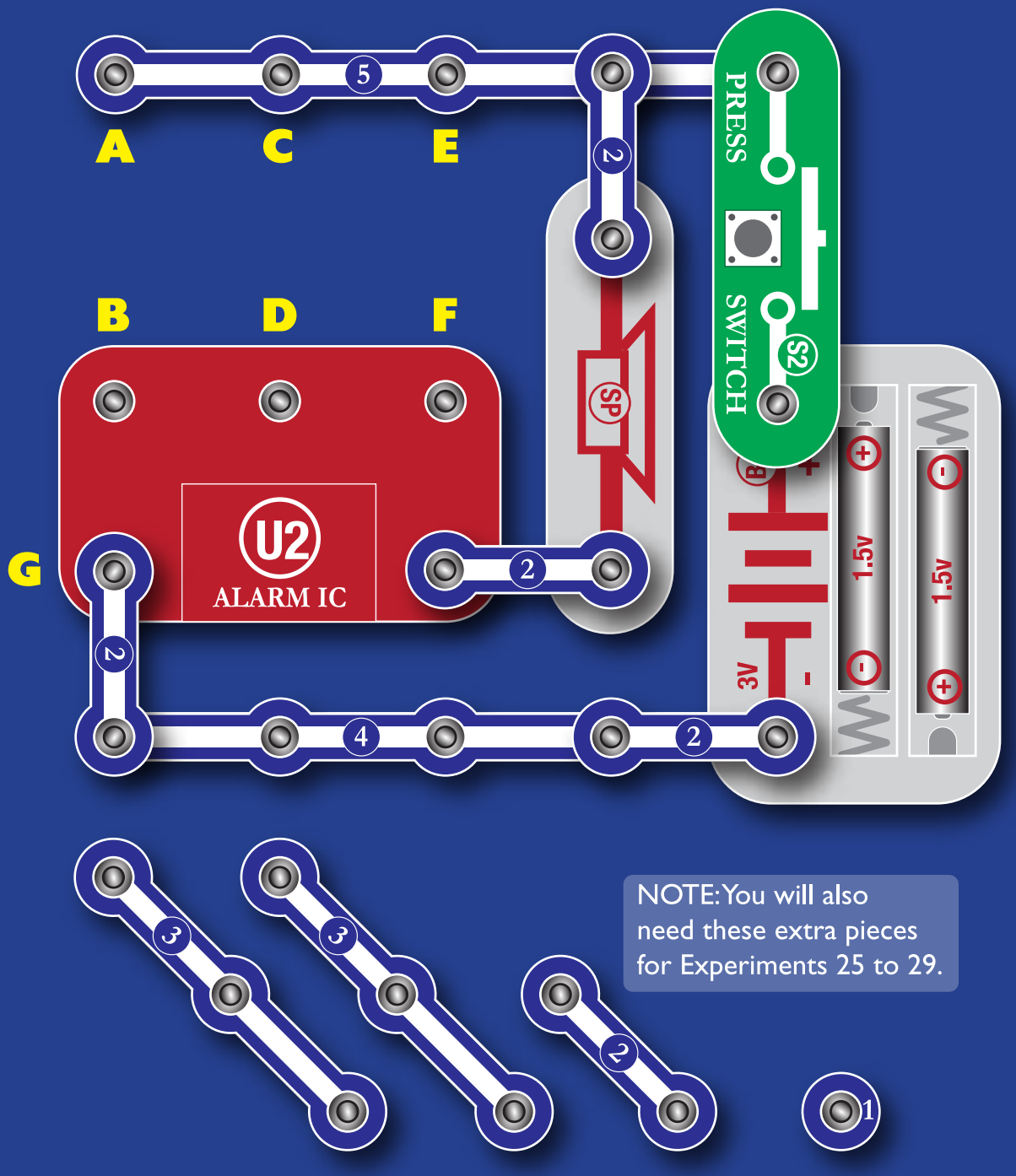
Here is a chart showing you the alphabet in Morse Code:

A	•—	H	••••	O	———	V	•••—
B	—•••	I	••	P	•——•	W	•——
C	—•—•	J	•———	Q	——•—	X	—••—
D	—••	K	—•—	R	•—•	Y	—•——
E	•	L	•—••	S	•••	Z	——••
F	••—•	M	——	T	—		
G	——•	N	—•	U	••—		



Experiments 24: Variable Tone Generator.

This circuit produces a continuous tone which can be varied in pitch from high to low by moving the slider on the Variable Resistor. Try changing the 100K Resistor (R5) for the 10K Resistor (R4), and see what difference this makes to the sound.



NOTE: You will also need these extra pieces for Experiments 25 to 29.

Experiment 25: Sound Effects.

These circuits make use of the Alarm IC Unit (U2). This unit contains circuitry that can produce a variety of different alarm sounds. Build the Circuit and use one of your extra pieces to connect **C** to **D**. When you press the Button Switch, the Loudspeaker will produce the sound of a Police car siren.

Experiment 26:

Use two of the extra pieces to connect **C** to **D** and **E** to **F**. When you press the Button Switch, the Loudspeaker will produce the sound of a laser gun.

Experiment 27:

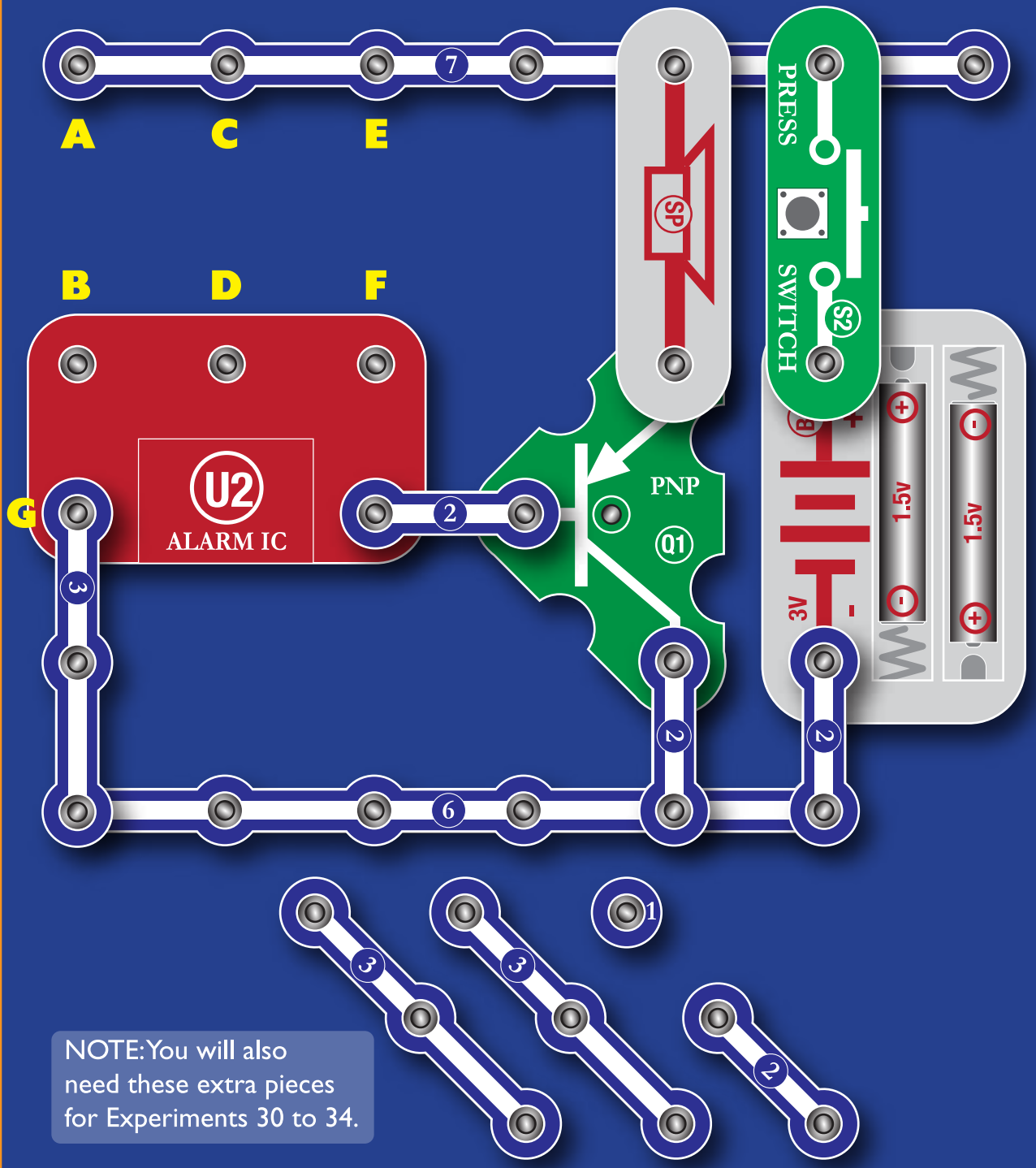
Use two of the extra pieces to connect **A** to **B** and **C** to **D**. When you press the Button Switch, the Loudspeaker will produce the sound of a fire engine.

Experiment 28:

Use three of the extra pieces to connect **C** to **D** and **B** to **G**. When you press the Button Switch, the Loudspeaker will produce the sound of an ambulance.

Experiment 29:

Use one of the extra pieces to connect **A** to **B**. When you press the Button Switch, the Loudspeaker will produce the sound of a space ship.



NOTE: You will also need these extra pieces for Experiments 30 to 34.

Experiment 30: Amplified Sound Effects.

In the next 5 experiments, a transistor is used to amplify the various sound effects produced. Build the Circuit and use one of your extra pieces to connect **C** to **D**. When you press the Button Switch, the Loudspeaker will produce the sound of a Police car siren.

Experiment 31:

Use two of the extra pieces to connect **C** to **D** and **E** to **F**. When you press the Button Switch, the Loudspeaker will produce the sound of a laser gun.

Experiment 32:

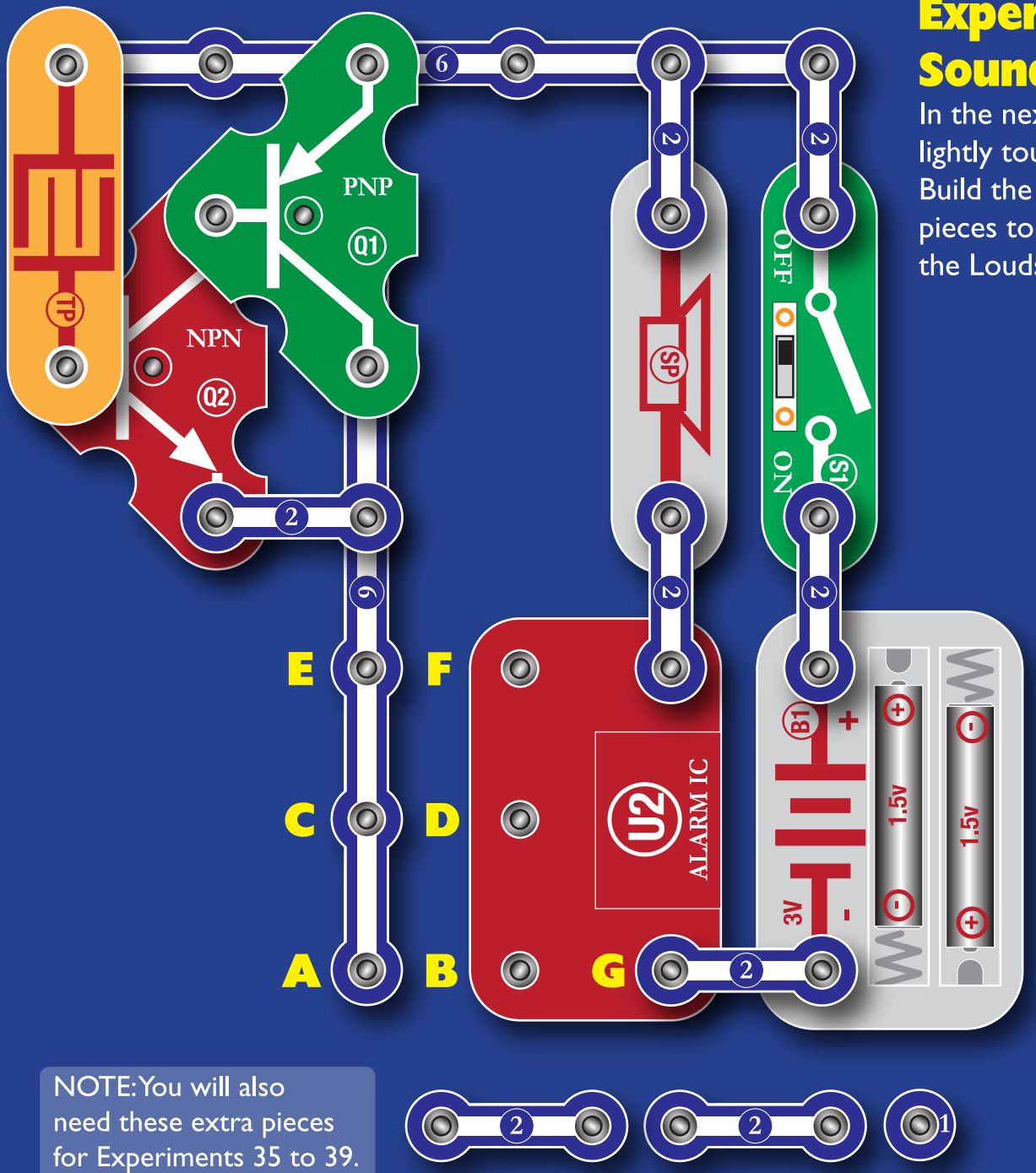
Use two of the extra pieces to connect **A** to **B** and **C** to **D**. When you press the Button Switch, the Loudspeaker will produce the sound of a fire engine.

Experiment 33:

Use three of the extra pieces to connect **C** to **D** and **B** to **G**. When you press the Button Switch, the Loudspeaker will produce the sound of an ambulance.

Experiment 34:

Use one of the extra pieces to connect **A** to **B**. When you press the Button Switch, the Loudspeaker will produce the sound of a space ship.



NOTE: You will also need these extra pieces for Experiments 35 to 39.

Experiment 35: Touch Sensitive Sound Effects.

In the next five circuits, the sound effects are activated by lightly touching the Touch Plate (TP).
Build the Circuit and close the switch. Use one of your extra pieces to connect **C** to **D**. When you touch the Touch Plate, the Loudspeaker will produce the sound of a Police car siren.

Experiment 36:

Use two of the extra pieces to connect **C** to **D** and **E** to **F**. When you touch the Touch Plate, the Loudspeaker will produce the sound of a laser gun.

Experiment 37:

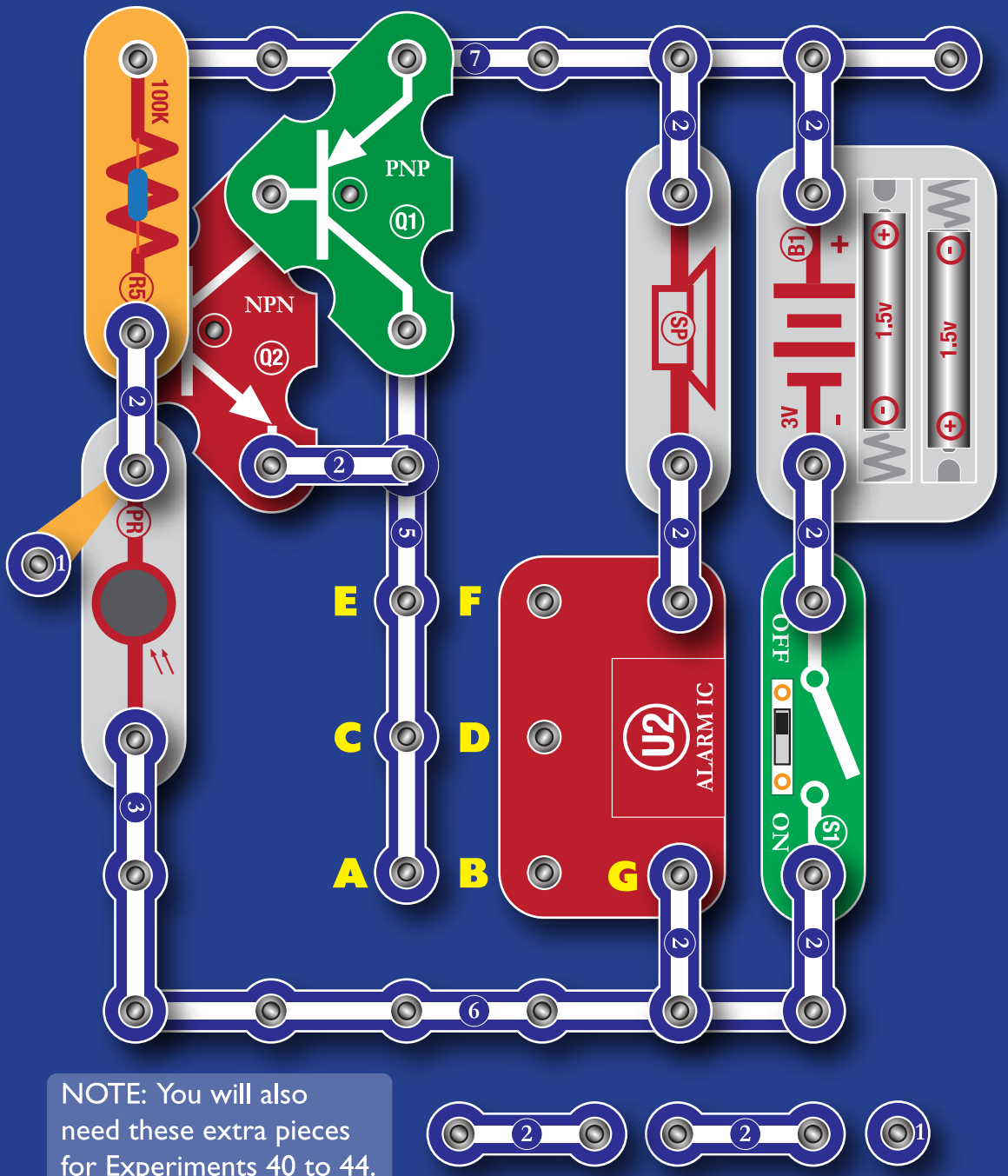
Use two of the extra pieces to connect **A** to **B** and **C** to **D**. When you touch the Touch Plate the Loudspeaker will produce the sound of a fire engine.

Experiment 38:

Use three of the extra pieces to connect **C** to **D** and **B** to **G**. When you touch the Touch Plate, the Loudspeaker will produce the sound of an ambulance.

Experiment 39:

Use one of the extra pieces to connect **A** to **B**. When you touch the Touch Plate, the Loudspeaker will produce the sound of a space ship.



NOTE: You will also need these extra pieces for Experiments 40 to 44.

Experiment 40: Dark Activated Sound Effects.

The next 5 experiments are silent when it is light, but produce sound effects when you shade the Photo Sensitive Resistor. Build the circuit and close the Switch. Use one of the extra pieces to connect **C** to **D**. When you shade the Photo Sensitive Resistor, the Loudspeaker will produce the sound of a Police car siren.

Experiment 41:

Use two of the extra pieces to connect **C** to **D** and **E** to **F**. When you shade the Photo Sensitive Resistor, the Loudspeaker will produce the sound of a laser gun.

Experiment 42:

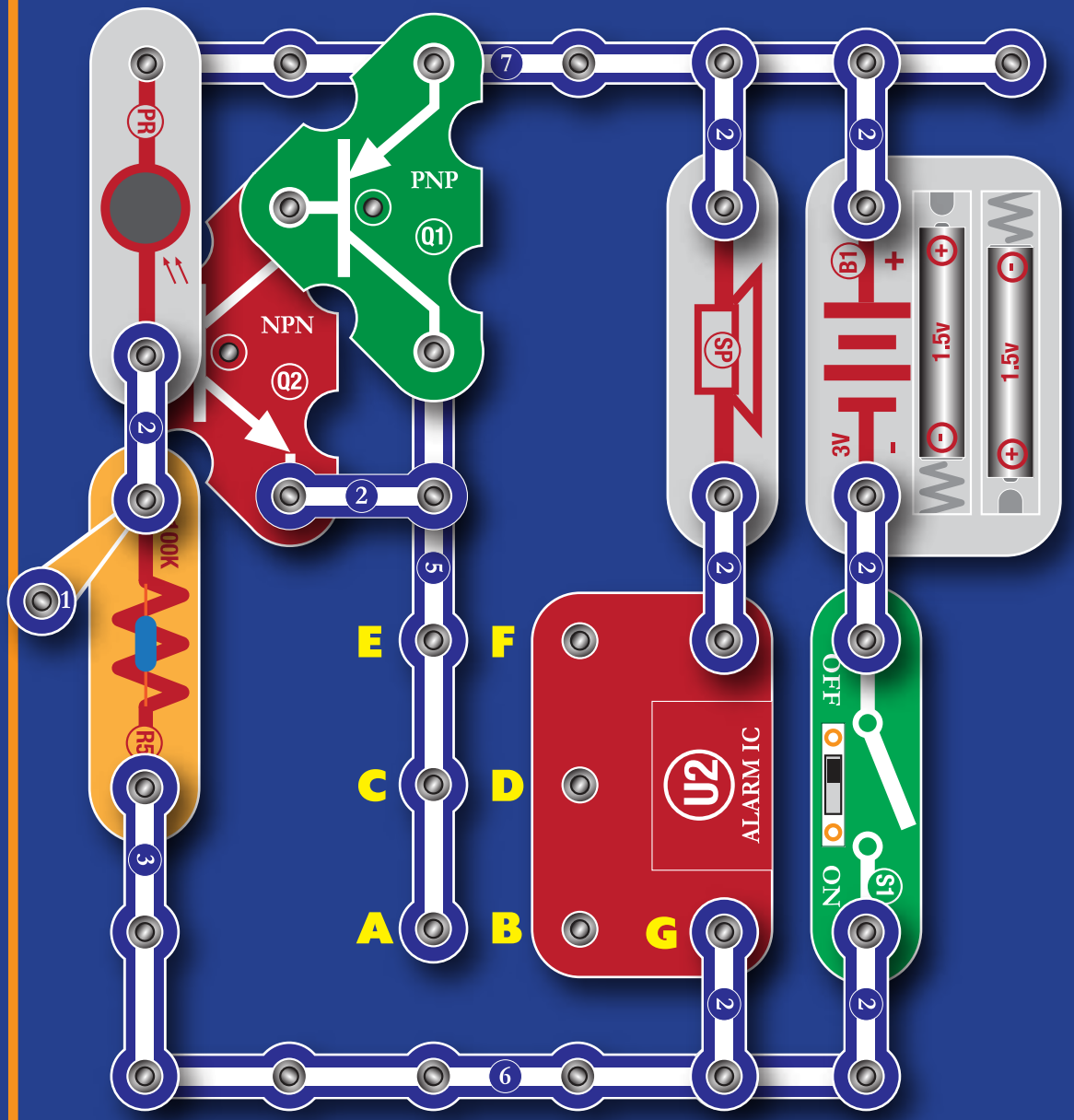
Use two of the extra pieces to connect **A** to **B** and **C** to **D**. When you shade the Photo Sensitive Resistor, the Loudspeaker will produce the sound of a fire engine.

