SNAP CIRCUITS™

Projects 102-305

Instruction Manual

REV-B Revised 2002

ADDITIONAL PARTS LIST (Colors and styles may vary) Symbols and Numbers

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
☐ 3	(1)	1-Snap Wire		6SC30001	☐ 1	(C3)	10µF Capacitor		6SC30032
☐ 3	(2)	2-Snap Wire		6SC30002	☐ 1	(C4)	100µF Capacitor		6SC30033
☐ 1	(3)	3-Snap Wire		6SC30003	☐ 1	(C5)	470µF Capacitor		6SC30034
☐ 1	(4)	4-Snap Wire		6SC30004	☐ 1	(R2)	1kΩ Resistor		6SC30041
☐ 1	(7)	7-Snap Wire		6SC30007	☐ 1	(R3)	5.1kΩ Resistor		6SC30042
☐ 1	(B1)	Battery Holder - uses 2 1.5V type AA (not Included)		6SC30019	☐ 1	(R4)	10kΩ Resistor		6SC30043
☐ 1	(A1)	Antenna Coil		6SC30025	☐ 1	(R5)	100kΩ Resistor		6SC30044
☐ 1	(D2)	Green Light Emitting Diode (LED)		6SC30026	☐ 1	(U5)	High Frequency Integrated Circuit		6SC30045
☐ 1	(L2)	6V Lamp Socket 6V Bulb (6.2V, 0.5A) Type 425 or similar		6SC30027 6SC30027B	☐ 1	(Q1)	PNP Transistor		6SC30051
☐ 1	(X1)	Microphone		6SC30028	☐ 1	(Q2)	NPN Transistor		6SC30052
☐ 1	(U4)	Power Amplifier Integrated Circuit		6SC30029	☐ 1	(RV)	Adjustable Resistor		6SC30053
☐ 1	(C1)	0.02µF Capacitor		6SC30030	☐ 1	(CV)	Variable Capacitor		6SC30054
☐ 1	(C2)	0.1µF Capacitor		6SC30031					

HOW TO USE IT

The Electronic Snap Circuit Kit has 204 projects. They are simple to build and understand.

The snap circuit kit uses building blocks with snaps to build the different electrical and electronic circuits in the projects. Each block has a function: there are switch blocks, lamp blocks, battery blocks, different length wire blocks, etc. These blocks are in different colors and have numbers on them so that you can easily identify them. The circuit you will build is shown in color and numbers, identifying the blocks that you will use and snap together to form a circuit.

For Example:

This is the switch block which is green and has the marking (S1) on it.

This is a wire block which is blue and comes in different wire lengths. This one has the number (2), (3), (4), (5), (6), or (7) on it depending on the length of the wire connection required.

There is also a 1-snap wire that is used as a spacer or for interconnection between different layers.

To build each circuit, you will have two (2) power source blocks marked (B1) that need two (2) "AA" batteries each (not included with the snap circuit kit).

A large clear plastic base grid is included with this kit to help keep the circuit block together. You will see evenly spaced posts that the different blocks snap into. You do not need this base to build your circuits, but it does help in keeping your circuit together neatly. The base has rows labeled A-G and columns labeled 1-10.

Next to each part in every circuit drawing is a small number in black. This tells you which level the component is placed at. Place all parts on level 1 first, then all of the parts on level 2, then all of the parts on level 3, etc.

The 2.5V bulb comes packaged separate from its socket. Install the bulb in the lamp socket (L1) whenever that part is used. Do the same for the 6V bulb and socket (L2).

Place the fan on the motor (M1) whenever that part is used, unless the project you are building says not to use it.

Some circuits use the jumper wires to make unusual connections. Just clip them to the metal snaps or as indicated.

Note: While building the projects, be careful not to accidentally make a direct connection across the battery holder (a "short circuit"), as this will damage and/or quickly drain the batteries.

Creating Your Own Circuits

After building the circuits given in this booklet, you may wish to experiment on your own. Use the projects in this booklet as a guide, as many important design concepts are introduced throughout them. Every circuit will include a power source (the batteries), a resistance (which might be a resistor, lamp, motor, integrated circuit, etc.), and wiring paths between them and back. You must be careful not to create "short circuits" (very low-resistance paths across the batteries) as this will damage components and/or quickly drain your batteries. Only connect the ICs using configurations given in the projects, incorrectly doing so may damage them. **Elenco™ Electronics is not responsible for parts damaged due to incorrect wiring.**

For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

You are encouraged to tell us about new circuits you create. Upon review, we will post them with your name, age, and hometown in a special section on our website.