Experiment 43:

Use three of the extra pieces to connect **C** to **D** and **B** to **G**. When you shade the Photo Sensitive Resistor, the Loudspeaker will produce the sound of an ambulance.

Experiment 44:

Use one of the extra pieces to connect **A** to **B**. When you shade the Photo Sensitive Resistor, the Loudspeaker will produce the sound of a space ship.



NOTE: You will also need these extra pieces for Experiments 45 to 49.

Experiment 45: Light Activated Sound Effects.

The next 5 experiments produce sound effects when it is light, but are silent when you shade the Photo Sensitive Resistor. Build the circuit and close the Switch. Use one of the extra pieces to connect **C** to **D**. The Loudspeaker will produce the sound of a Police car siren until you shade the Photo Sensitive Resistor.

Experiment 46:

Use two of the extra pieces to connect **C** to **D** and **E** to **F**. The Loudspeaker will produce the sound of a laser gun until you shade the Photo Sensitive Resistor.

Experiment 47:

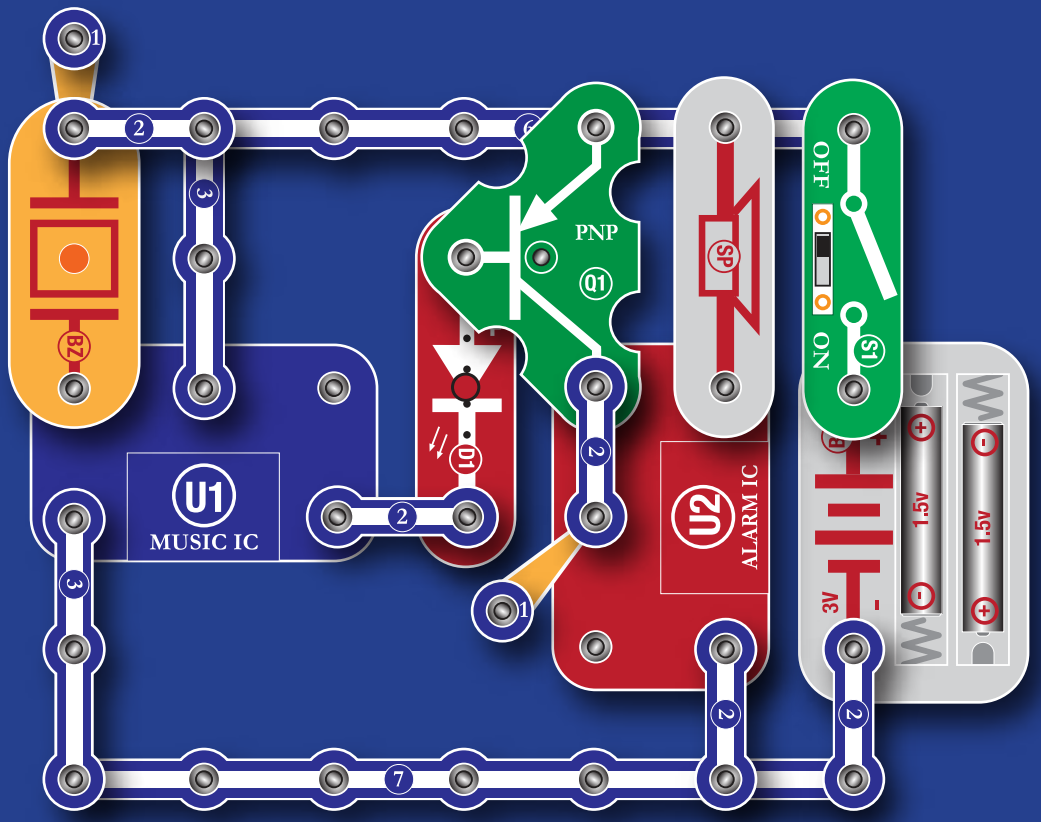
Use two of the extra pieces to connect **A** to **B** and **C** to **D**. The Loudspeaker will produce the sound of a fire engine until you shade the Photo Sensitive Resistor.

Experiment 48:

Use three of the extra pieces to connect **C** to **D** and **B** to **G**. The Loudspeaker will produce the sound of an ambulance until you shade the Photo Sensitive Resistor.

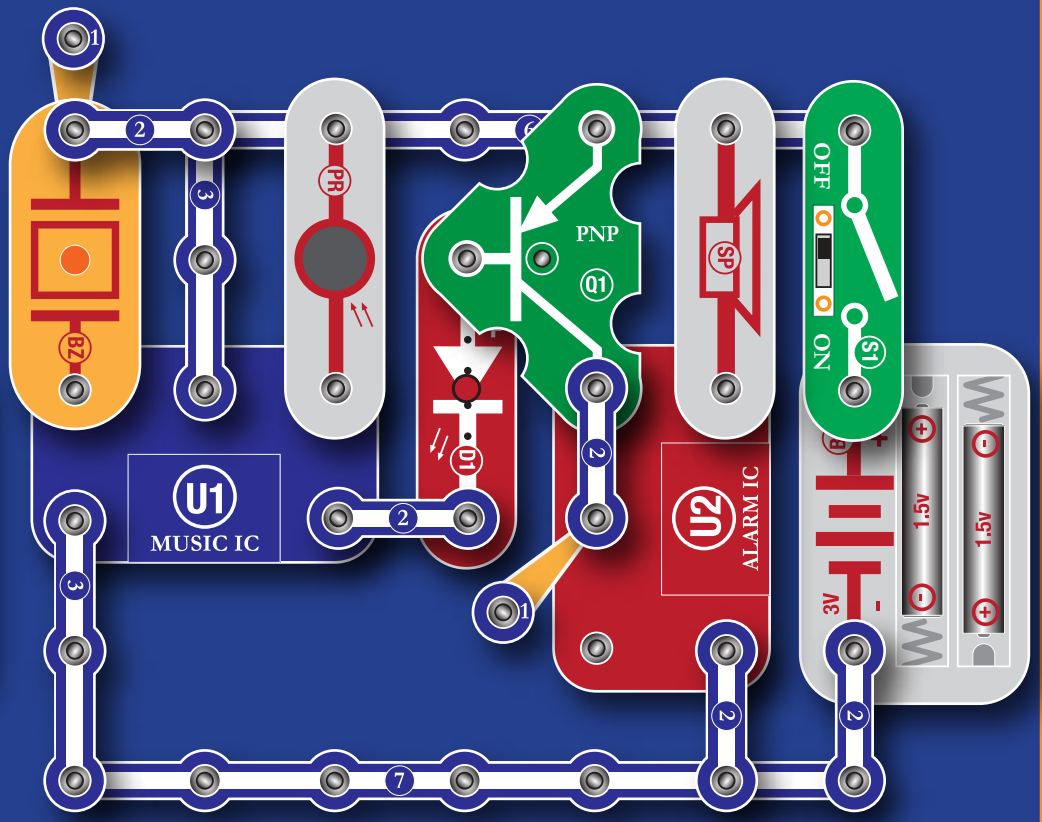
Experiment 49:

Use one of the extra pieces to connect **A** to **B**. The Loudspeaker will produce the sound of a space ship until you shade the Photo Sensitive Resistor.



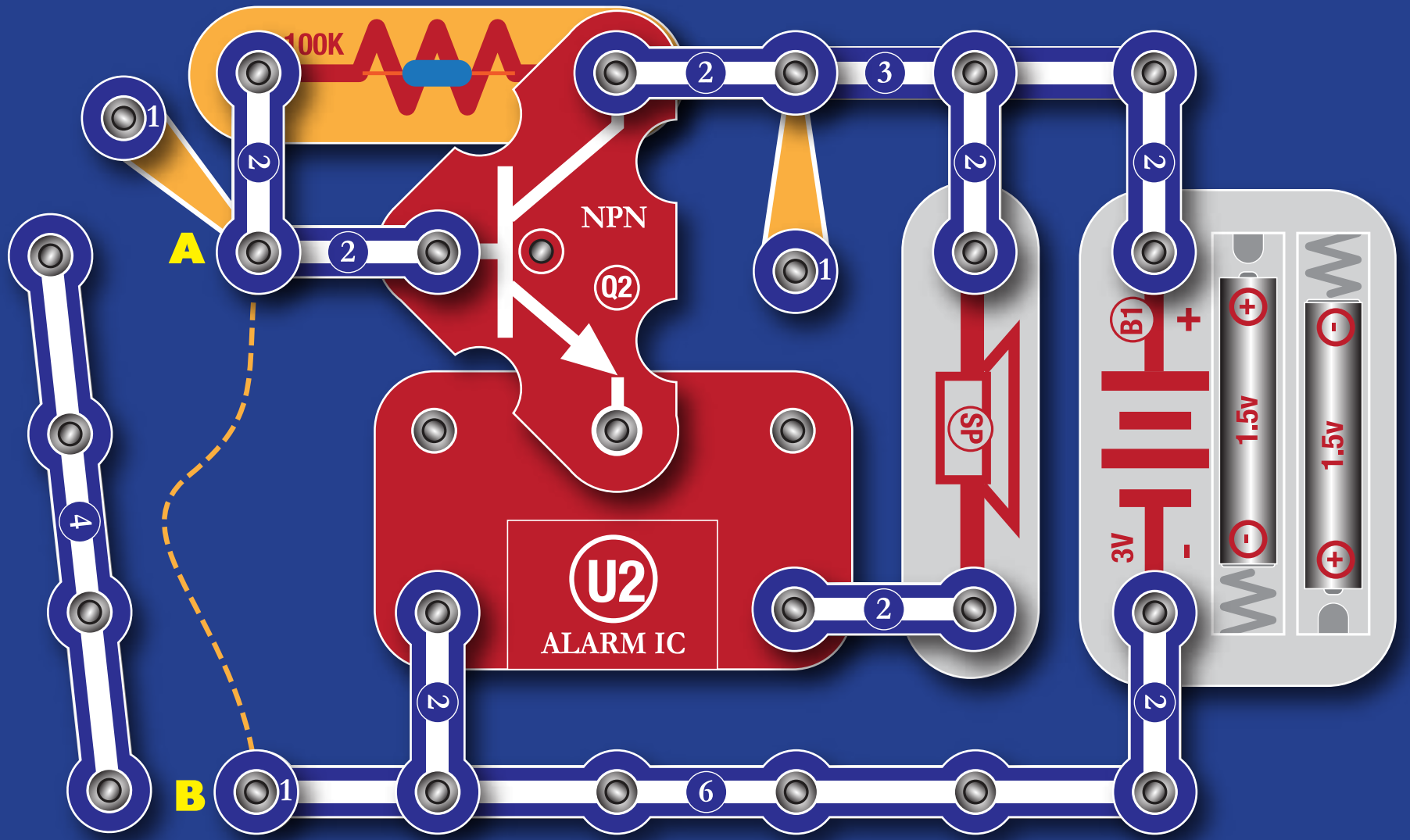
Experiment 50: Sound Activated Burglar Alarm.

Build the circuit shown in the diagram, insert the batteries and close the switch. The alarm will sound for a few seconds and then go silent. In this circuit, the Buzzer (BZ) is used as a microphone. If it picks up a sound from an intruding burglar, the circuit will become activated and the alarm will begin to sound again!



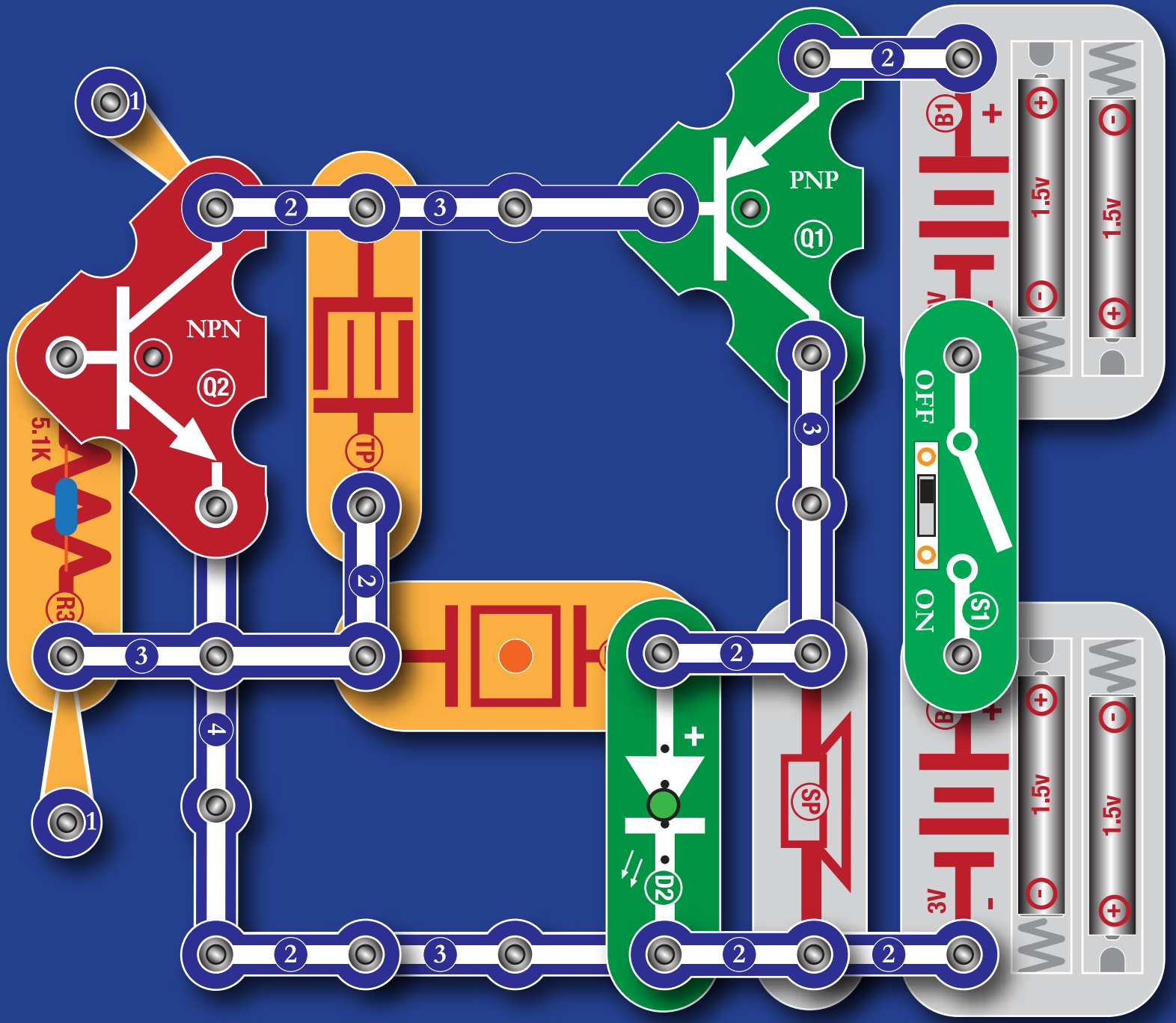
Experiment 51: Light Activated Burglar Alarm.

This light activated burglar alarm will sound if a burglar switches on the lights!
Build the circuit, then take it into a darkened room and close the switch. The alarm will sound for a few seconds and then go silent. If a burglar enters the room and switches on the lights, the alarm will be activated!



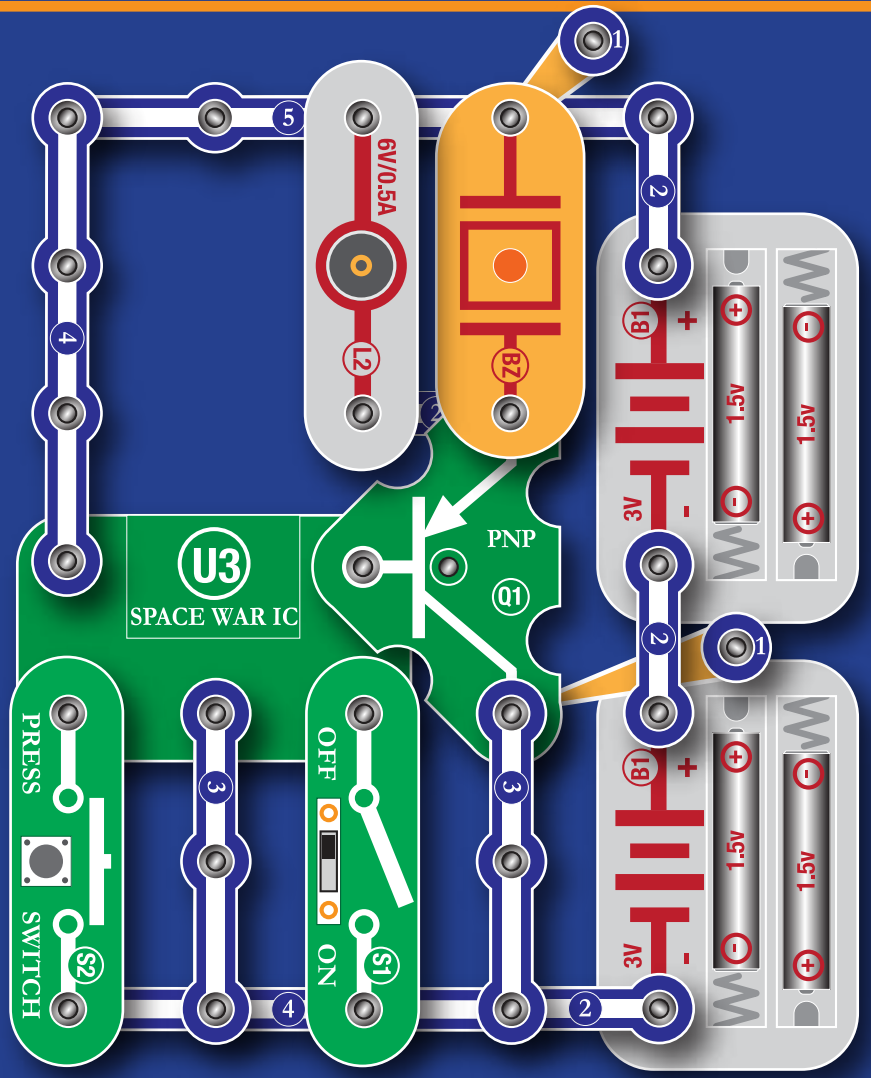
Experiment 52: Circuit Breaking Burglar Alarm.

Build the circuit, and connect the Number 4 connector between terminals **A** and **B**. The alarm will sound whenever the circuit is broken by removing this connector. Using this circuit you can alarm your bedroom, by tying a length of string around the connector, and tying the other end to the door handle. If an intruder comes in, the string will be pulled and the connector will be pulled off the circuit, sounding the alarm. Another way to set up this alarm would be to connect some very thin fuse wire between terminals **A** and **B**. This could be used to make a trip wire that sounds the alarm when broken!



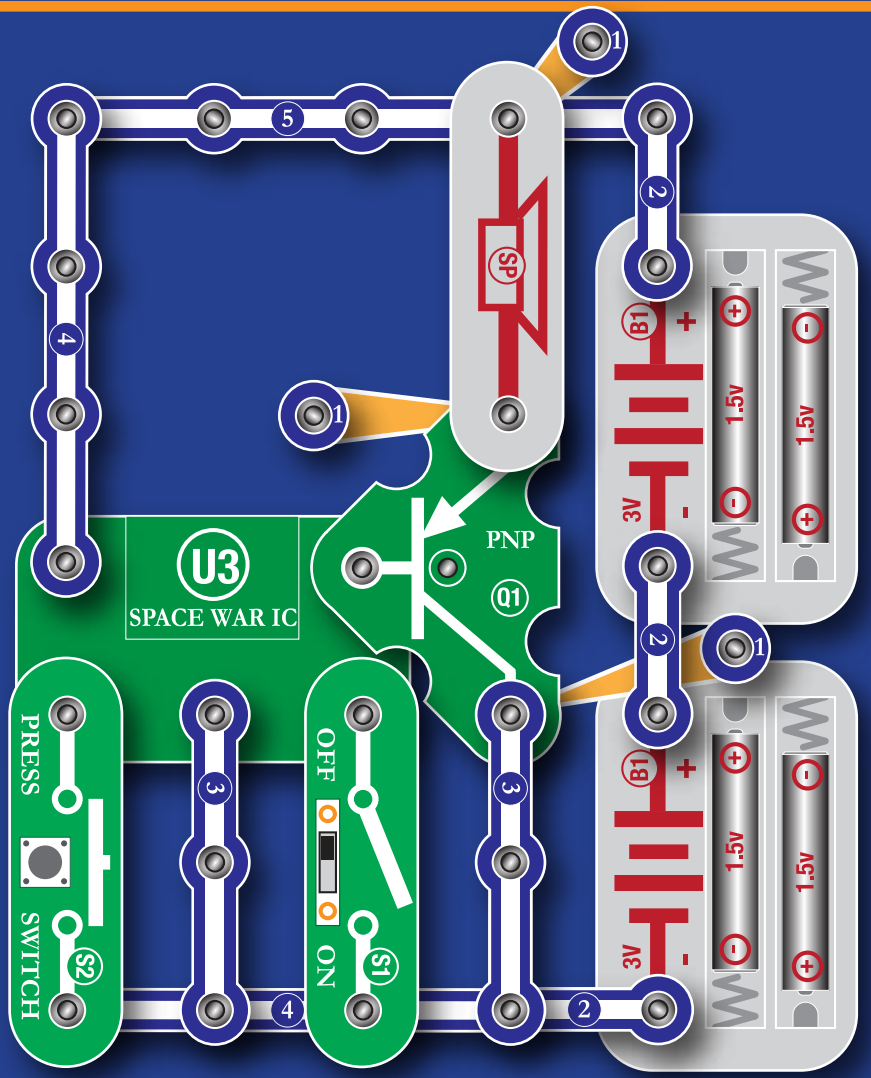
Experiment 53: Lie Detector.

When people tell lies they become nervous and sweat slightly. This alters the electrical resistance of their skin.
When you have built the circuit and inserted the batteries, close the switch and place your finger on the centre of the Touch Plate (TP). The Loudspeaker produces a low note, indicating that your skin has a high electrical resistance.
If you wet your finger and touch the Touch Plate, the note produced becomes high and loud. This is because damp skin has a much lower electrical resistance.
Use your Lie Detector to test your family and friends!



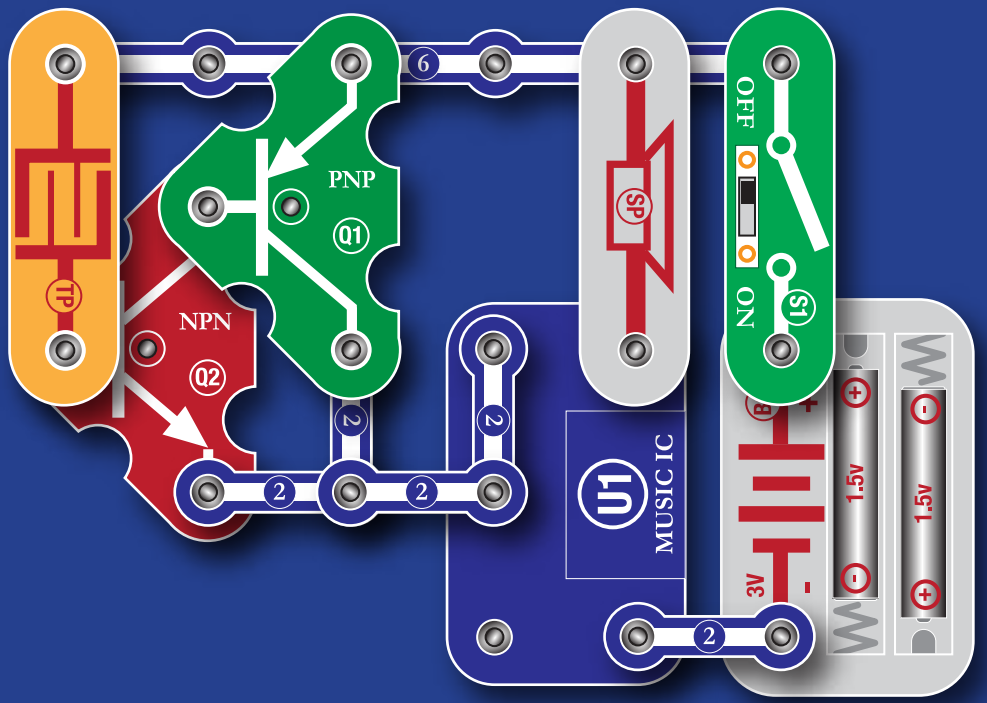
Experiment 54:
Multiple Sound Effects.

The Sound Effect IC Unit can produce various different sound effects. When you have built the circuit and inserted the batteries, you can control the sounds by operating the two switches (S1 & S2). The buzzer (BZ) will produce the sounds.



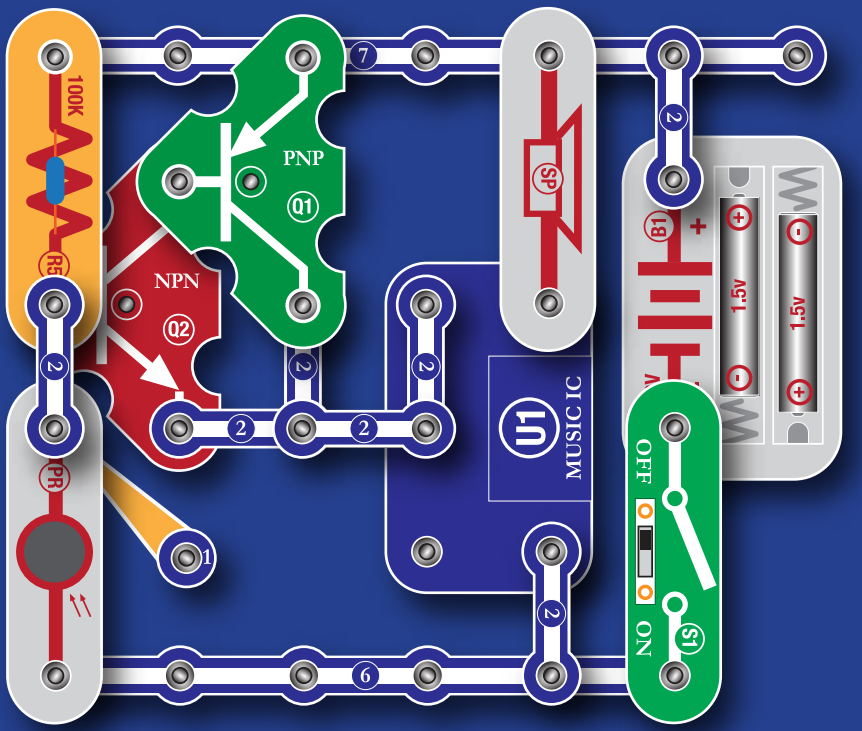
Experiment 55:
Amplified Multiple Sound Effects.

This circuit produces much louder sound effects, as the sounds are amplified through the Loudspeaker, instead of the Buzzer as in the previous experiment.



Experiment 56:
Touch Sensitive Musical Doorbell.

The Music IC Unit is programmed to play a tune. In this circuit the tune is triggered when you lightly touch the centre of the Touch Plate.

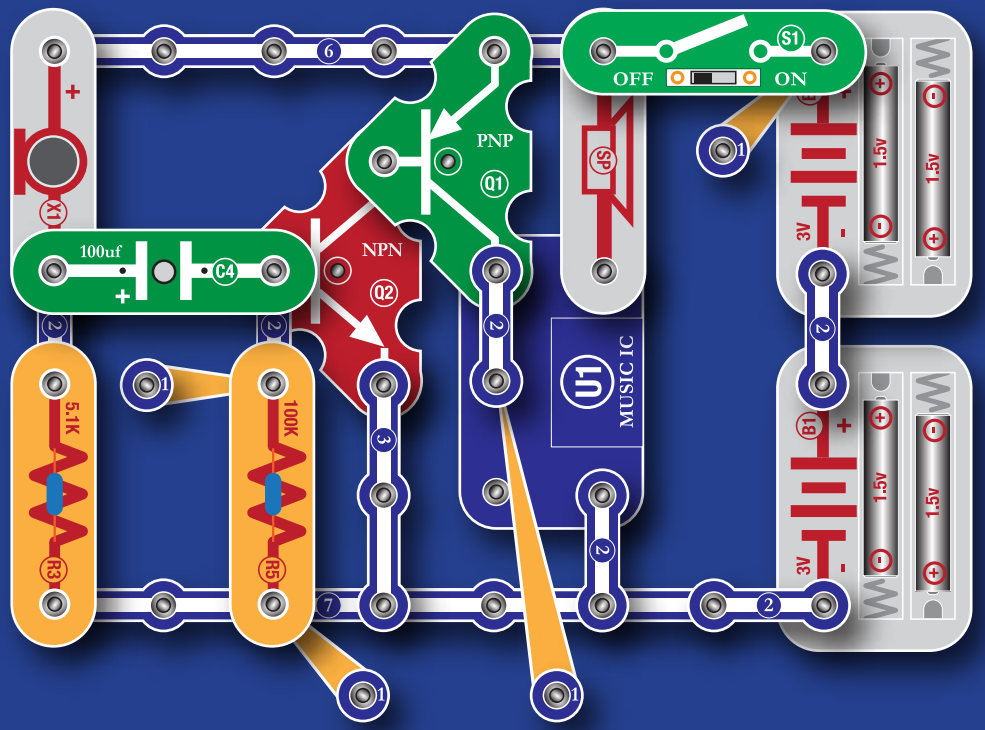


Experiment 57:
Dark Activated Music.

Build the circuit, and after inserting the batteries, close the switch to activate it. The circuit is silent when it is placed in light, but if you shade the Photo Sensitive Resistor (PR) with your hand, the Loudspeaker will begin to play music. When you remove your hand, the music will stop.

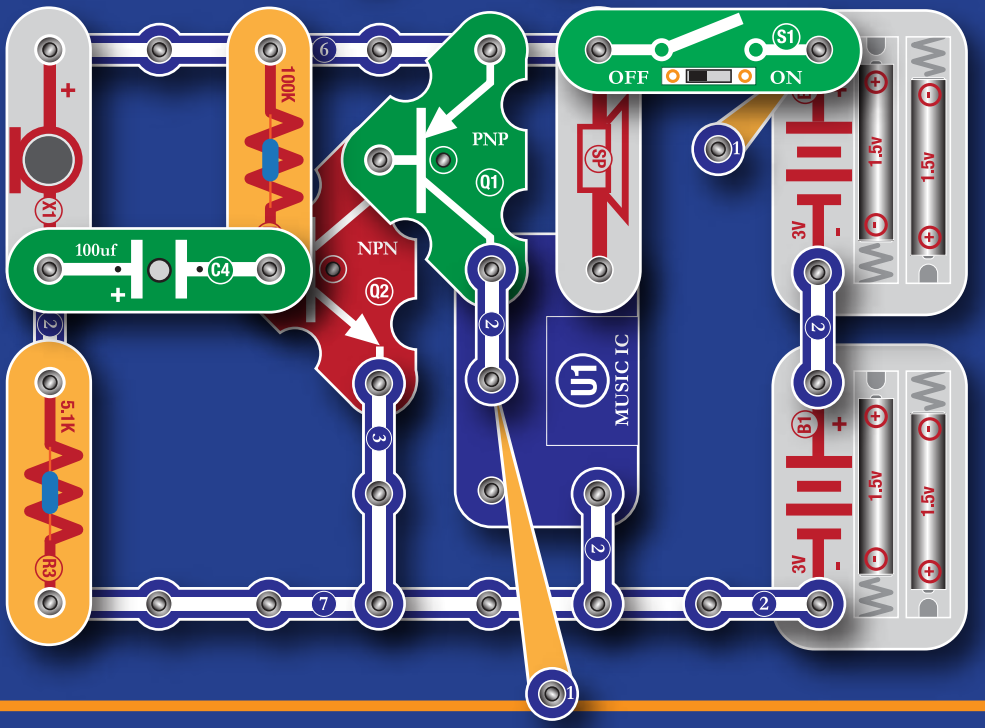
Experiment 58:
Light Activated Music.

If you swap the positions of the Photo Sensitive Resistor (PR), and the 100K Resistor (R5), the circuit will play music when it is light, and stop when you shade the Photo Sensitive Resistor.



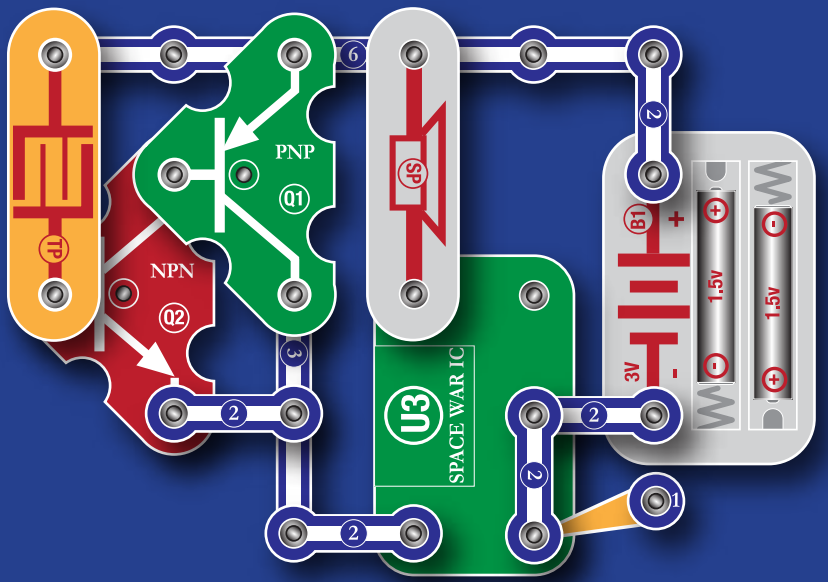
Experiment 59: Sound Activated Music.

Once you have built the circuit, insert the batteries and close the switch. The circuit is silent, but try whistling or blowing into the Microphone (X1).
As long as there is sound being picked up by the Microphone, the Loudspeaker will play music.



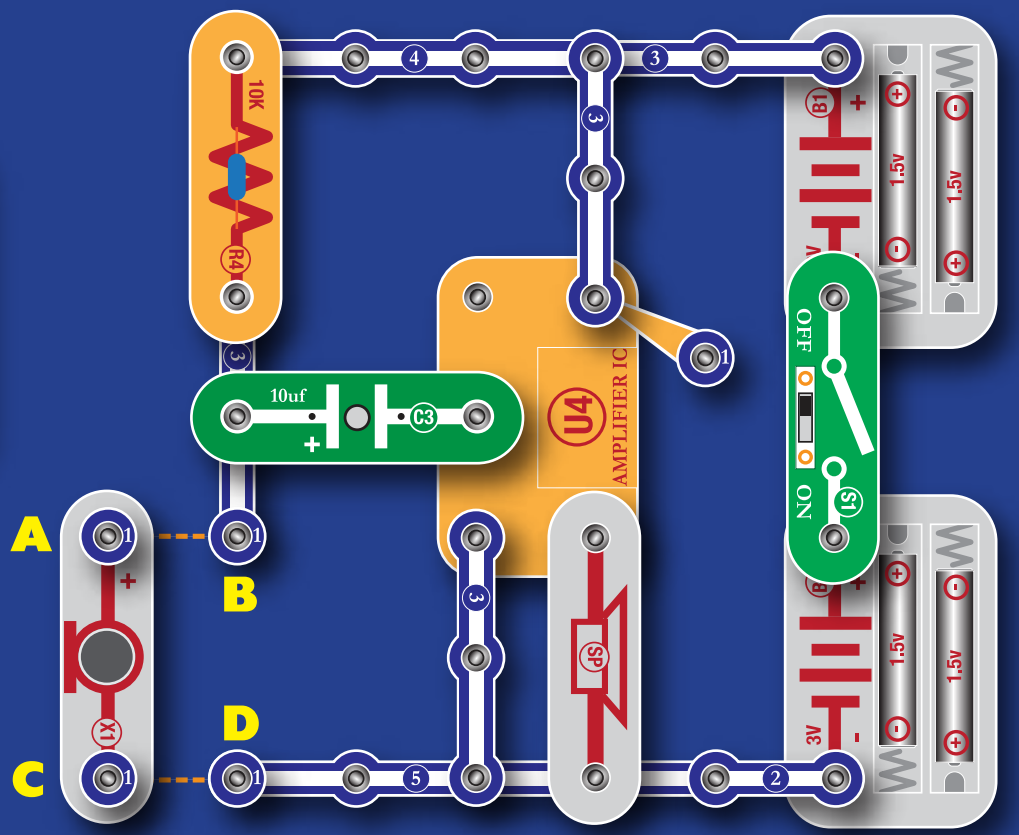
Experiment 60: Sound De-activated Music.

This circuit is based on the previous experiment, but operates in the opposite way. Once you have built the circuit and inserted the batteries, close the switch. The Loudspeaker will begin to play music, and will only stop if the Microphone picks up a sound. When the Microphone stops receiving sound, the music will start playing again.



Experiment 61: Touch Sensitive Sound Effects.

Build the circuit and then insert the batteries. When you touch the Touch Plate (TP), the Loudspeaker will produce various different sounds — a different one each time!

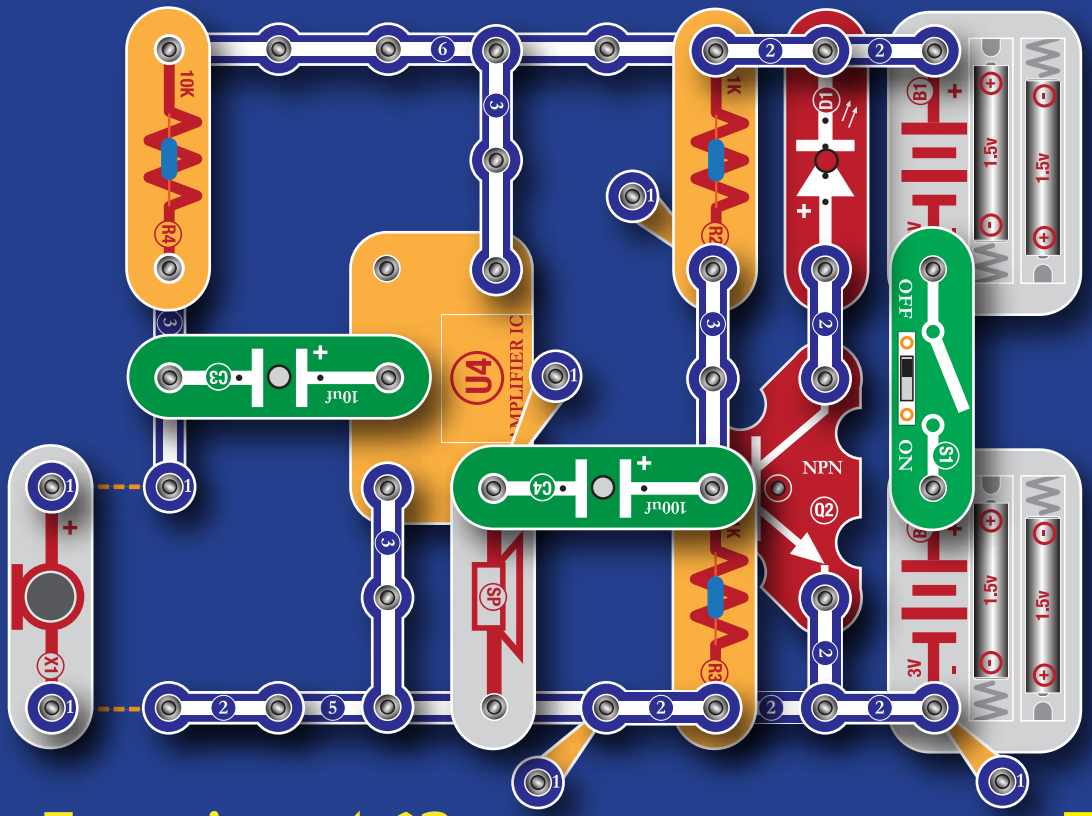


Experiment 62: Simple Voice Amplifier.

Use this circuit to amplify your own voice! This circuit uses the Power Amplifying IC Unit (U4) to amplify your own voice and relay it through the loudspeaker.

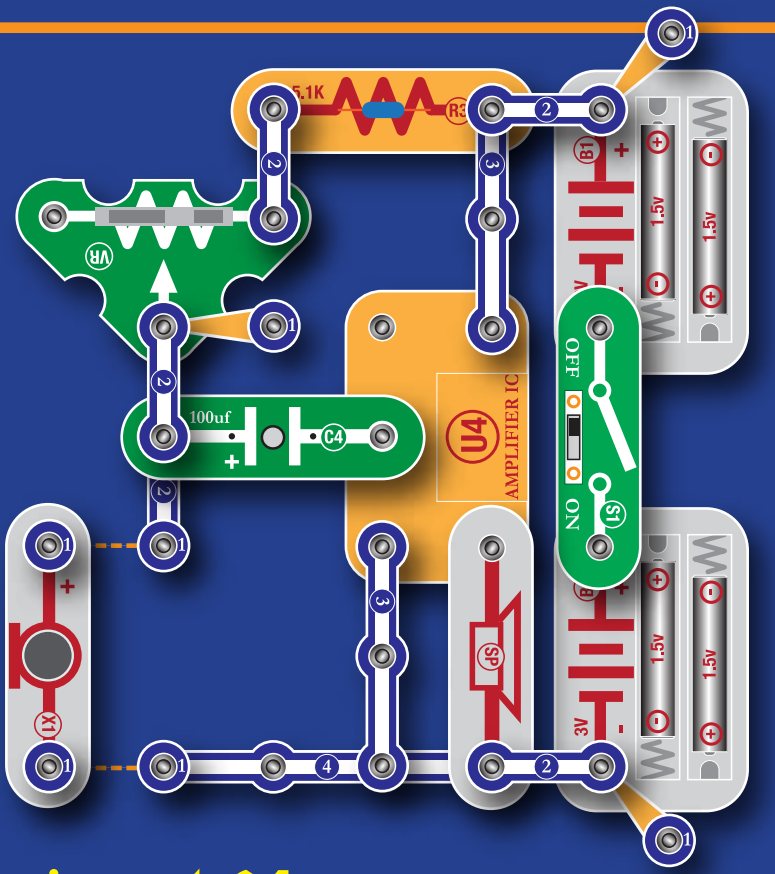
Build the circuit as shown in the diagram, but before switching it on, connect two long wires (about 1.5 metres each) between terminals **A** and **B**, and between terminals **C** and **D**. To do this, place the end of the wire at the terminal, and clip the single connector over the top of it. Now move the Microphone as far away from the circuit as it will go and close the switch. When you talk into the Microphone your voice will be amplified through the loudspeaker!

NOTE: The Microphone needs to be far away from the Loudspeaker, otherwise it will pick up the sound produced by the loudspeaker and re-amplify it. This results in a high-pitched whistling noise called Feedback, which could result in damage to the Loudspeaker.



Experiment 63:
Voice Amplifier with LED indicator.

This circuit, is a modification of the previous experiment and works in the same way. Build the circuit and connect the Microphone as described in Experiment 62. Make sure the Microphone is as far away from the Loudspeaker as it can go and close the switch. When you talk into the Microphone, your voice is amplified by the Loudspeaker, and the red LED will light, to indicate that the Voice Amplifier is in use.