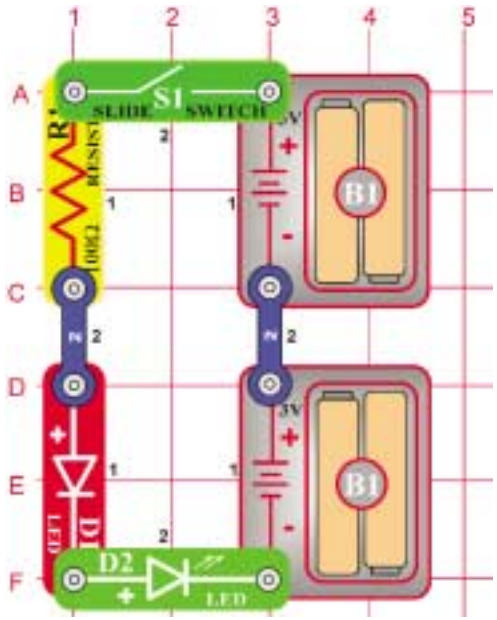
Troubleshooting

Most circuit problems are due to incorrect assembly, always double-check that your circuit exactly matches the drawing for it. Be sure that parts with positive/negative markings are positioned as per the drawing. Sometimes the light bulbs come loose, tighten them as needed. Try replacing the batteries.

PROJECT LISTINGS

PROJECT LISTINGS

Project #102



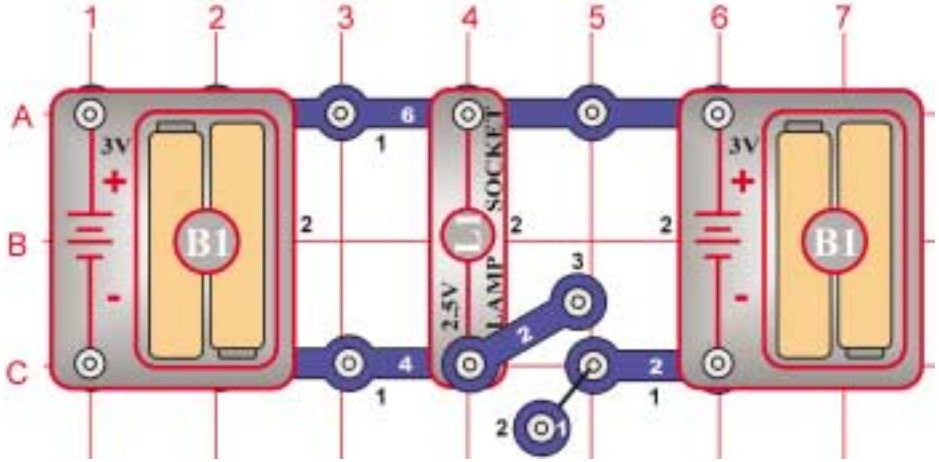
Batteries in Series

OBJECTIVE: To show the increase in voltage when

When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), the 1kΩ resistor (R1), the LED (D1), through the LED (D2), and back to the second group of batteries (B1). Notice how both LEDs are lit. The voltage is high enough to turn on both LEDs when the batteries are connected in series. If only one set of batteries is used, the LEDs will not light up.

Some devices use only one 1.5 volt battery, but they make hundreds of volts electronically from this small source. A flash camera is an example of this.

Project #103



Batteries in Parallel

OBJECTIVE: To show how batteries in parallel are

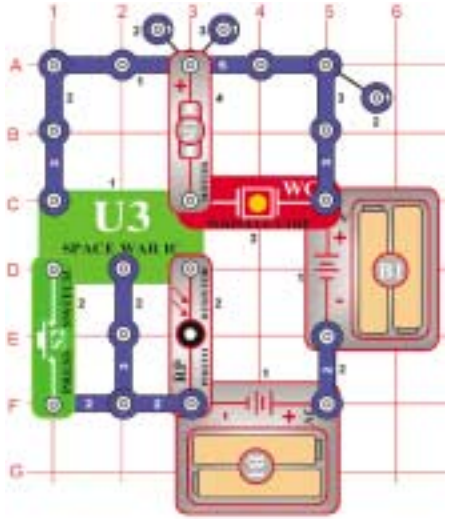
Build the circuit shown on the left by placing all of the parts with a black 1 next to them on the board first. Then, assemble the parts marked with a 2 (including the 1-snap wire at base grid location C5). Finally, place a 2-snap wire at grid location C4, leaving the other end of it unconnected as shown.

The light should be on and the brightness of the lamp will depend on the quality of the batteries in the holder on the left. Put weak batteries in the left holder and strong batteries in the right holder. Snap in the loose end of the 2-snap wire to grid point C5. Now the lamp will get brighter as the fresh batteries take over and supply the current to the light.

Batteries are placed in parallel when the voltage is adequate but the load needs more current than one group of batteries can supply. Think of each battery as a storage tank that supplies water. If you put two in parallel, you can get more water (current), but the pressure (voltage) stays the same.

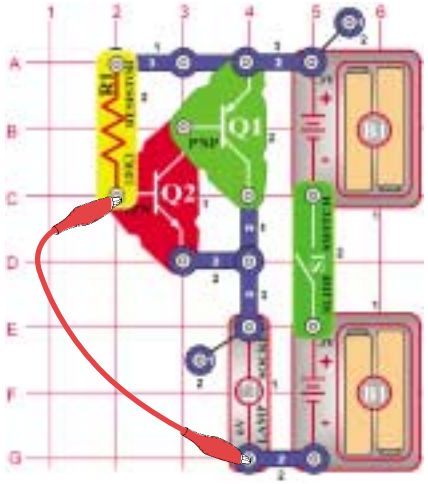
Project #104 Spacey Fan

OBJECTIVE: To build a fan with space war sounds that



Place the fan onto the motor. Space war sounds are heard if light shines on the photosensitive resistor OR if you press the press switch (S2), the fan may start to spin, but will only get to high speed if you do BOTH. Try various combinations of shining light and holding down the press switch.

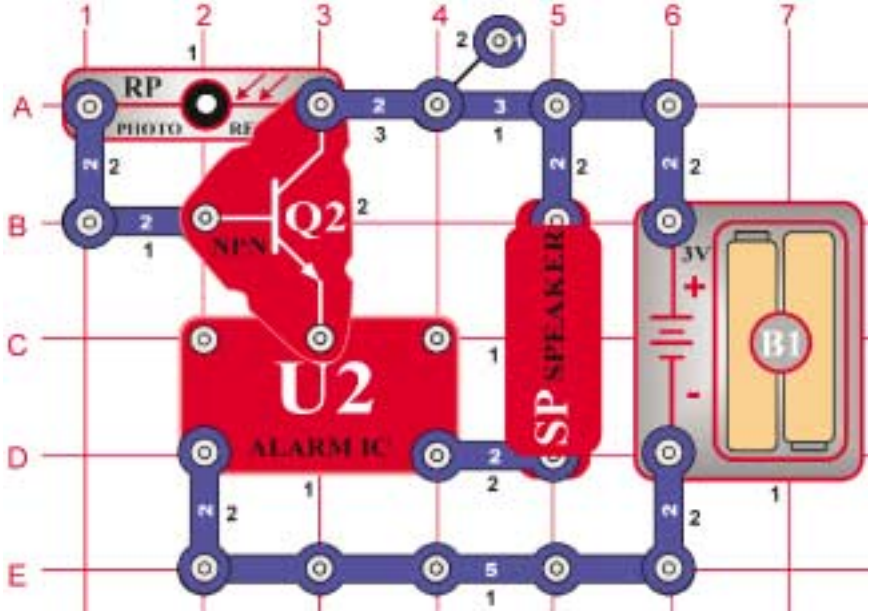
Project #105
Two-Transistor Light Alarm



This light alarm circuit uses two (2) transistors and both sets of batteries. Build the circuit with the jumper connected as shown, and turn it on. Nothing happens. Break the jumper connection and the light turns on. You could replace the jumper with a longer wire and run it across a doorway to signal an alarm when someone enters.