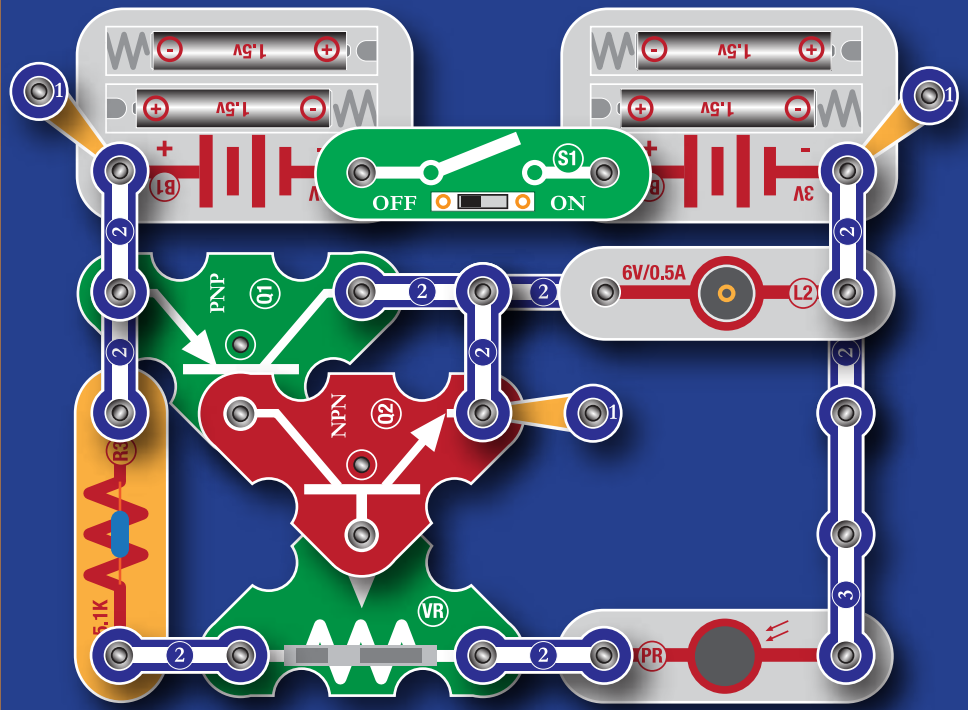


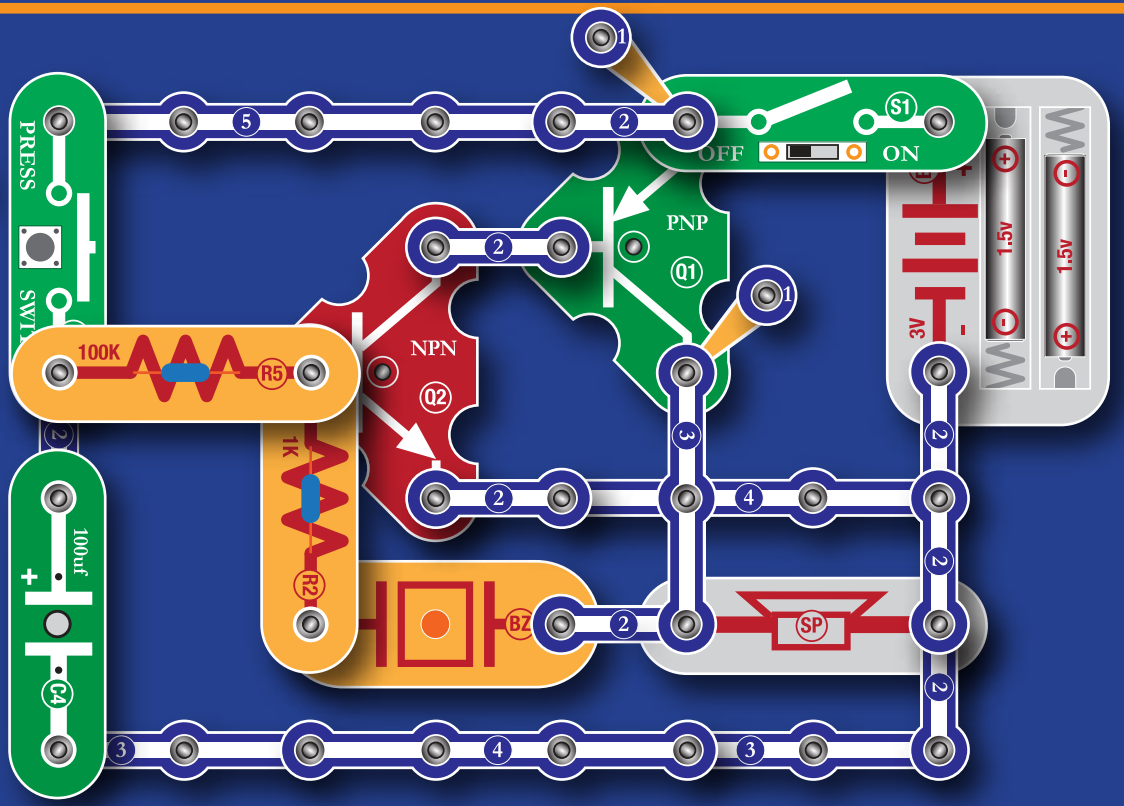
Experiment 64:
Voice Amplifier with Volume Control.

This circuit adds a volume control to the voice amplifying circuit. Build the circuit as shown, remembering to keep the Microphone as far away from the Loudspeaker as possible, then close the switch.

Now, when you speak into the Microphone, your voice is amplified by the Loudspeaker and you can control the volume by adjusting the slider on the Variable Resistor (VR).

NOTE: The Microphone needs to be far away from the Loudspeaker, otherwise it will pick up the sound produced by the loudspeaker and re-amplify it. This results in a high-pitched whistling noise called Feedback, which could result in damage to the Loudspeaker.





Experiment 65: Automatic Street Lamp.

This circuit demonstrates how street lamps come on when it gets dark.

Build the circuit as shown in the diagram and insert the batteries. Close the switch, and then adjust the slider on the Variable Resistor (VR) until the 6V Bulb just goes out.

Now, when you shade the Photo Sensitive Resistor, the 6V Bulb will light up. As you remove your hand, and allow the light to fall on the Photo Sensitive Resistor, the bulb goes out again.

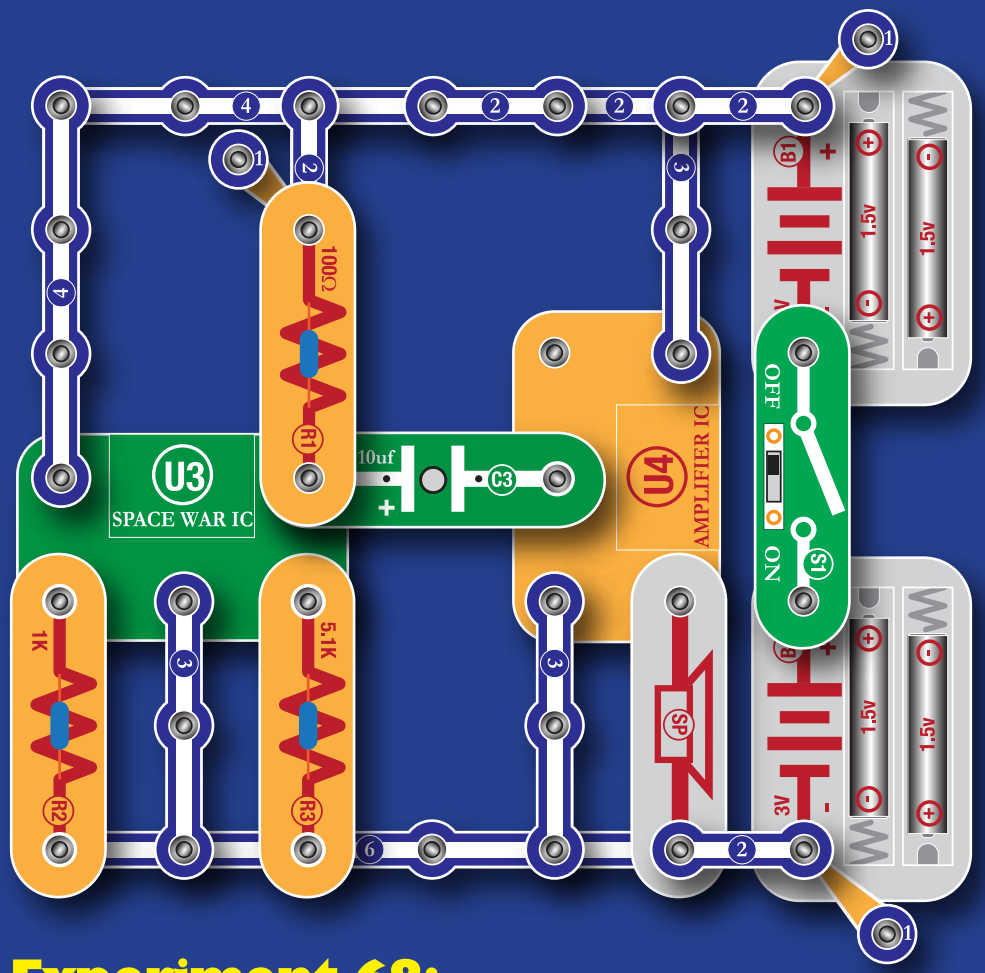
Experiment 66: Decaying Sound Effects 1.

Build the circuit, and insert the batteries. When you close the switch, the Loudspeaker will produce a high pitched tone which will gradually get lower and lower until it disappears.

Experiment 67: Decaying Sound Effects 2.

Use the same circuit as experiment 66, but but this time use the 10µf Capacitor (C3) instead of the 100µf (C4).

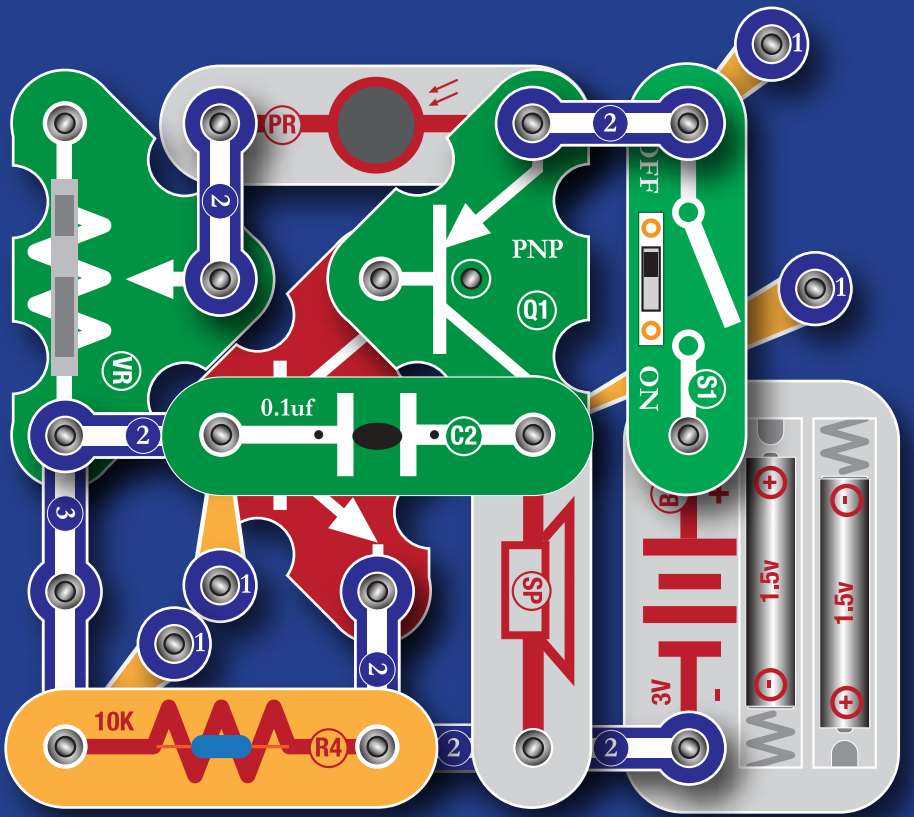
Make sure that the '+' end of the capacitor is connected to part 2. Now when you close the switch, the Loudspeaker will produce a rhythm that gradually gets slower and slower until it stops altogether.



Experiment 68: Power Amplified Sound Effects Generator.

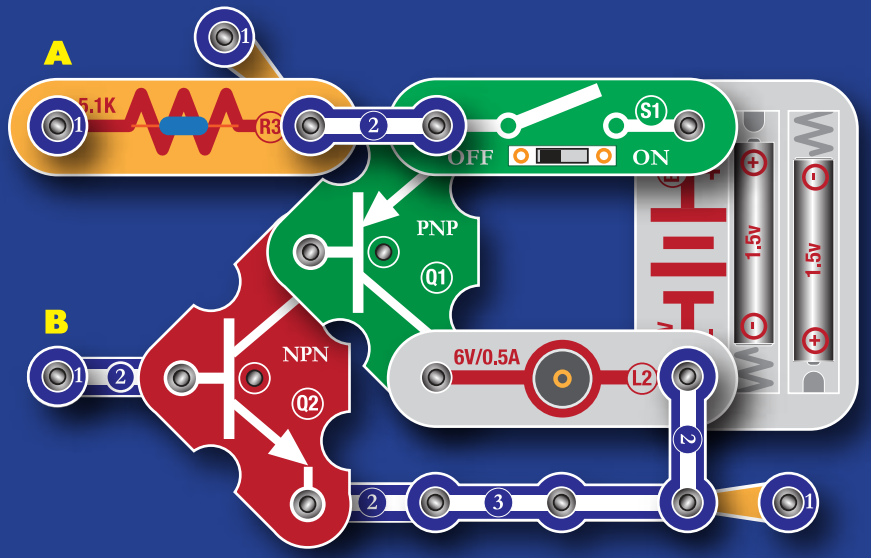
This circuit uses the Power Amplifying IC Unit (U4) to amplify the sound effects produced by the Sound Effects IC Unit (U3) and output them through the Loudspeaker.

Build the Circuit and insert the batteries, then close the switch to produce the amplified sound effects.



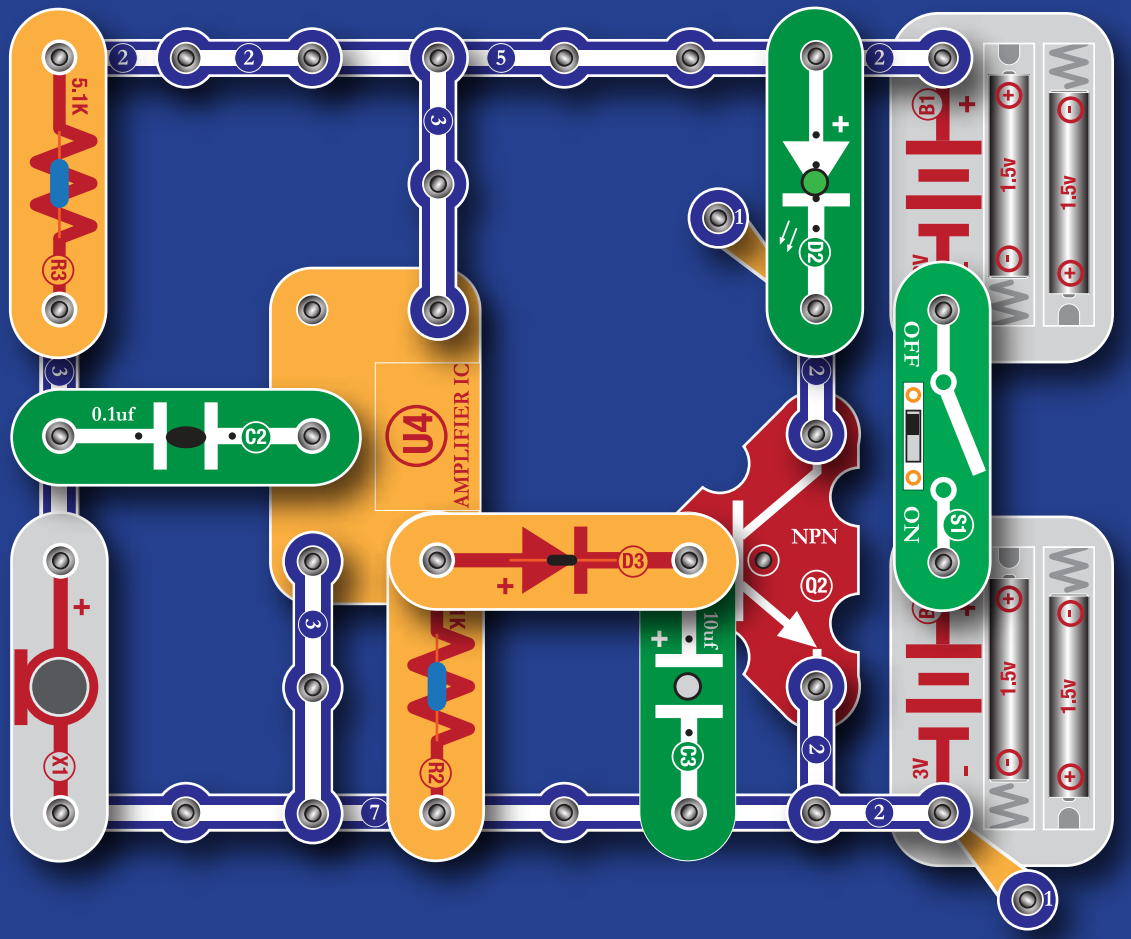
Experiment 69: Electronic Bird Song Generator.

Build the circuit shown in the diagram, and insert the batteries. When you close the switch, you can control the electronic chirping sound by moving the slider on the Variable Resistor (VR), and waving your hand over the Photo Sensitive Resistor (PR).



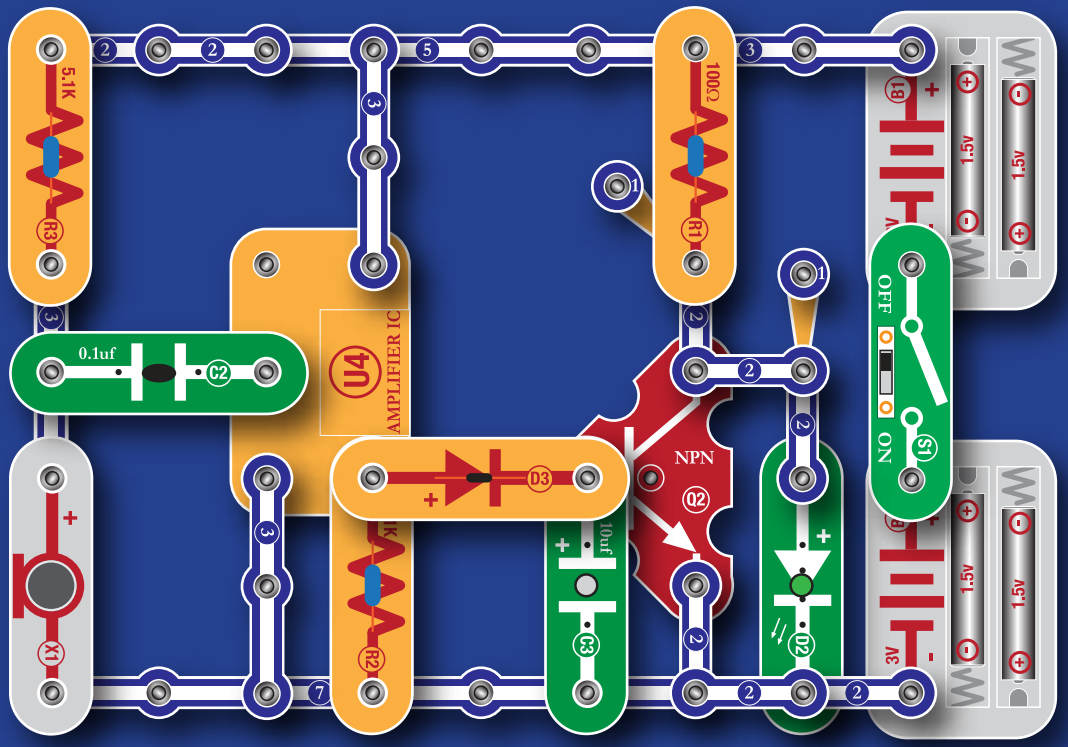
Experiment 70: Soil Tester.

Build the circuit as shown in the diagram, and connect two wires to terminals **A** and **B**. Find a small potted plant, and insert the ends on the two wires into the soil, then close the switch. If the soil is damp, the 6V Bulb will light up. If not, pour a little water onto the soil. The damper the soil, the brighter the 6V Bulb will light.



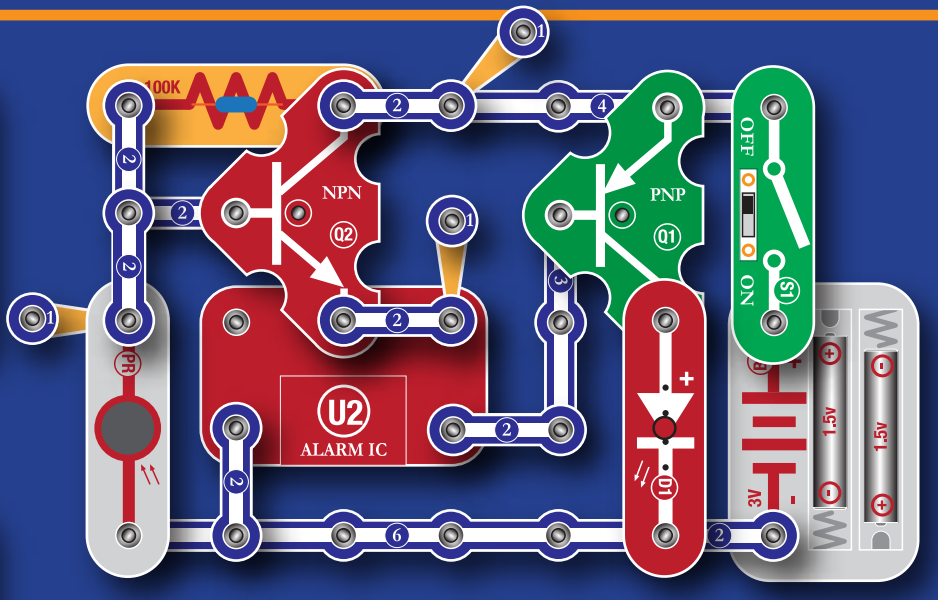
Experiment 71: Sound Activated Disco Light.

Build the circuit shown in the diagram. and place it so that the Microphone (X1) is near to the speaker of a Radio or Hi-Fi. Turn the Radio or Hi-Fi on, and close the switch on your circuit. When the Microphone picks up the music, the Green LED (D2) will flash on and off in time with the Music.



Experiment 72: Sound De-Activated Disco Light.

Build the circuit shown in the diagram, and place it so that the Microphone (X1) is near to the speaker of a Radio or Hi-Fi. Turn the Radio or Hi-Fi on, and close the switch on your circuit. This circuit works in a similar way to the circuit in experiment 70 except that in this circuit the LED is lit and goes out with each beat of the music.