Project #106
Light-Controlled Alarm

OBJECTIVE: To show how light is used to turn an

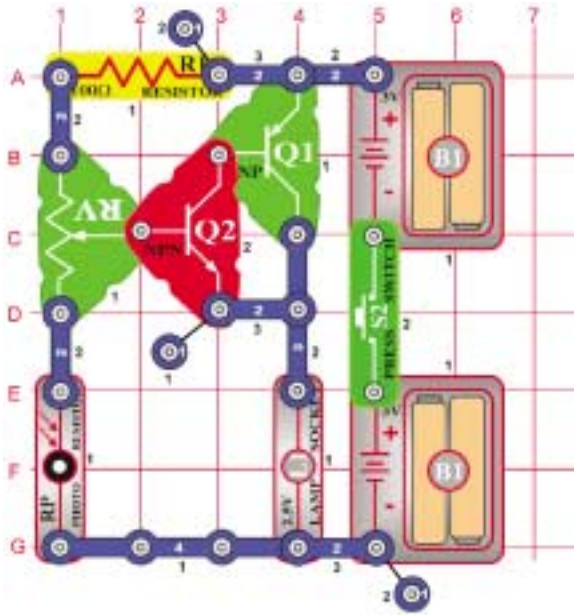


The alarm will sound, as long as light is present. Slowly cover the photosensitive resistor (RP), and the volume goes down. If you turn off the lights, the alarm will stop. The amount of light changes the resistance of the photosensitive resistor (less light means more resistance). The photosensitive resistor and transistor (Q2) act like a dimmer switch, adjusting the voltage applied to the alarm.

This type of circuit is used in alarm systems to detect light. If an intruder turned on a light or hit the sensor with a flashlight beam, the alarm would trigger and probably force the intruder to leave.

Project #107

Automatic Street Lamp



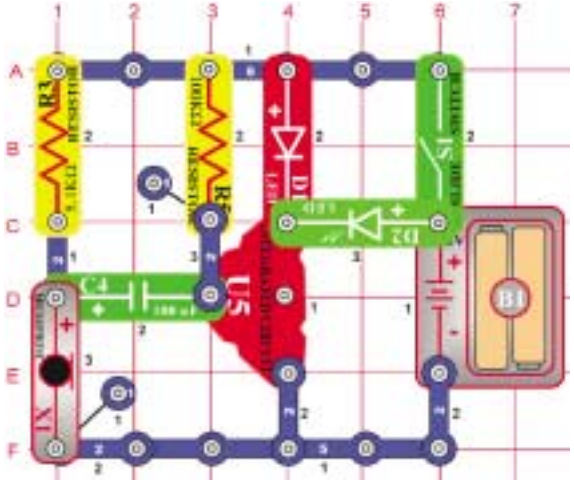
OBJECTIVE: To show how light is used to control a

Press the press switch (S2) on and set the adjustable resistor (RV) so the lamp just lights. Slowly cover the photosensitive resistor (RP) and the lamp brightens. If you place more light at the photosensitive resistor the light dims.

This is an automatic street lamp that you can turn on by a certain darkness and turn off by a certain brightness. This type of circuit is installed on many outside lights and forces them to turn off and save electricity. They also come on when needed for safety.

Project #108

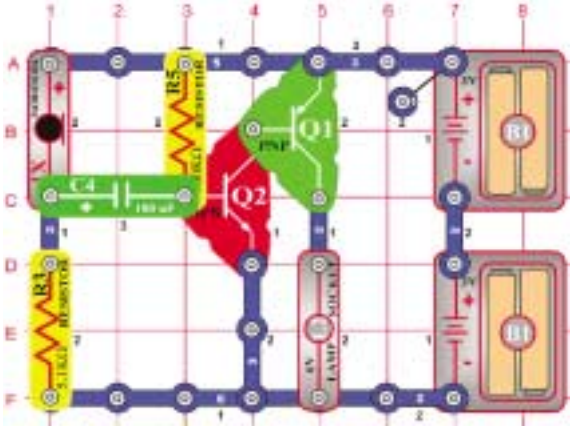
Voice-Controlled Rays of Light



Turn the slide switch (S1) on. There will be only a weak light emitting from the green LED. By blowing on the mic (X1) or putting it near a radio or TV set, the green LED will emit light, and its brightness changes as the loudness changes.