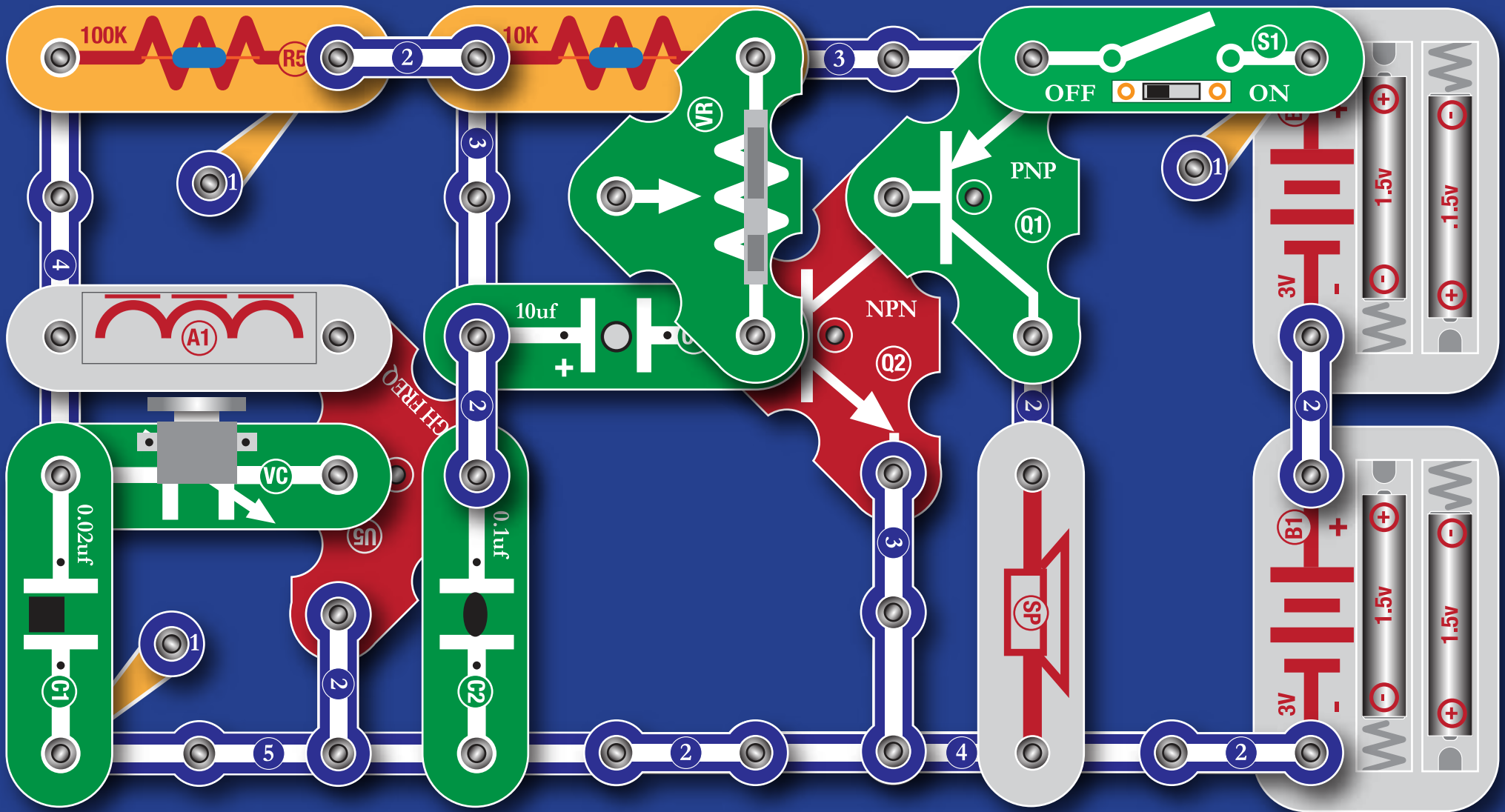


Experiment 73: Dark Activated Flashing Lamp.

This circuit makes a light which flashes when it is dark. Build the circuit shown in the diagram and insert the batteries. When you close the switch, nothing will happen, until you shade the Photo Sensitive Resistor with your hand. The Red LED will begin flashing and won't stop until you remove your hand and allow light fall on the Photo Sensitive Resistor.

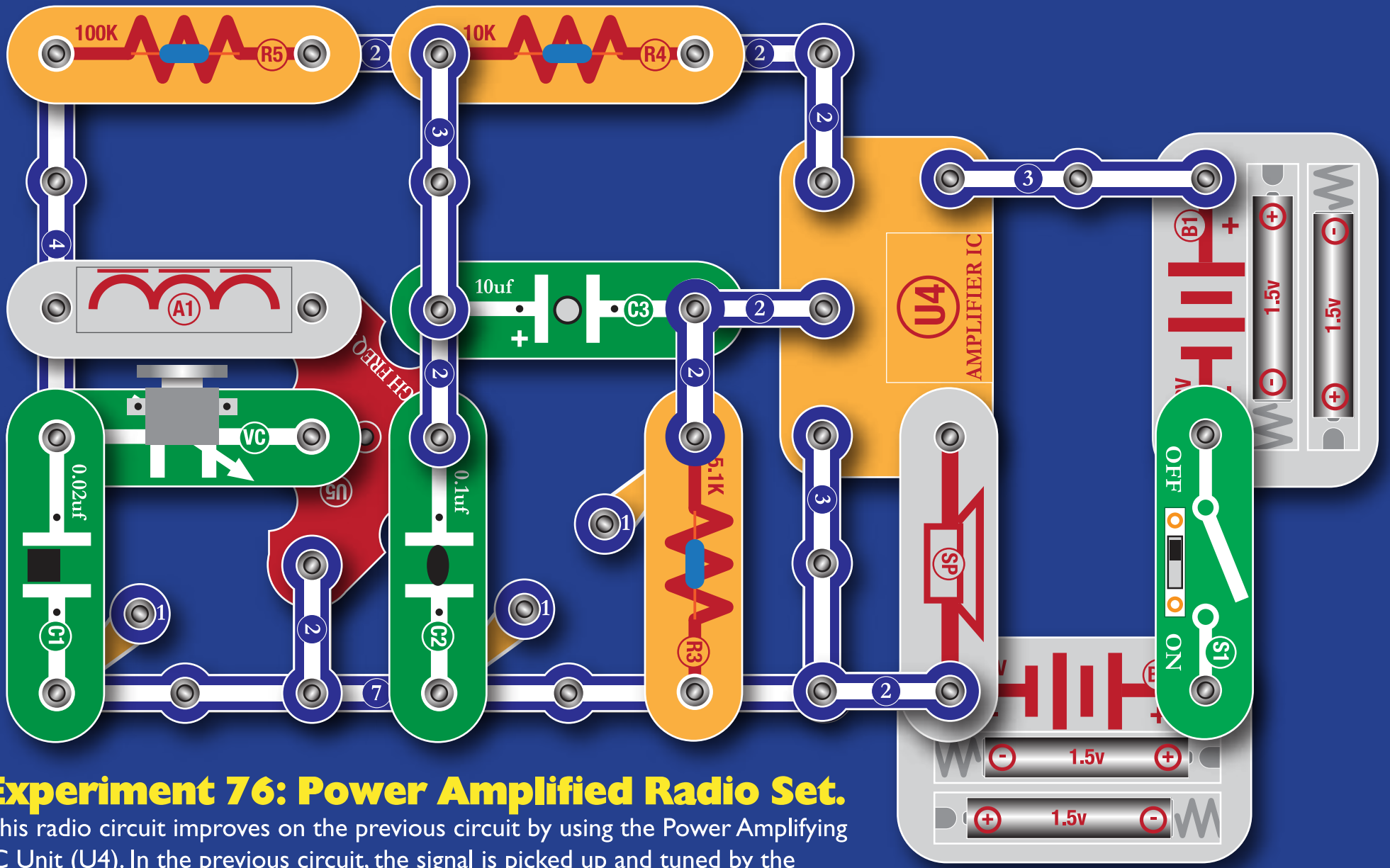
Experiment 74: Light Activated Flashing Lamp.

To make the circuit work the opposite way round, swap the positions of the Photo Sensitive Resistor (PR) and the 100K Resistor (R5). Now the LED will flash in the light, and fade out when you shade the Photo Sensitive Resistor.



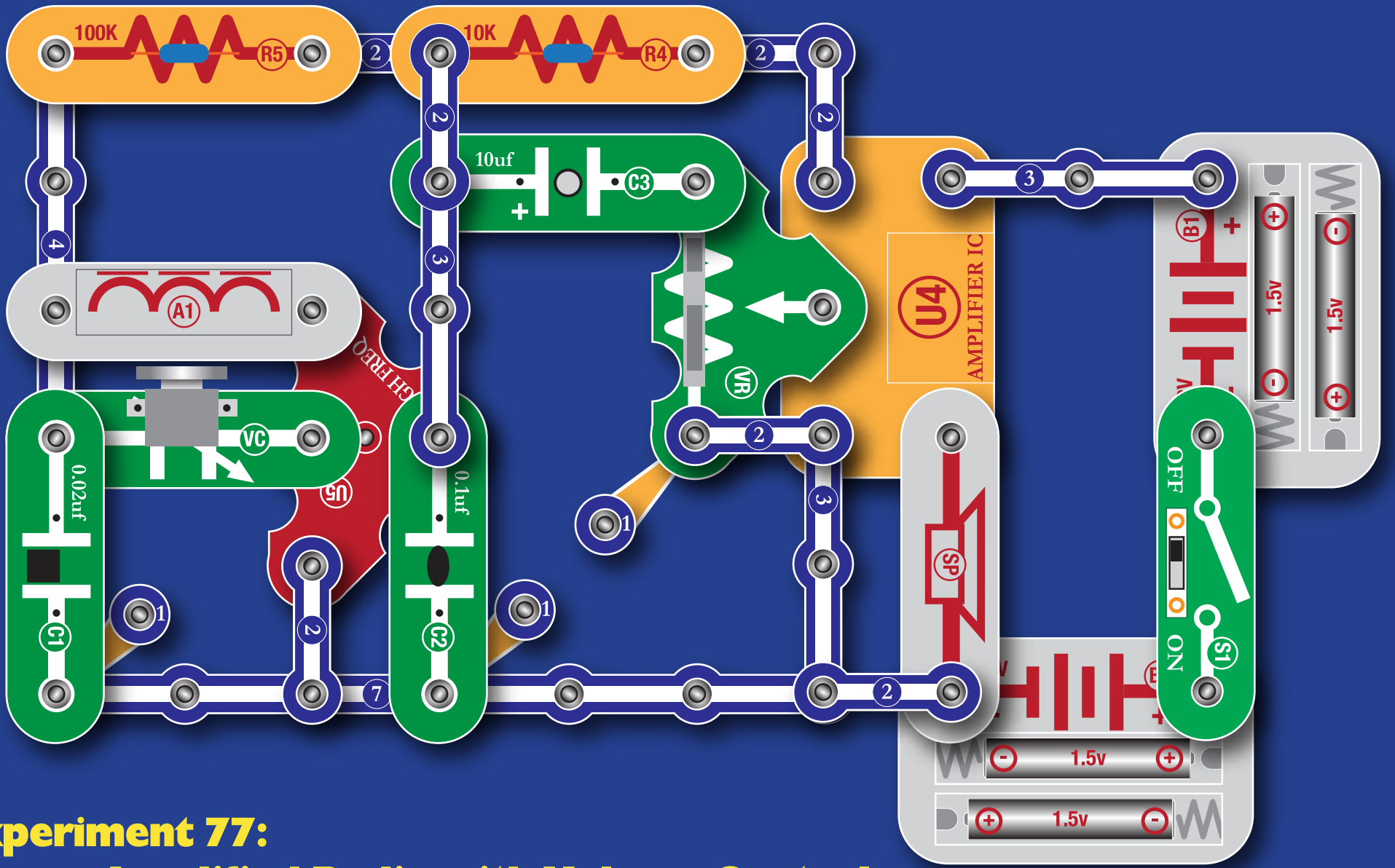
Experiment 75: Simple Radio Set.

This circuit uses 2 new components, the Variable Capacitor (VC) and the Antenna Coil (A1).
Build the circuit, insert the batteries and then close the switch. Tune the Radio by adjusting the dial on the Variable Capacitor until you find a radio station. The radio broadcast is picked up by the antenna coil. It may help if you turn the base board around so that it faces a different direction, as the Antenna Coil is directional.



Experiment 76: Power Amplified Radio Set.

This radio circuit improves on the previous circuit by using the Power Amplifying IC Unit (U4). In the previous circuit, the signal is picked up and tuned by the Antenna Coil (A1) and the Variable Capacitor (VC), and then amplified by the Transistors and played through the Loudspeaker. In this circuit, the Power Amplifying IC Unit replaces the Transistor to amplify the signal received by the Antenna Coil.

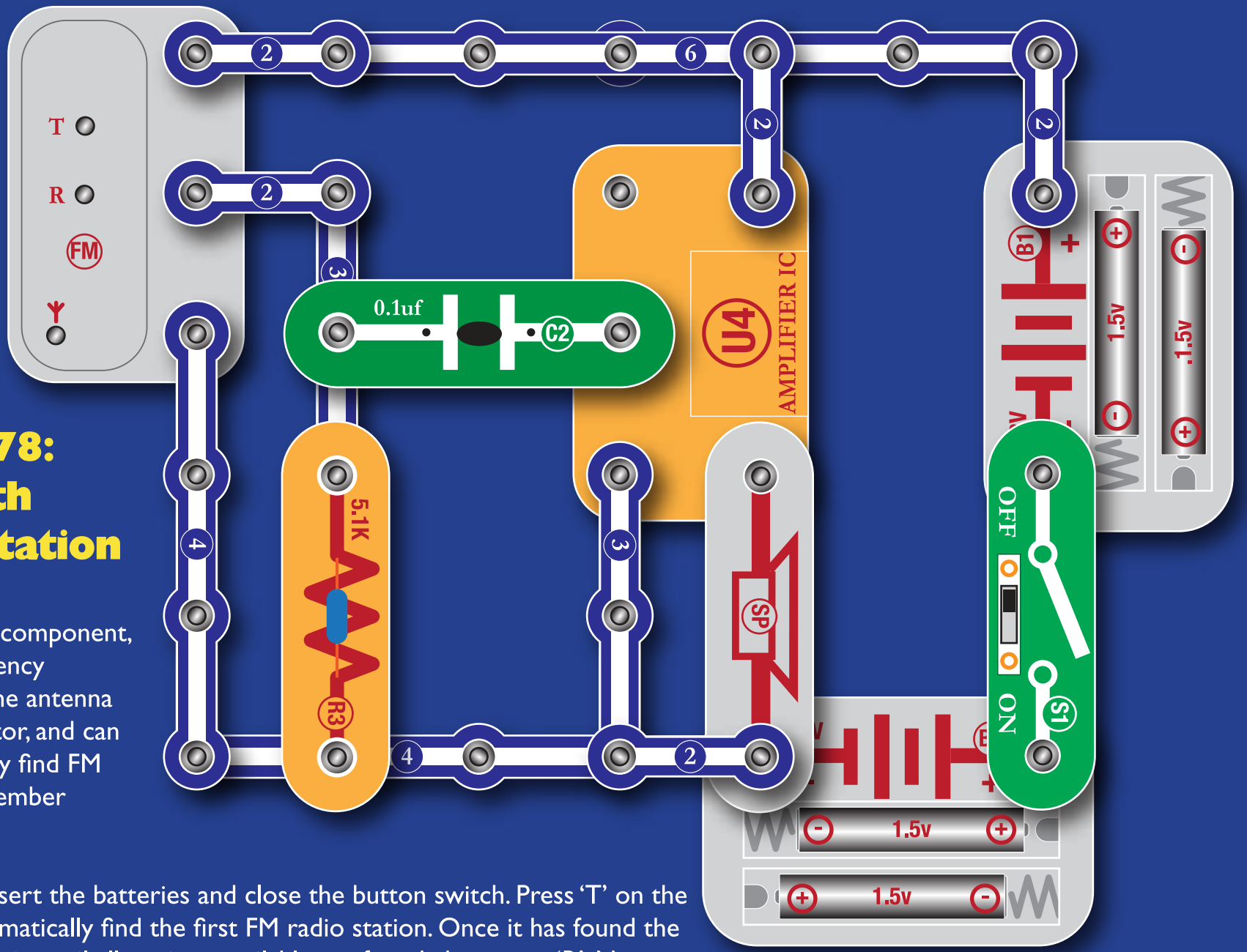


Experiment 77:
Power Amplified Radio with Volume Control.

This Radio circuit works in the same way as the previous radio circuit, only now, a volume control has been added! Tune the radio by turning the Variable Capacitor (VC) and adjust the volume by moving the slider on the Variable Resistor (VR).

Experiment 78: FM Radio with Automatic Station Selection.

This circuit uses a new component, FM, the FM High Frequency IC Unit. This replaces the antenna coil and Variable capacitor, and can be used to automatically find FM radio stations, and remember them too!

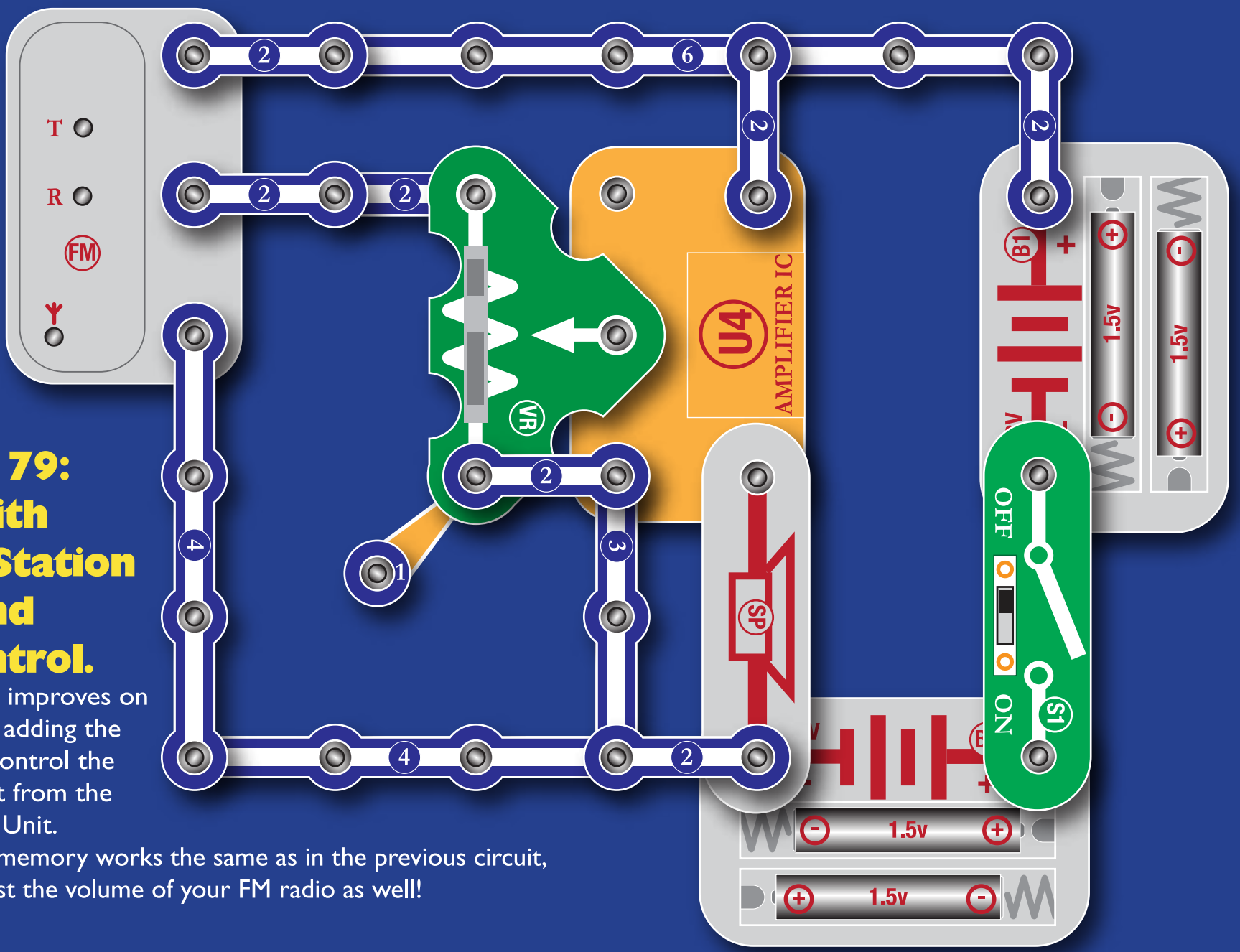


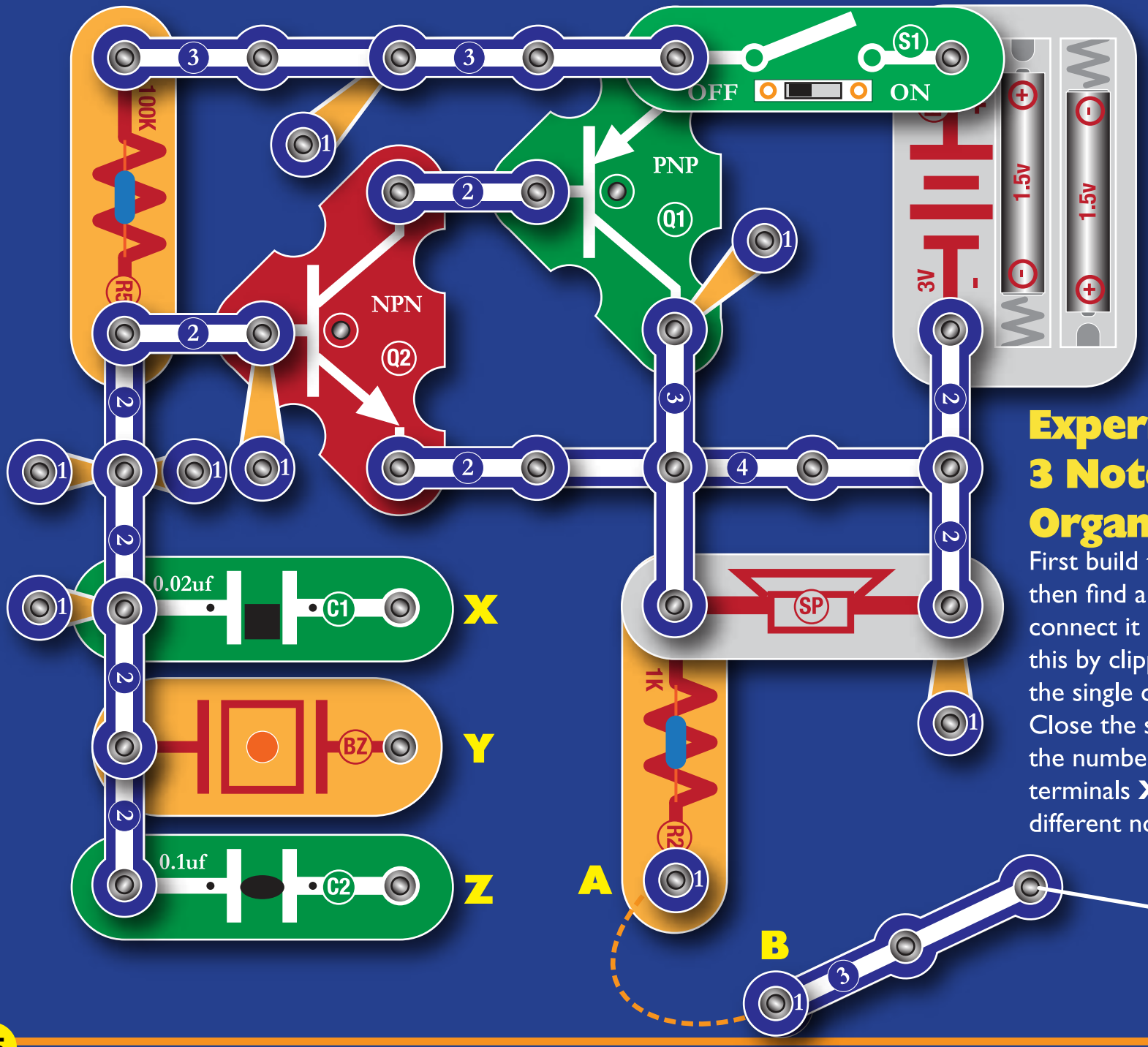
Assemble the circuit, insert the batteries and close the button switch. Press 'T' on the IC Unit, and it will automatically find the first FM radio station. Once it has found the first station, press 'T' again until all stations available are found, then press 'R'. Now you can use 'T' to quickly rotate through all the stations you have found.

Experiment 79: FM Radio with Automatic Station Selection and Volume Control.

This FM radio circuit improves on the last FM Radio by adding the variable resistor to control the volume of the output from the Power Amplifying IC Unit.

Station selection and memory works the same as in the previous circuit, but now you can adjust the volume of your FM radio as well!



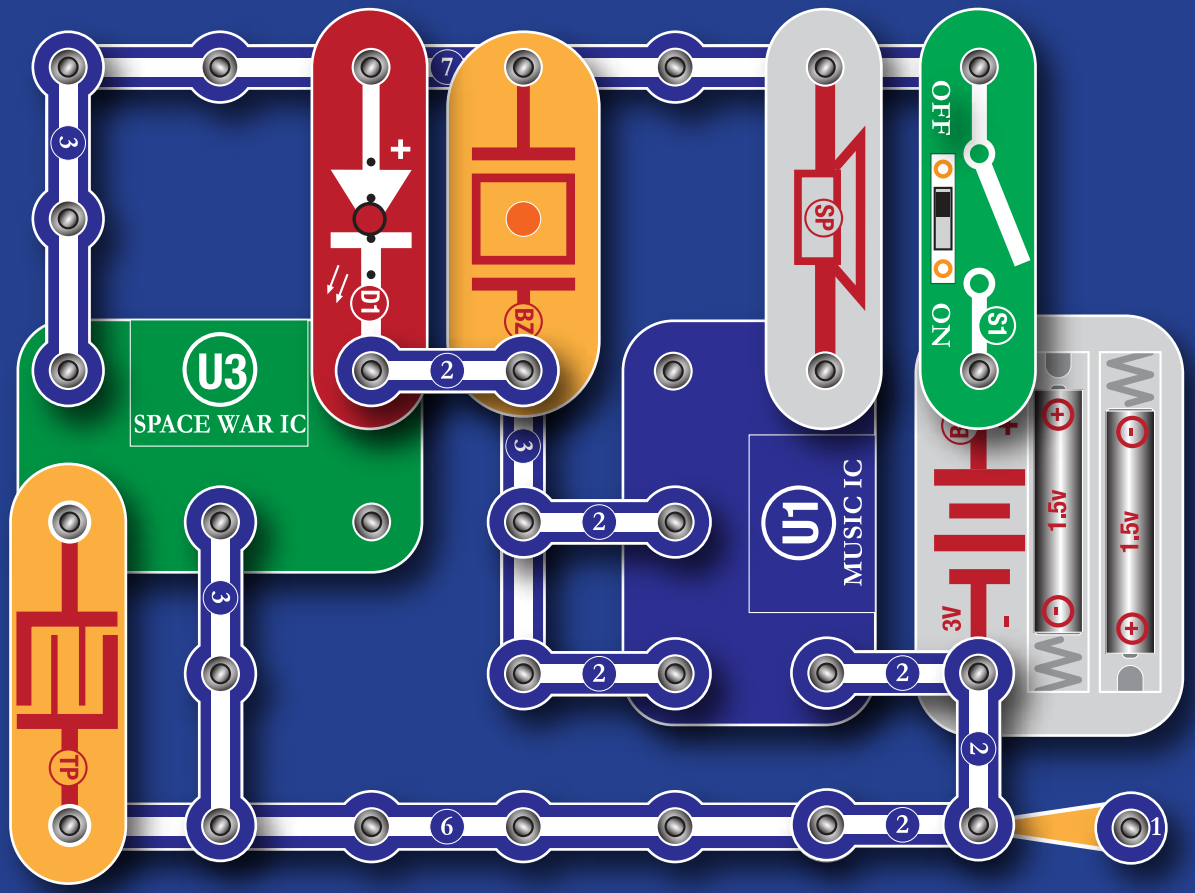


Experiment 80: 3 Note Electronic Organ.

First build the circuit shown in the diagram, then find a short length of wire and connect it between terminals **A** and **B**. Do this by clipping the end of the wire under the single connectors.

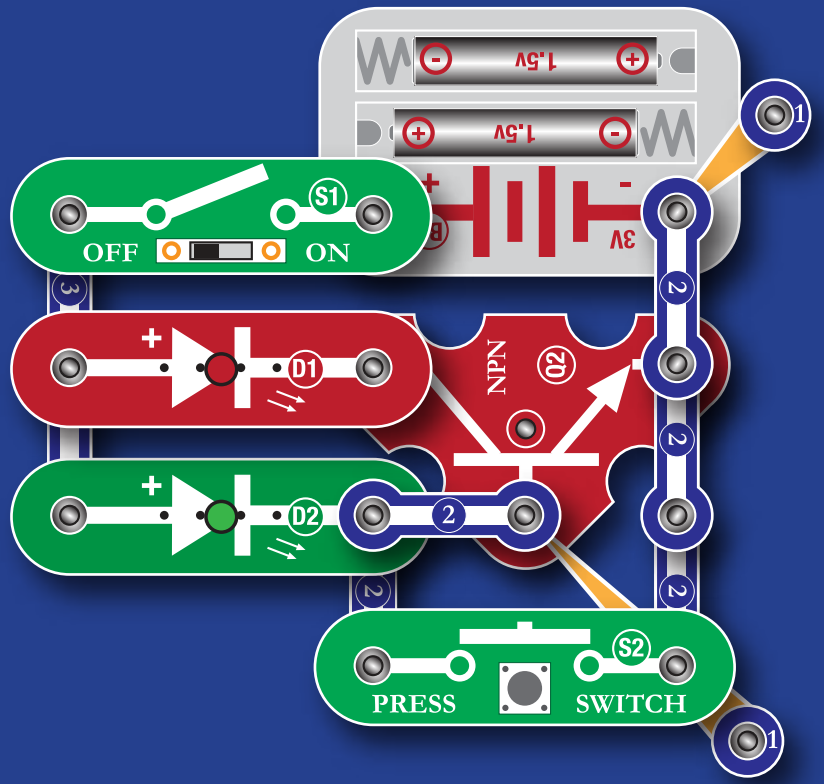
Close the switch, and the use the end of the number 3 connector to touch terminals **X**, **Y** and **Z** to produce three different notes!

NOTE: Touch this end of the connector onto terminals **X**, **Y** and **Z**.



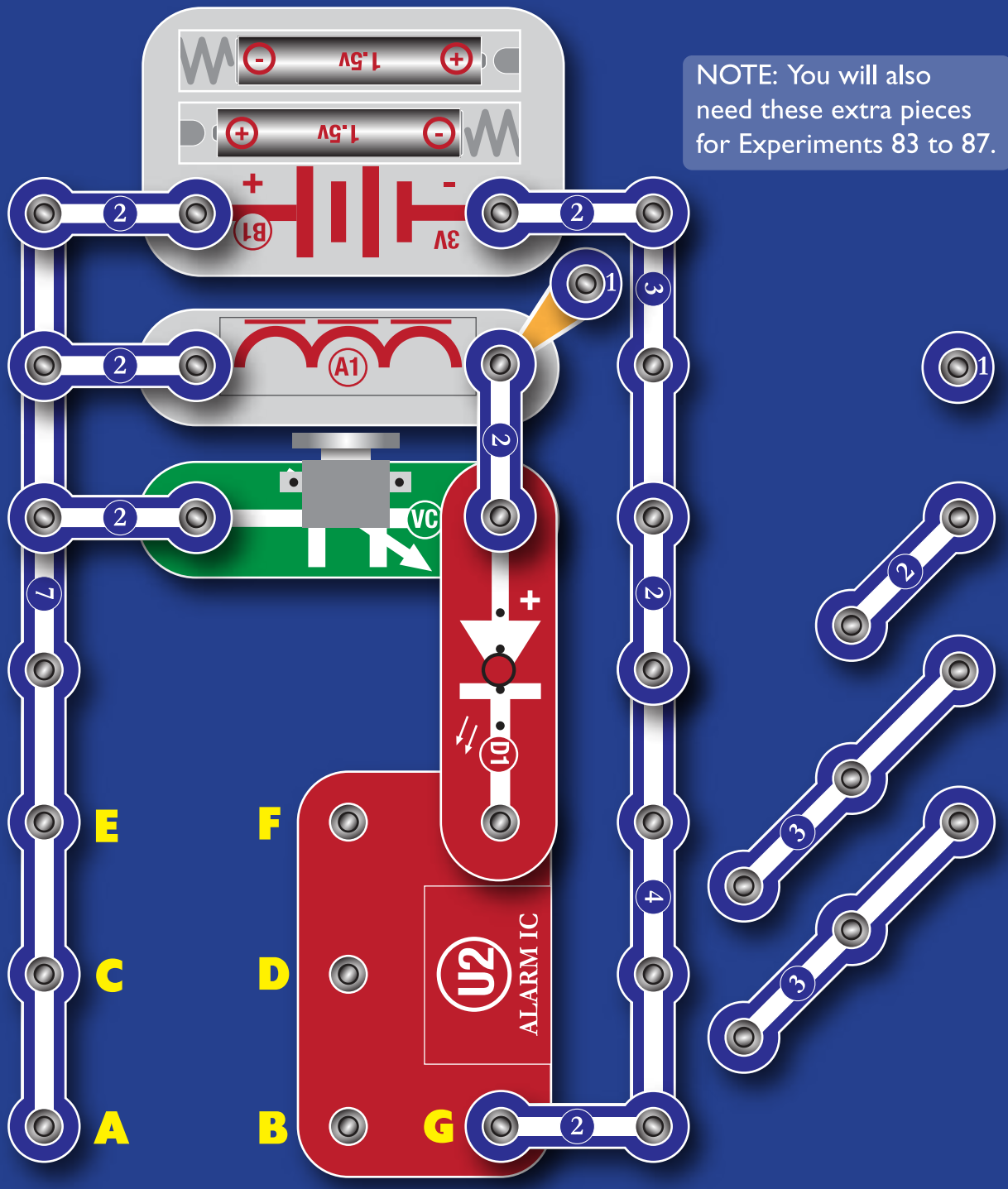
Experiment 81: Touch Controlled Musical Sound Effects.

Build the circuit and insert the batteries. When you close the Switch, the Music IC Unit (U3) plays music through the Loudspeaker (SP). Touching your finger in the centre of the Touch Plate (TP), causes the music to stop, and the Sound Effects IC Unit to produce sounds through the buzzer (BZ). When you remove your finger, the circuit reverts to its original state.



Experiment 82: Traffic Lights.

Build the circuit shown in the diagram, and insert the batteries. When you close the Switch, the Red LED (D1) will light up, but the Green LED (D2) will not. Pressing down on the Button Switch (S2) causes the NPN Transistor to switch the circuit, so that the Green LED lights, and the Red LED goes out. When you release the Button Switch, the circuit reverts to its original state.



NOTE: You will also need these extra pieces for Experiments 83 to 87.

Experiment 83: Transmitted Sound Effects.

These circuit transmit sound to a radio set. Build the circuit and insert the batteries, then place it next to a Medium-Wave radio that has been tuned into a station. Using one of the extra pieces, connect C to D, then adjust the Variable Capacitor (VC). When you find the right place, the radio will produce the sound of a Police car siren. The sound generated by the Alarm IC Unit is being transmitted by the Antenna Coil to your Medium-Wave Radio.

Experiment 84:

Use two of the extra pieces to connect **C** to **D** and **E** to **F**. You can now tune your circuit so that the Radio produces the sound of a laser gun.

Experiment 85:

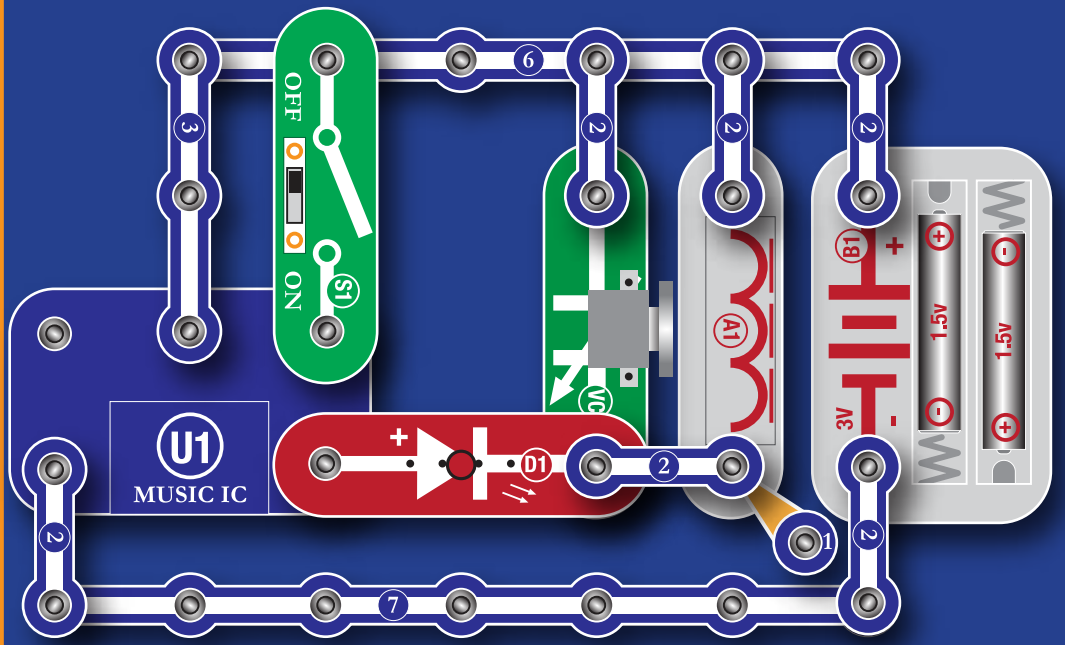
Use two of the extra pieces to connect **A** to **B** and **C** to **D.** You can now tune your circuit so that the Radio produces the sound of a fire engine.

Experiment 86:

Use three of the extra pieces to connect **C** to **D** and **B** to **G**. You can now tune your circuit so that the Radio produces the sound of an ambulance.

Experiment 87:

Use one of the extra pieces to connect **A** to **B**. You can now tune your circuit so that the Radio produces the sound of a space ship.

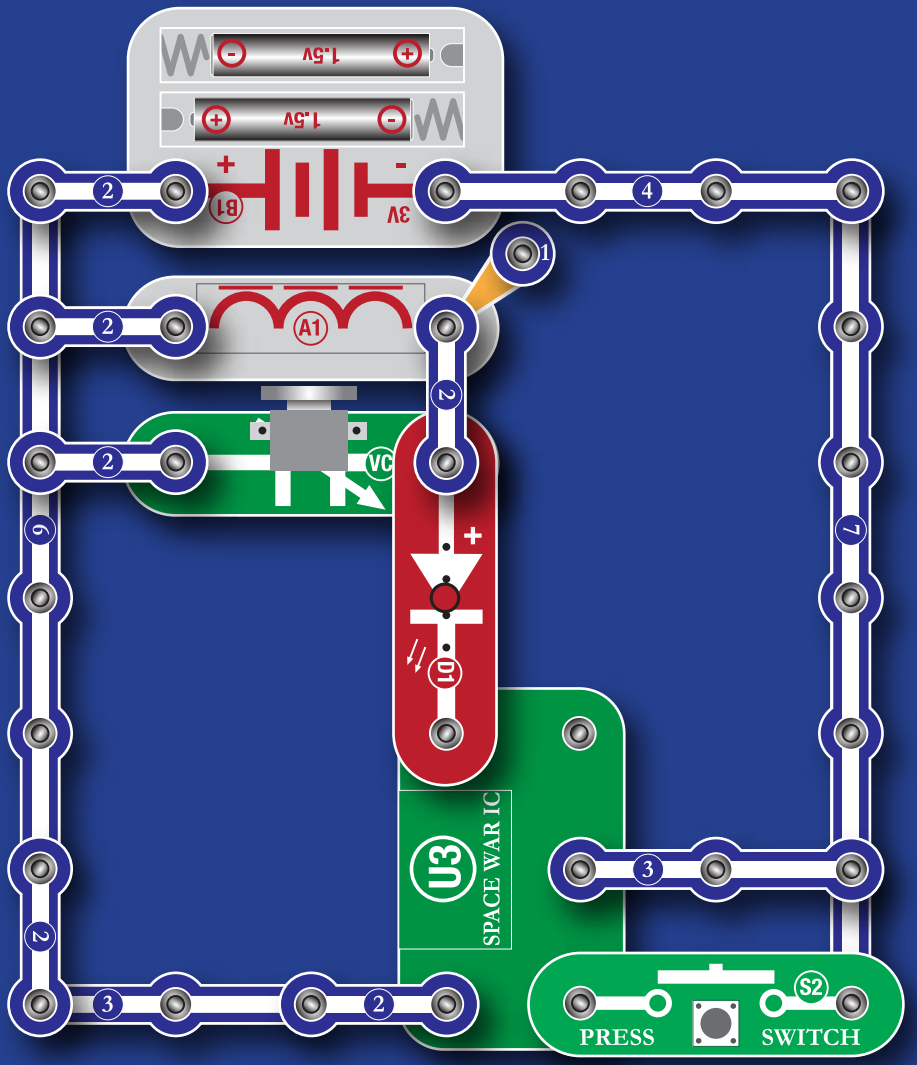


Experiment 88: Musical Radio Broadcast.

Build the circuit and insert the batteries, and again place it next to a Medium-Wave radio that is tuned into a station. Close the switch, and adjust the Variable Capacitor (VC) until the radio picks up the sounds produced from the Music IC Unit.

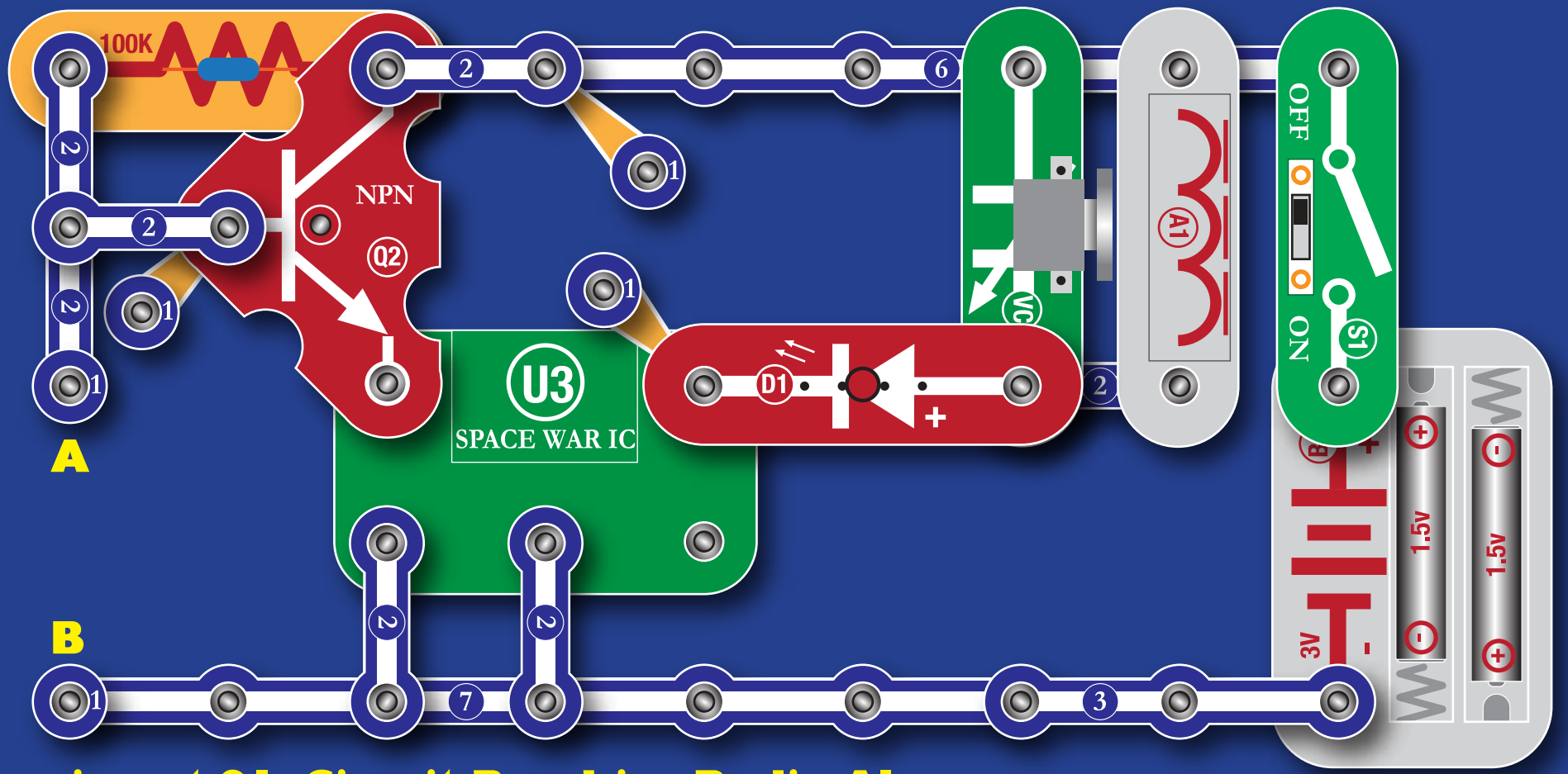
Experiment 89: Radio Water Detector.

Using the previous circuit, replace the Switch (S1) for the Touch Plate (TP). Now the circuit will become active and broadcast the music when water drops on the centre of the Touch Plate. Be careful not to splash water on other parts of the circuit.



Experiment 90: Sound Effects Radio Broadcast.

Build the circuit and insert the batteries, and again place it next to a Medium-Wave radio that is tuned into a station. Press the Button Switch, and adjust the Variable Capacitor (VC) until the radio picks up the sounds produced from the Sound Effects IC Unit.



Experiment 91: Circuit-Breaking Radio Alarm.