Project #109

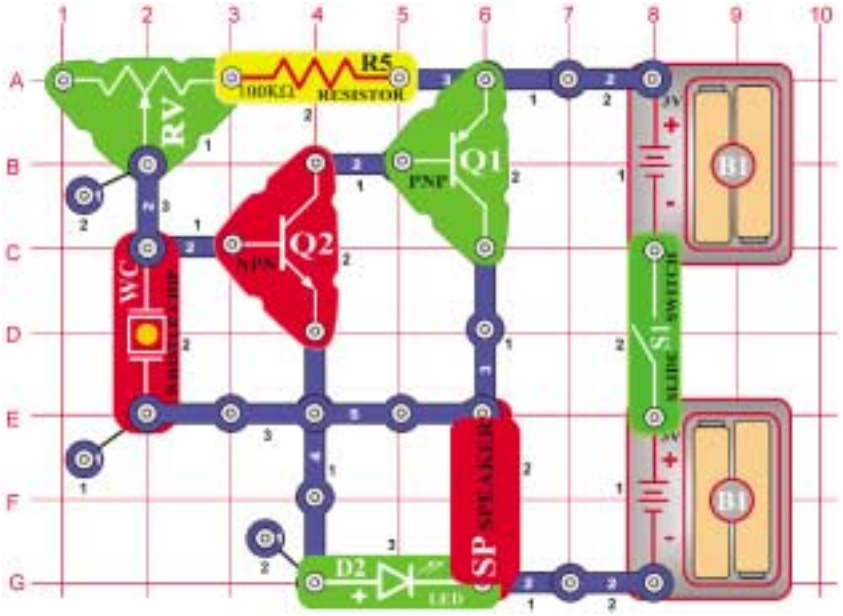
Blowing Off the Electric Light



Install the parts. The lamp (L1) will be on. It will be off as long as you blow on the mic (X1). Speaking loud into the mic will change the brightness of the lamp.

Project #110

Adjustable Tone Generator



OBJECTIVE: To show how resistor values change the

Turn on the slide switch (S1), the speaker (SP) will sound and the LED (D2) will light. Adjust the resistor (RV) to make different tones. In an oscillator circuit, changing the values of resistors or capacitors can vary the output tone or pitch.

Project #111

Photosensitive Electronic Organ

OBJECTIVE: To show how resistor values change the

Use the circuit from Project 110 shown above. Replace the 100kΩ (R5) with the photosensitive resistor (RP). Turn on the slide switch (S1). The speaker (SP) will sound and the LED (D2) will light. Move your hand up and down over the photosensitive resistor (RP) and the frequency changes. Decreasing the light on the photosensitive resistor increases the resistance and causes the circuit to oscillate at a lower frequency. Notice that the LED flashes also at the same frequency as the sound.

By using your finger, see if you can vary the sounds enough to make this circuit sound like an organ playing.

Project #112

Electronic Cicada

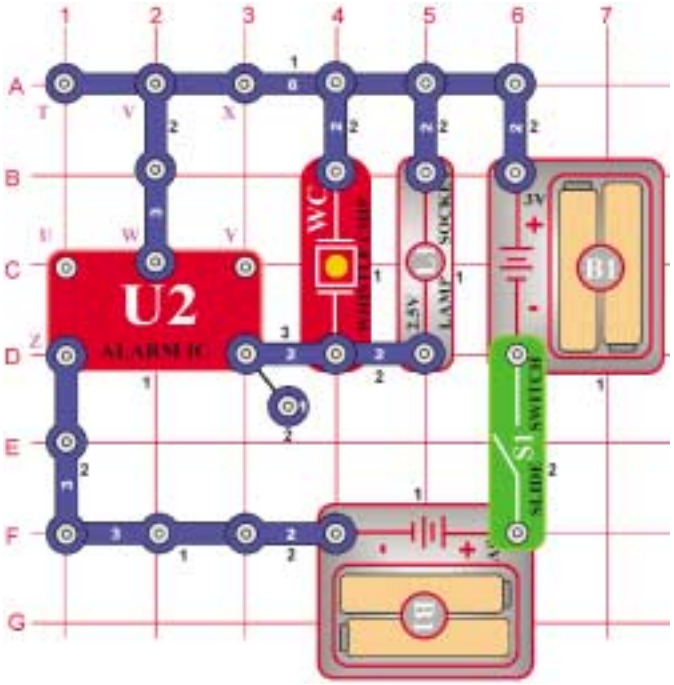
OBJECTIVE: To show how capacitors in parallel

Use the circuit from Project 110 shown above, replace the photosensitive resistor (RP) back to the 100kΩ (R5) resistor. Place the 0.02µF (C1) on top of the whistle chip (WC). Place the slide switch (S1) on and adjust the resistor (RV). The circuit produces the sound of the cicada insect. By placing the 0.02µF on top of the whistle chip, the circuit oscillates at a lower frequency. Notice that the LED flashes also at the same frequency.