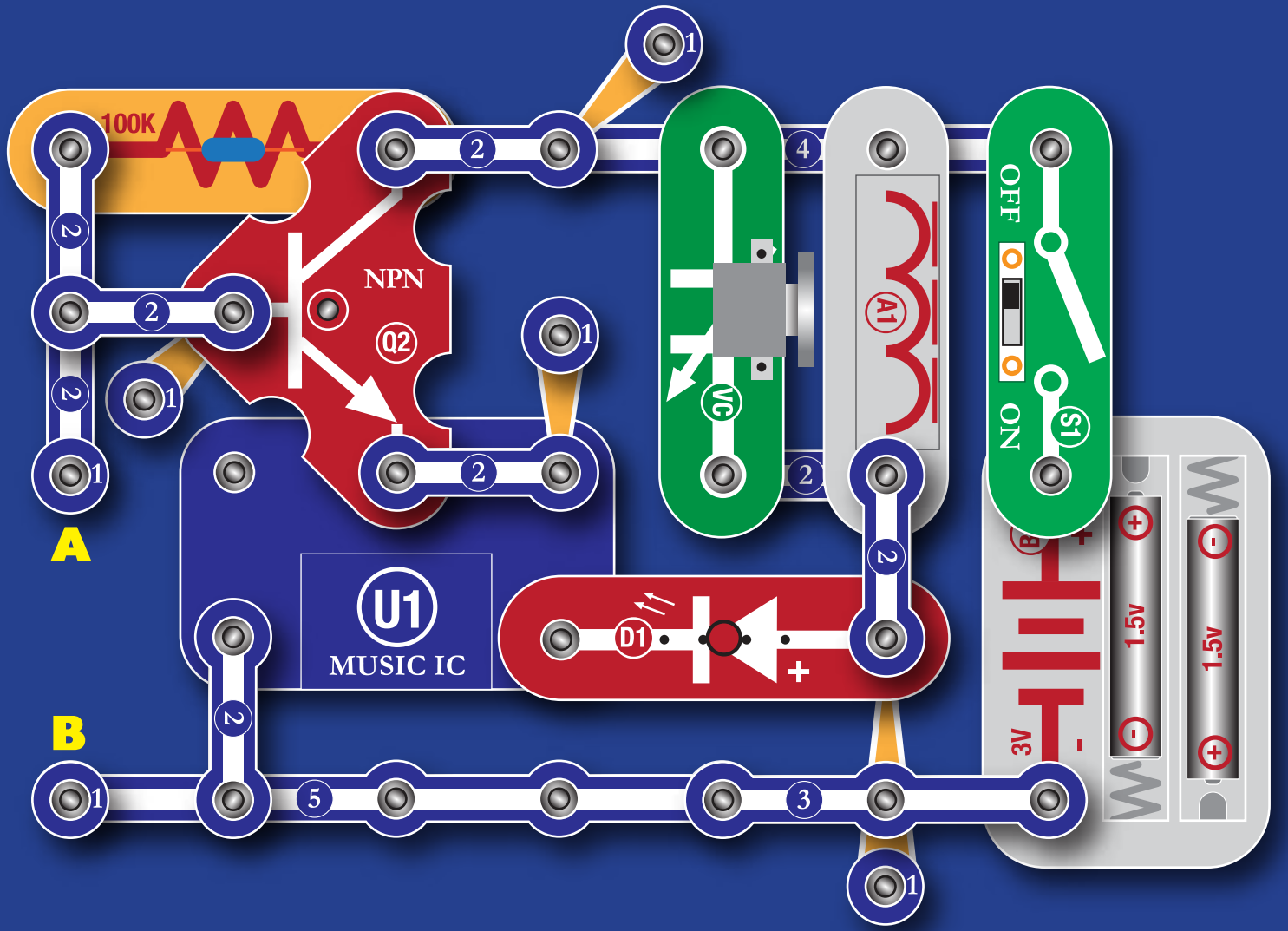
Build the circuit and insert the batteries, and again place it next to a Medium-Wave radio set, adjusted to a position where no radio station is broadcasting. Close the switch and adjust the variable capacitor (VC) until the radio produces sound effects. Now connect a spare number 3 connector to terminals **A** and **B**, to silence the circuit. You can now use the circuit like the Circuit-Breaking Burglar Alarm (Experiment 52, page 19).

Experiment 92: Light Activated Radio Sound Effects.

Replace the 100K Resistor (R5), with the Photo Sensitive Resistor (PR). Now Sound Effects will be broadcast when it is light, but stop when it is dark.

Experiment 93: Dark Activated Radio Sound Effects.

Put the 100K Resistor back into its original position, and connect the Photo Sensitive Resistor across terminals **A** and **B**. Now the circuit will be silent in the light, and broadcast sound effects in the dark.



Experiment 94: Circuit-Breaking Musical Alarm.

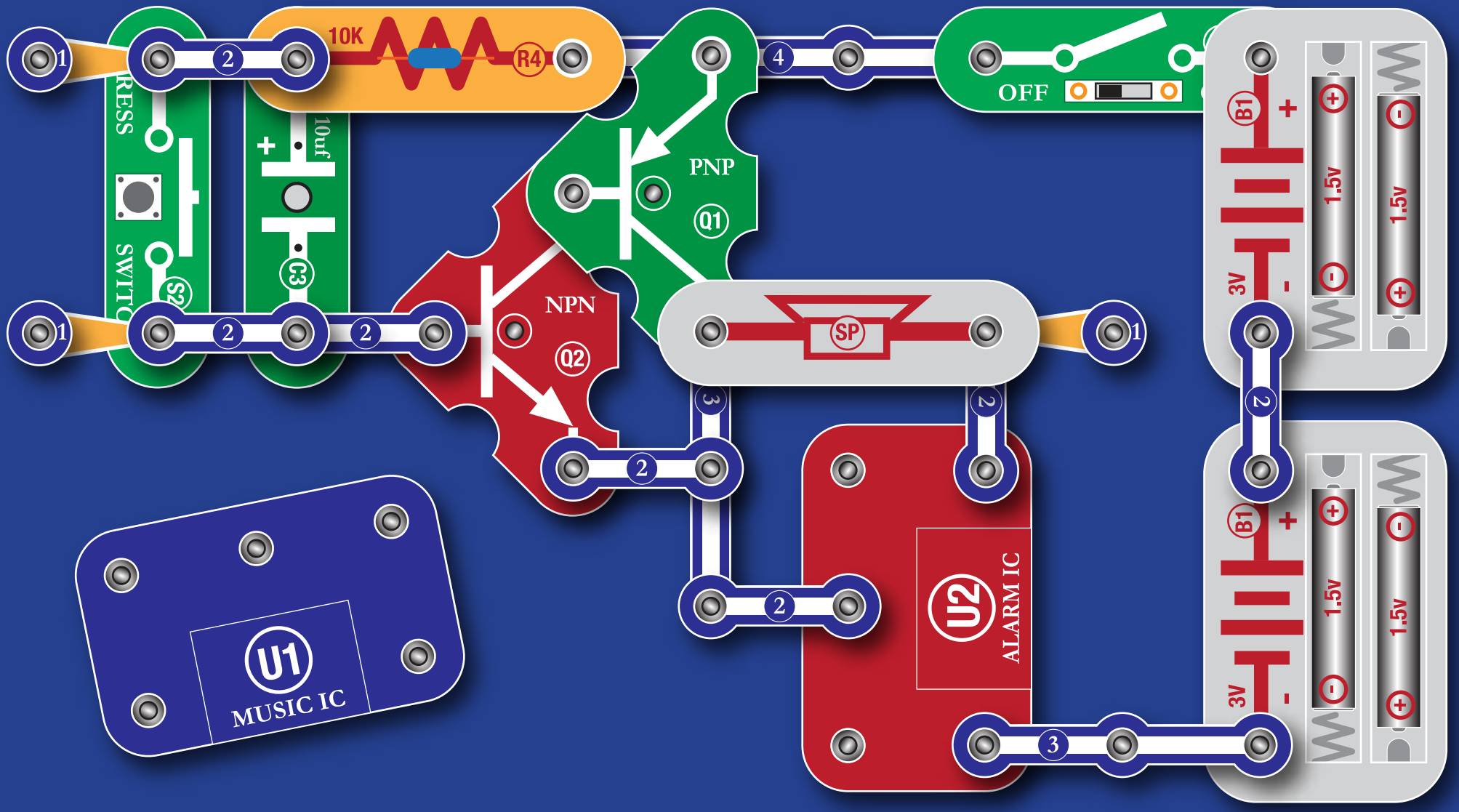
Build the circuit and insert the batteries, and again place it next to a Medium-Wave radio set, adjusted to a position where no radio station is broadcasting. Close the switch and adjust the variable capacitor (VC) until the radio receives the musical broadcast. Now connect a spare number 3 connector to terminals **A** and **B**, to silence the circuit. You can now use the circuit like the Circuit-Breaking Burglar Alarm (Experiment 52, page 19).

Experiment 95: Light Activated Radio Music.

Replace the 100K Resistor (R5), with the Photo Sensitive Resistor (PR). Now music will be broadcast when it is light, but stop when it is dark.

Experiment 96: Dark Activated Radio Music.

Put the 100K Resistor back into its original position, and connect the Photo Sensitive Resistor across terminals **A** and **B**. Now the circuit will be silent in the light, and broadcast music in the dark.

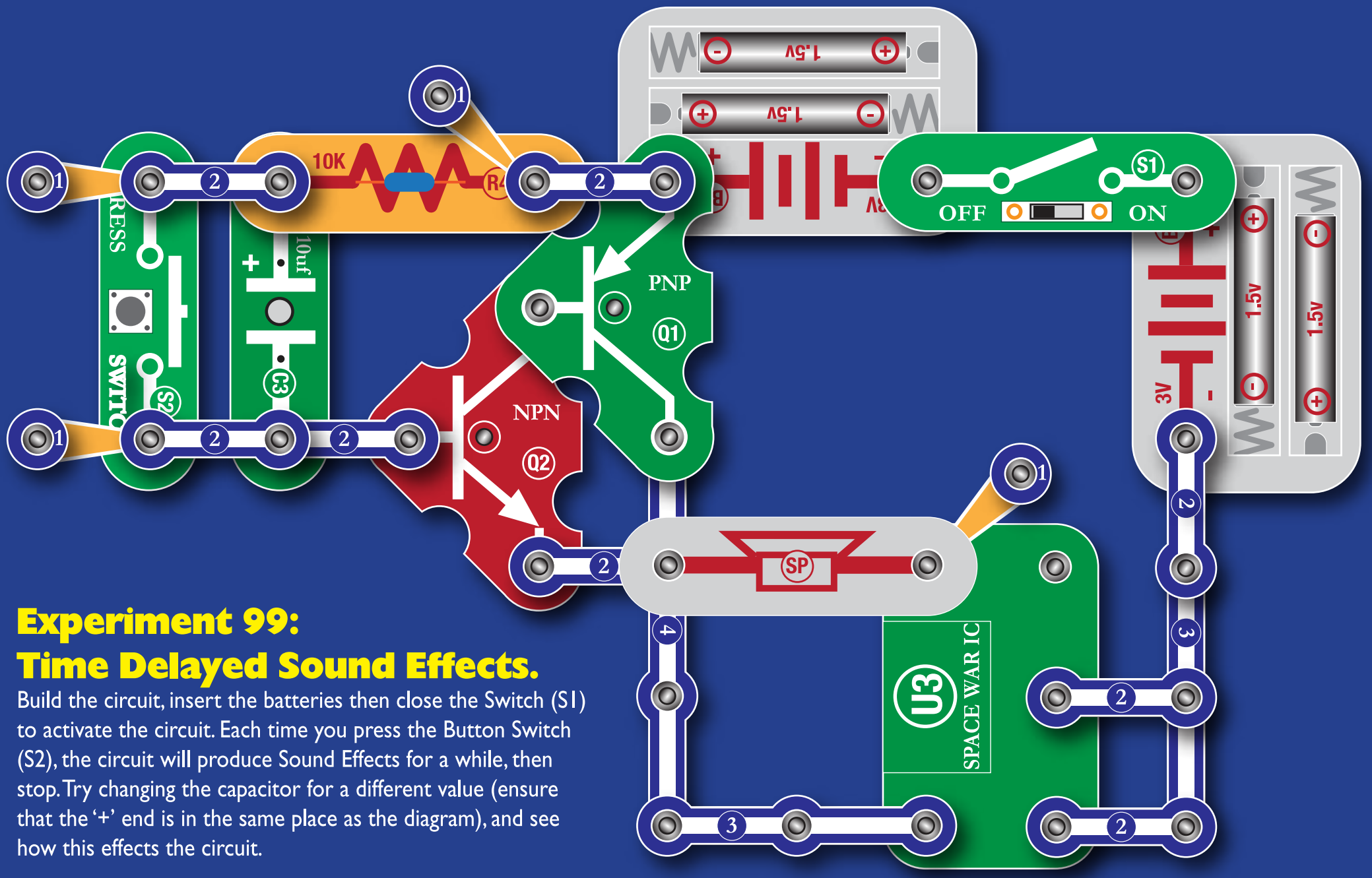


Experiment 97: Time Delay Circuit.

Build the circuit and insert the batteries, then close the Switch (S1). When you press the Button Switch (S2) and release it, the circuit will sound an alarm for a while, then stop.

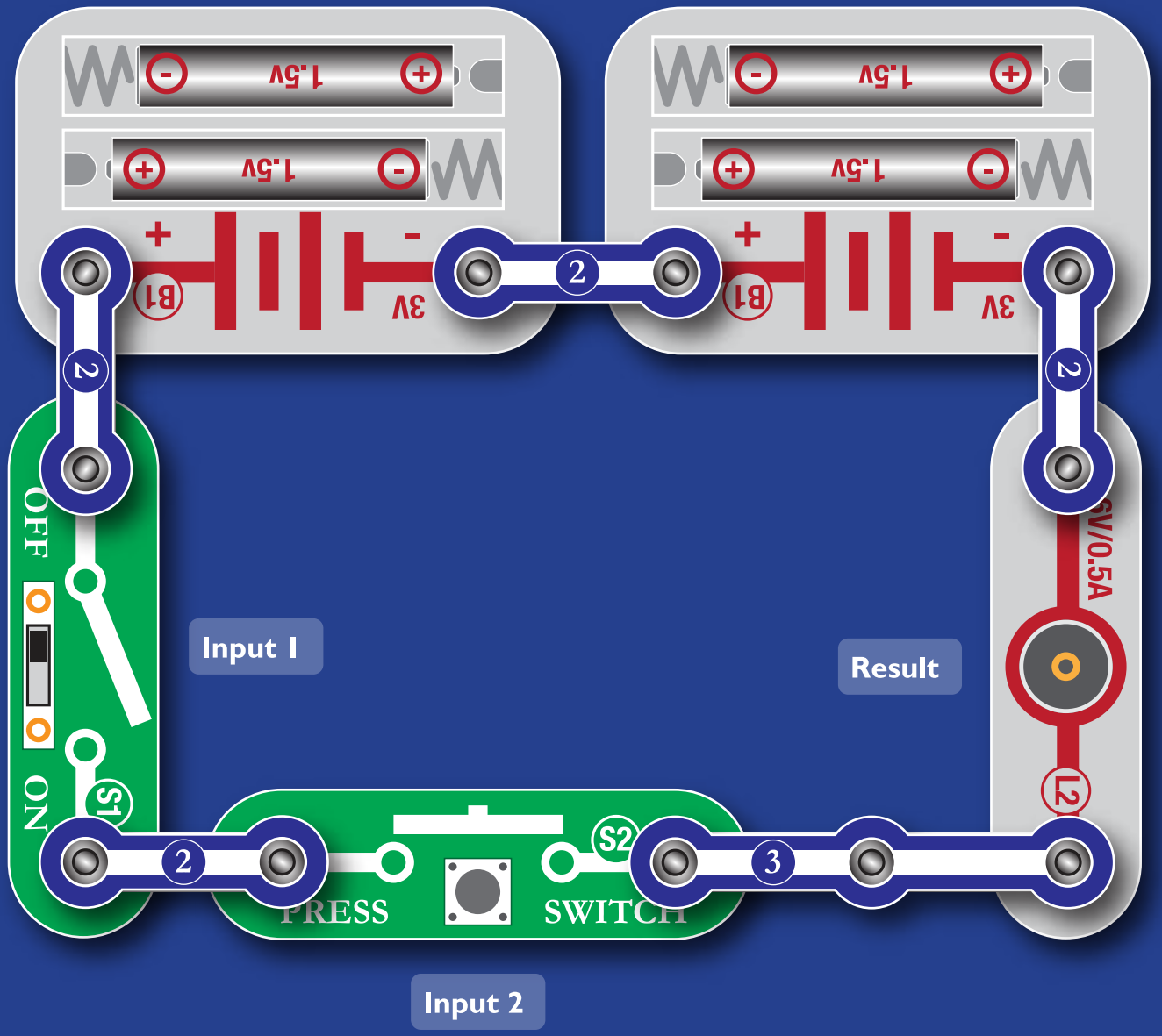
Experiment 98: Time Delay Musical Doorbell.

Replace the Alarm IC Unit (U2) with the Music IC Unit (U1). Now, when you operate the Button Switch, the circuit will play a tune and then stop — just like a real Musical Doorbell.



Experiment 99:
Time Delayed Sound Effects.

Build the circuit, insert the batteries then close the Switch (S1) to activate the circuit. Each time you press the Button Switch (S2), the circuit will produce Sound Effects for a while, then stop. Try changing the capacitor for a different value (ensure that the '+' end is in the same place as the diagram), and see how this effects the circuit.

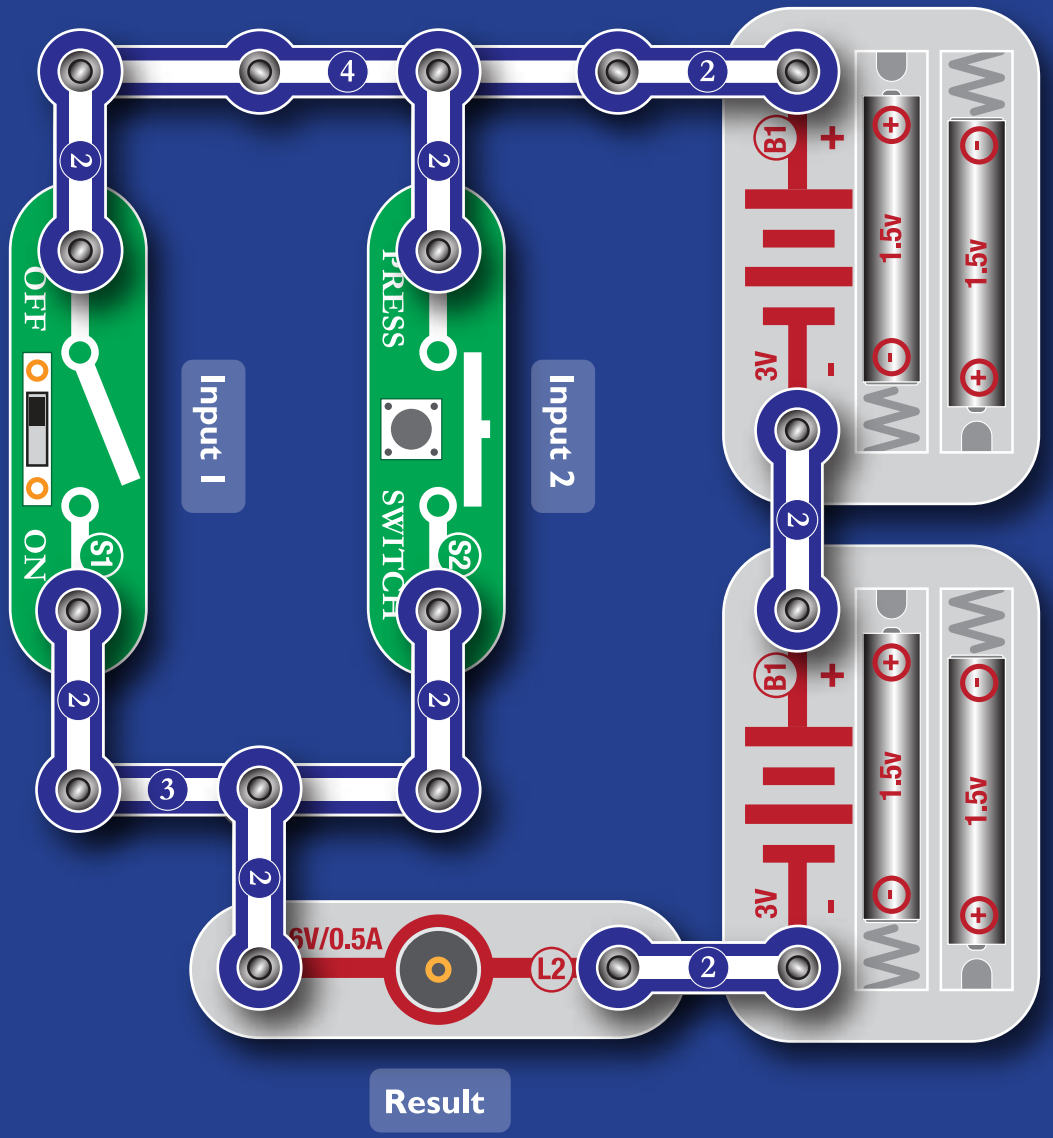


Experiment 100: Logic Circuits — AND Gate.

Computers process information in a form known as binary. In binary there are only 2 numbers: 1 and 0. A tiny pulse of electricity represents a 1, and no pulse of electricity represents a 0. The information is fed thought thousands of circuits called gates, which process it. The next 5 circuits demonstrate how the 5 basic gates work. In these circuits, the switches represent the input to the gate (1 for closed and 0 for open), and the result is read from the 6V Bulb (1 for lit or 0 for unlit).
Each microchip in a computer contains hundreds of thousands of gates, but instead of using switches they use transistors.

This first logic circuit is called an **"AND"** gate. When both inputs (switches) are 1 (closed), the answer is 1.