It is possible to pick resistors and capacitors that will make the pitch higher than humans can hear. Many animals, however, can hear these tones. For example, a parakeet can hear tones up to 50,000 cycles per second, but a human can only hear to 20,000.

Project #113

Light & Sounds



Turn on the slide switch (S1). A police siren is heard and the lamp lights.

Project #114

More Light & Sounds

OBJECTIVE: To show a variation of the circuit in

Modify the last circuit by connecting points X and Y. The circuit works the same way but now it sounds like a machine gun.

Project #115

More Light & Sounds (II)

OBJECTIVE: To show a variation of the circuit in

Now remove the connection between X and Y and then make a connection between T and U. Now it sounds like a fire engine.

Project #116

More Light & Sounds (III)

OBJECTIVE: To show a variation of the circuit in

Now remove the connection between T and U and then make a connection between U and Z. Now it sounds like an ambulance.

Project #117

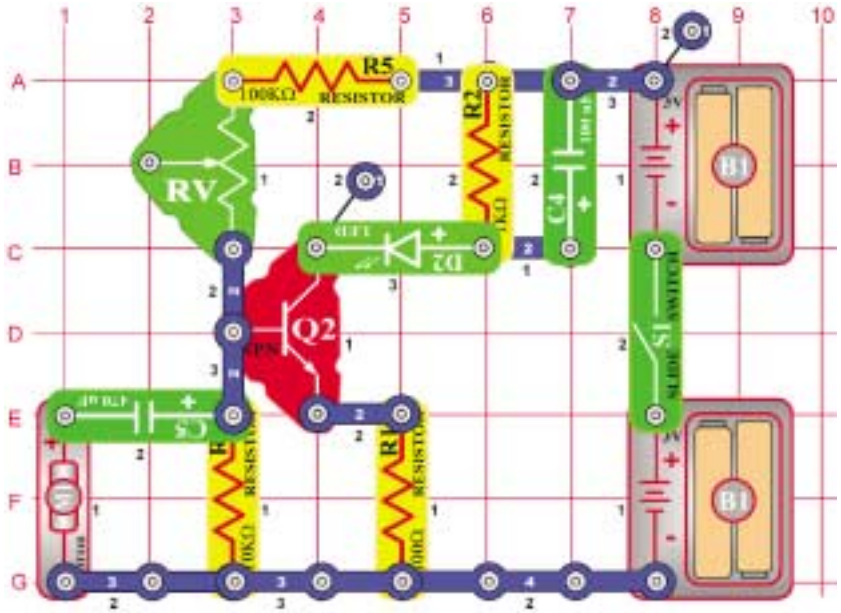
More Light & Sounds (IV)

OBJECTIVE: To show a variation of the circuit in

Now remove the connections between U and Z and between V and W, then make a connection between T and U. Now it sounds like a water faucet.

Project #118

Motor Speed Detector



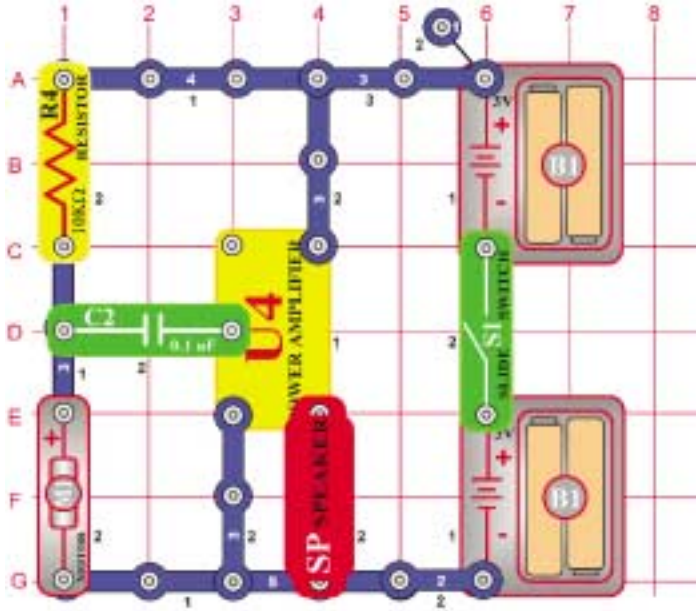
OBJECTIVE: To show how to make electricity in one

When building the circuit, be sure to position the motor with the positive (+) side snapped to the 470µF capacitor (C5). Turn on the slide switch (S1), nothing will happen. It is a motor speed detector, and the motor isn't moving. Watch the LED (D2) and give the motor a good spin CLOCKWISE with your fingers (don't use the fan blade); you should see a flash of light. The faster you spin the motor, the brighter the flash will be. As a game, see who can make the brightest flash.