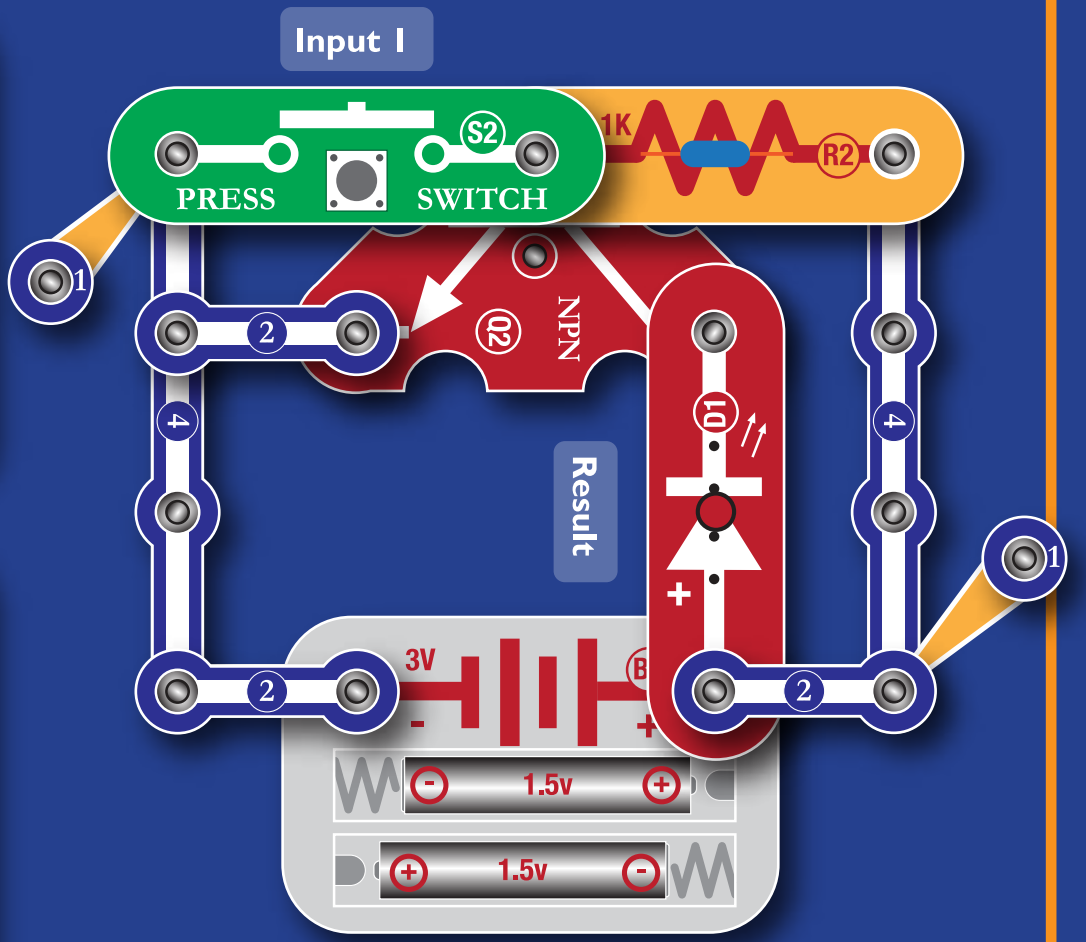
INPUT1	INPUT2	RESULT
0	0	0
1	0	0
0	1	0
1	1	1



Experiment 101: OR Gate.

This circuit is called a **"OR"** gate. Closing either one switch or the other will cause the bulb to light.

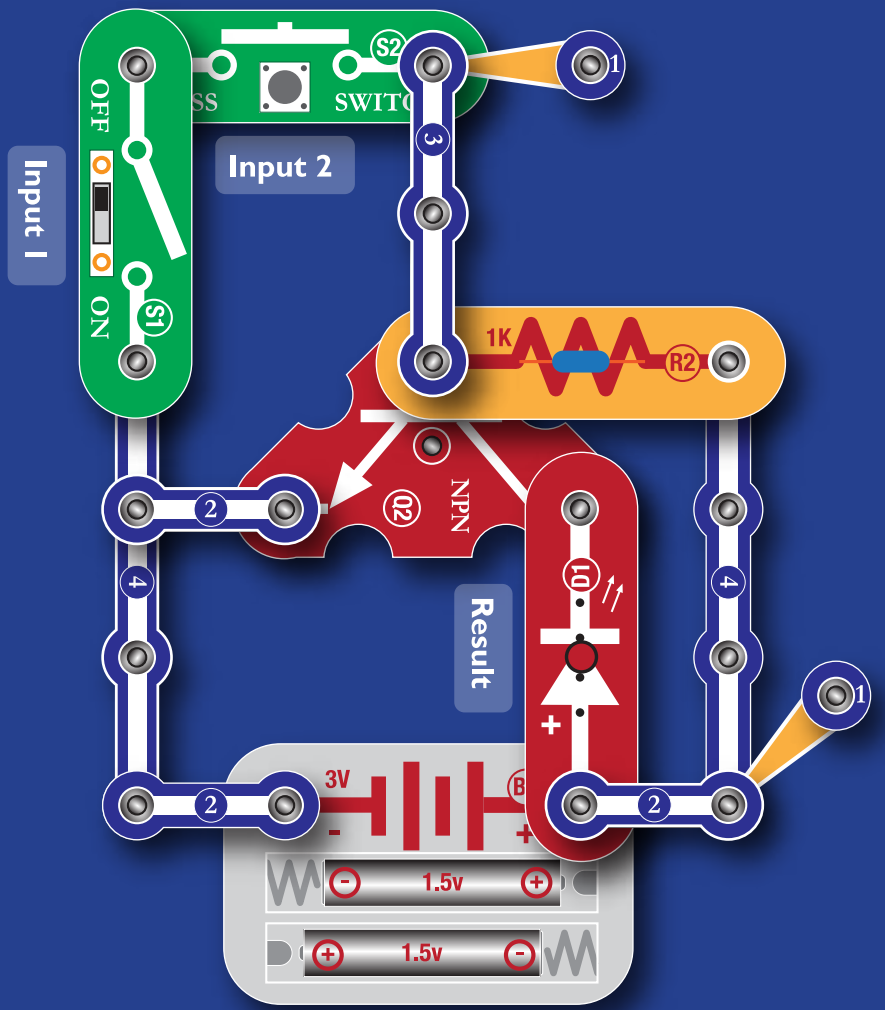
INPUT1	INPUT2	RESULT
0	0	0
1	0	1
0	1	1
1	1	1



Experiment 102: NOT Gate.

This circuit is called a **"NOT"** gate. It only has one input. The Red LED is already lit, and pressing the Button Switch will cause the LED to go out.

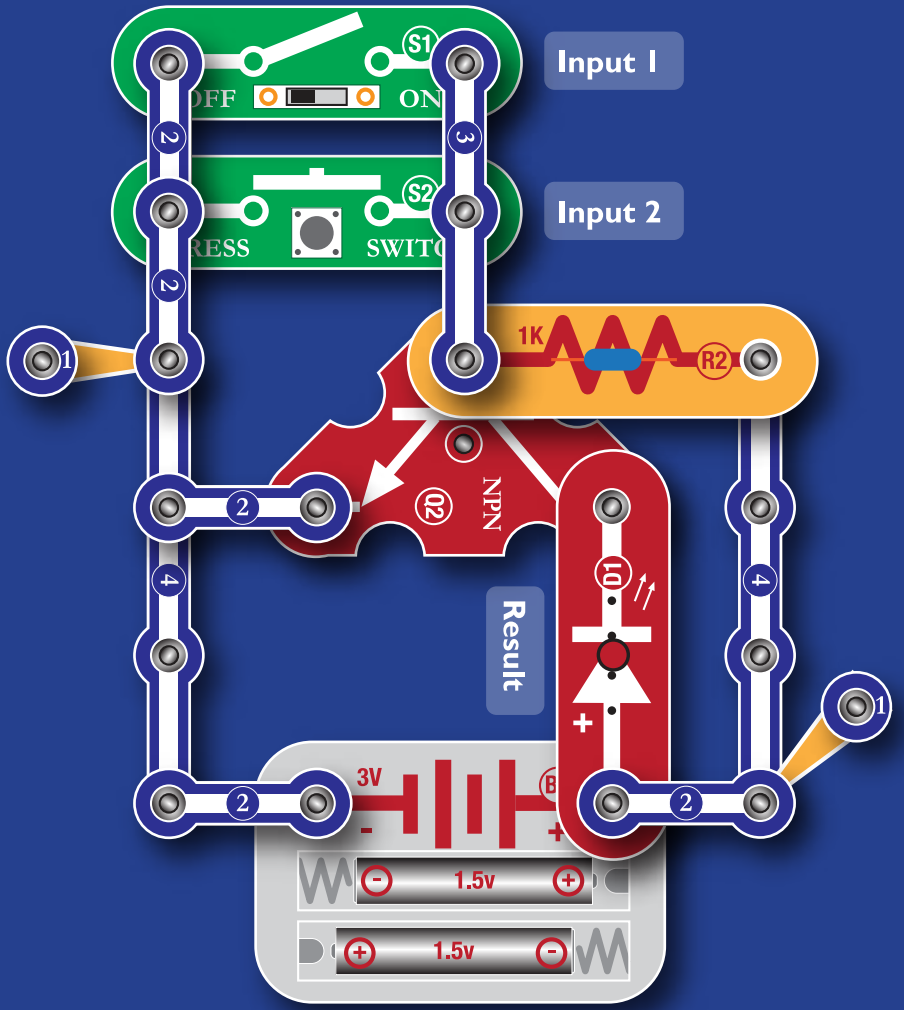
INPUT1	RESULT
0	1
1	0



Experiment 103: NAND Gate.

This circuit is called a **"NAND"** gate. **NAND** stands for **NOT-AND**, and this circuit is a combination of a **NOT** gate and an **AND** gate. In this circuit, closing one or other of the switches has no effect, but closing both switches causes the light to go out.

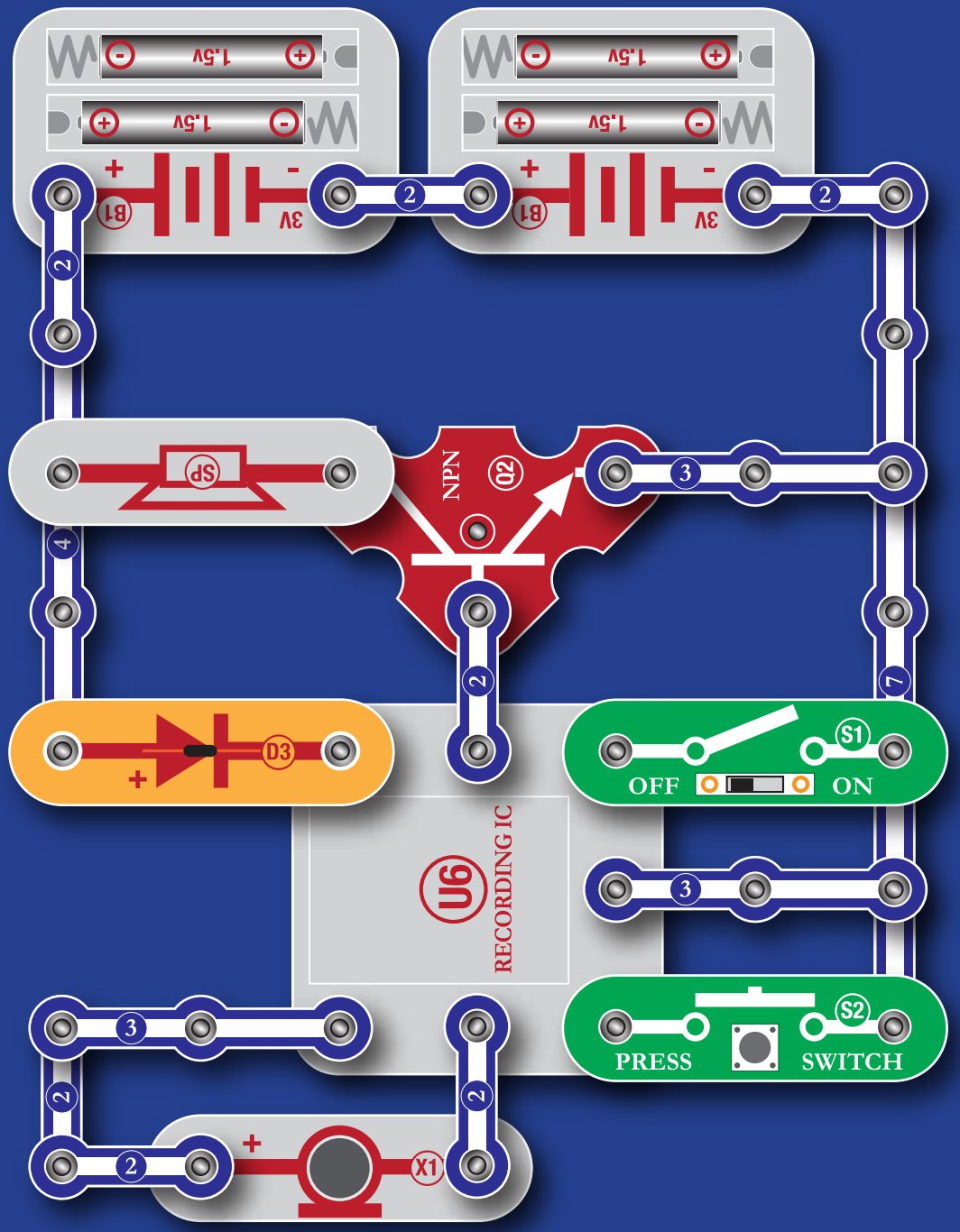
INPUT1	INPUT2	RESULT
0	0	1
1	0	0
0	1	0
1	1	0



Experiment 104: NOR Gate.

This circuit is called a **"NOR"** gate. **NOR** stands for **NOT-OR**, and this circuit is a combination of a **NOT** gate and an **OR** gate. In this circuit, closing one or other of the switches will cause the light to go out

INPUT1	INPUT2	RESULT
0	0	1
1	0	1
0	1	1
1	1	0



Experiment 105: Three Melodies.

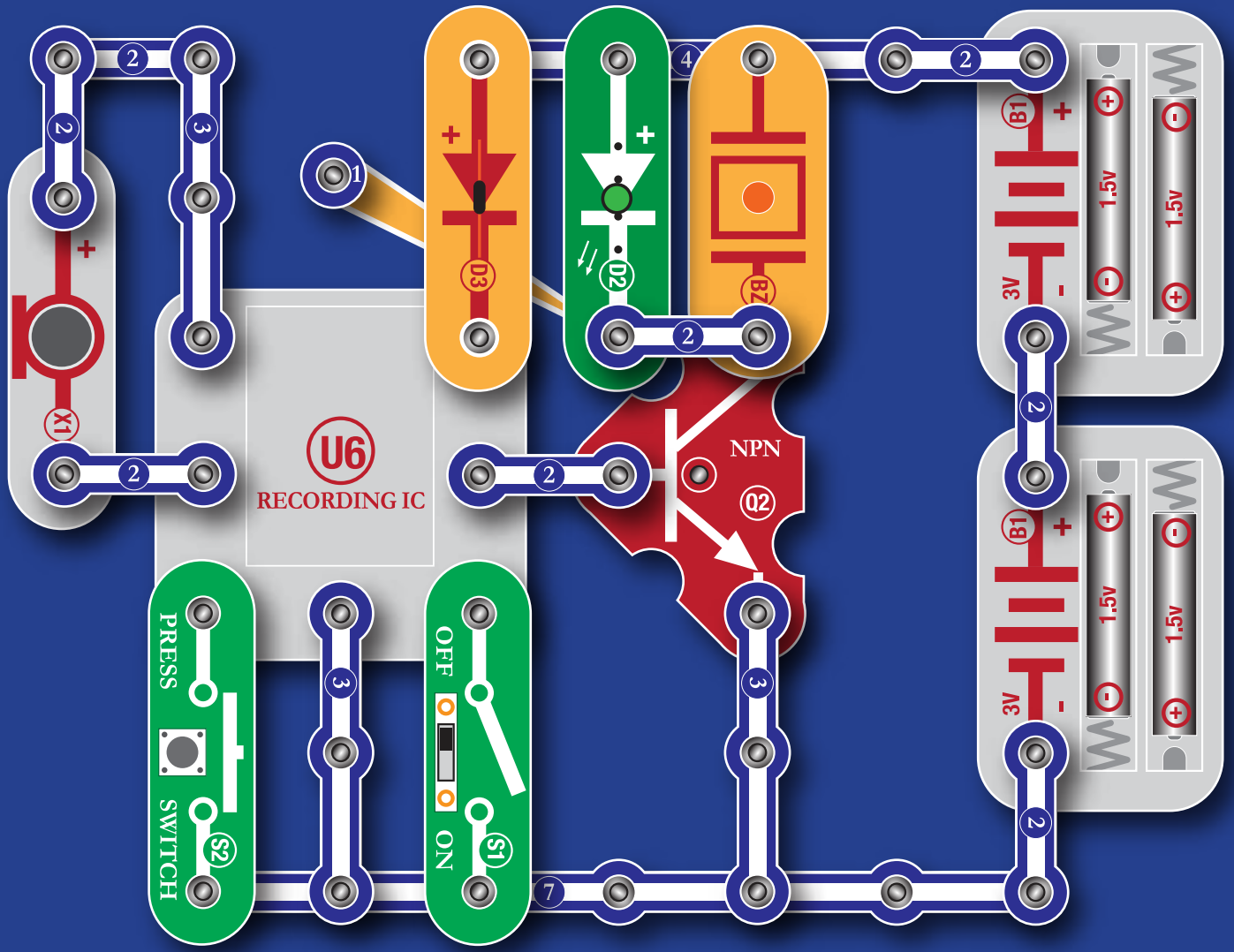
Build the circuit as shown in the diagram. Leave the switch (S1) open, and press the Button Switch (S2). Each time you press it, the Sound Recording IC Unit will play one of three different tunes.

Experiment 106: Sound Recording.

Close the Switch (S1). The Loudspeaker produces a 'beep', and the circuit starts recording — try speaking into the Microphone (X1). After a few seconds, the Loudspeaker produces a 'beep, beep', and the recording is finished. Now open the Switch (S1).

Experiment 107: Sound Playback.

Once you have recorded a sound (experiment 106), you can play it back by pressing the Button Switch (S2) once. The sound that you have recorded is sent from the Sound Recording IC Unit (U6), through the NPN Transistor (Q2) and played by the Loudspeaker.

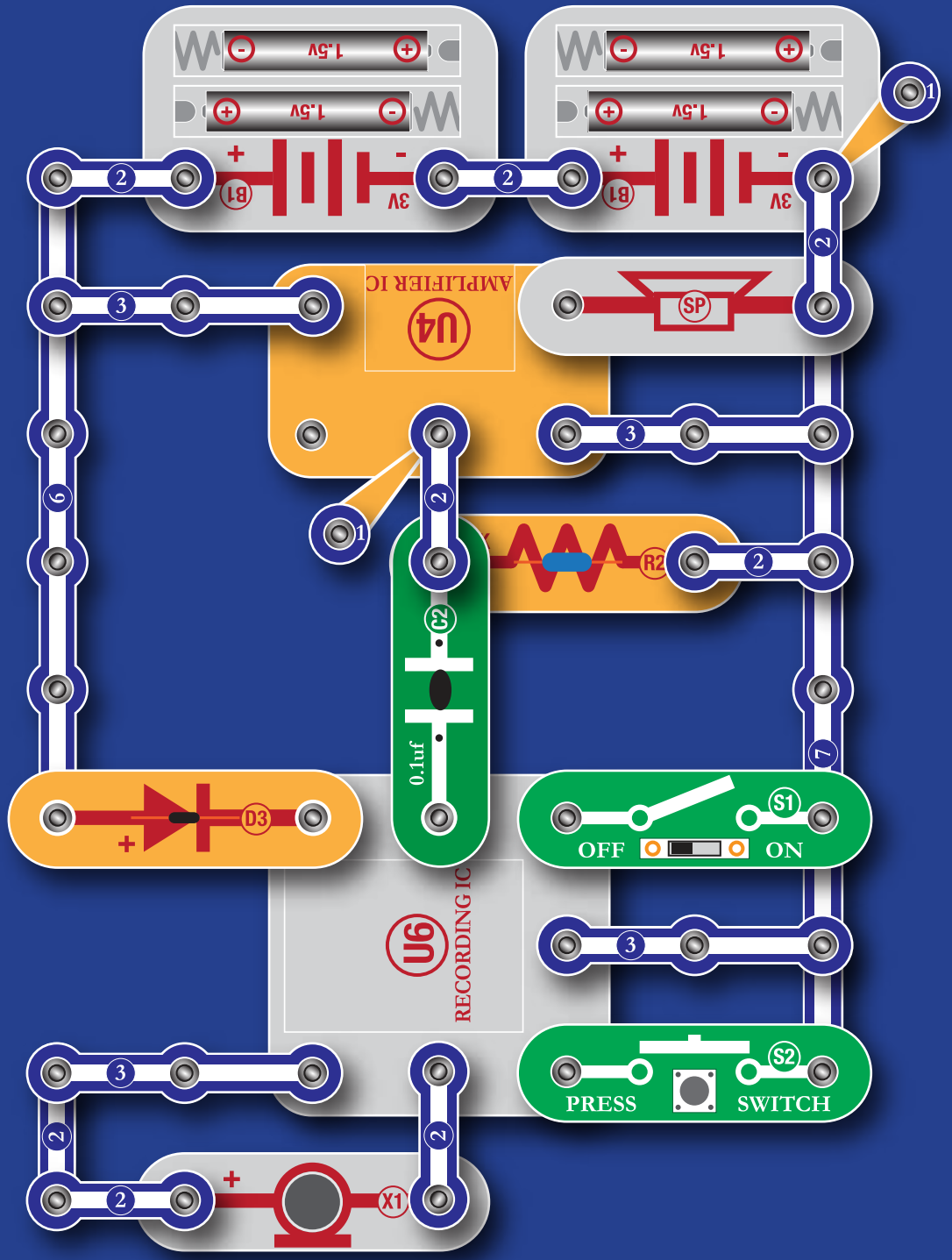


Experiment 108: Sound Recording with Flashing Light.

Close the Switch (S1). The Buzzer (BZ) produces a 'beep' and the Green LED flashes once. The circuit is now recording. Try speaking into the Microphone (X1). After a while, the Buzzer produces two 'beeps' and the Green LED flashed twice, this is to signal the end of recording. Open the Switch (S1).

Experiment 109: Sound Playback with Flashing Light.

Once you have recorded a sound (experiment 108), you can play it back by pressing the Button Switch (S2) once. The sound that you have recorded is sent from the Sound Recording IC Unit (U6) to the Buzzer (BZ), to be played.



Experiment 110: Three Melodies with Power Amplification.

Build the circuit as shown in the diagram. Leave the switch (S1) open, and press the Button Switch (S2). Each time you press it, the Sound Recording IC Unit will play one of three different tunes. This is amplified by the Power Amplifying IC Unit (U4), and played through the Loudspeaker.

Experiment 111: Sound Recording with Power Amplification.

Close the Switch (S1). The Loudspeaker produces a 'beep', and the circuit starts recording — try speaking into the Microphone (X1). After a few seconds, the Loudspeaker produces a 'beep, beep', and the recording is finished. Now open the Switch (S1).

Experiment 112: Sound Playback with Power Amplification.

Once you have recorded a sound (experiment 111), you can play it back by pressing the Button Switch (S2) once. The sound that you have recorded is sent from the Sound Recording IC Unit (U6) to the Power Amplifying IC Unit (U4), to be amplified, and then it is played through the Loudspeaker.

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