Now try spinning the motor in the opposite direction (counter-clockwise) and see how bright the flash is — it won't flash at all because the electricity it produces, flows in the wrong direction and won't activate the diode. Flip the motor around (positive (+) side snapped to the 3-snap wire) and try again. Now the diode lights only if you spin the motor counter-clockwise.

Project #119

Old-Style Typewriter

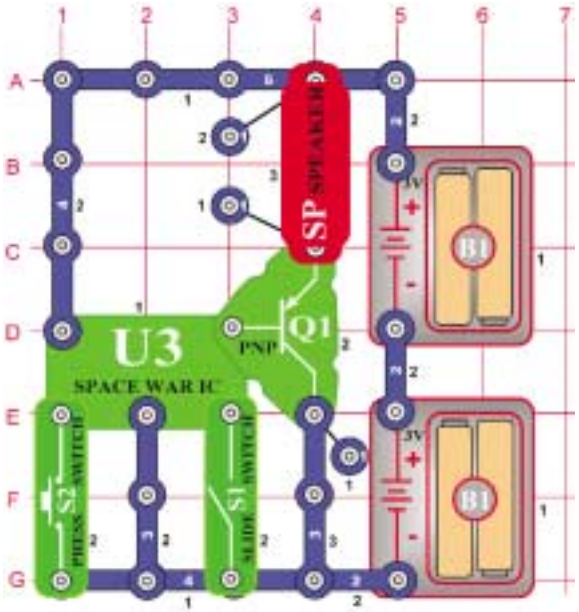


Turn on the slide switch (S1), nothing will happen. Turn the motor slowly with your fingers (don't use the fan blade), you will hear a clicking that sounds like an old-time manual typewriter keystrokes. Spin the motor faster and the clicking speeds up accordingly.

This circuit works the same if you spin the motor in either direction (unlike the Motor Speed Detector project).

By spinning the motor with your fingers, the physical effort you exert is converted into electricity. In electric power plants, steam is used to spin large motors like this, and the electricity produced is used to run everything in your town.

Project #120



Space War Sounds

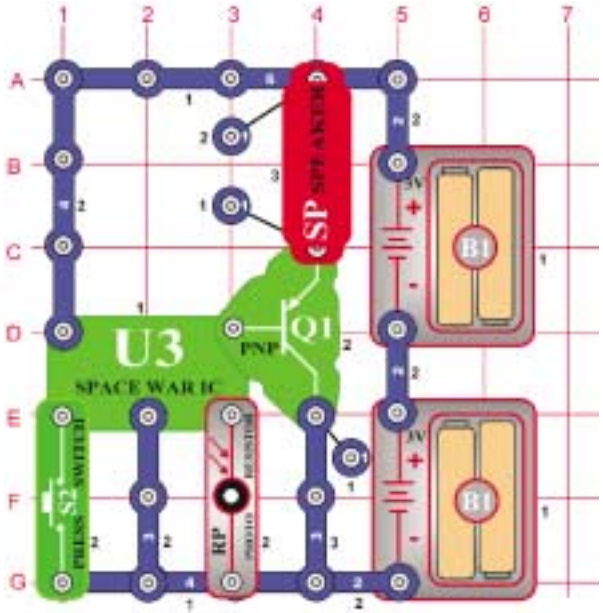
OBJECTIVE: To build a circuit that produces multiple

Set the slide switch (S1) to the OFF position. Press the press switch (S2) down and a space sound will be played. If you hold the press switch down the sound repeats. Press the press switch again and a different sound is played. Keep pressing the press switch to hear all the different sounds.

Next, set the slide switch (S1) to ON position. One of the sounds will be played continuously. Turn the switch off and then back on. A different sound is played. Keep pressing the press switch to hear all the different combinations of sounds.

The space war integrated circuit has “logic” built into its circuitry that allows it to switch between many different sounds.

Project #121



Space War Sounds Controlled By Light

OBJECTIVE: To change the sounds of a multiple space

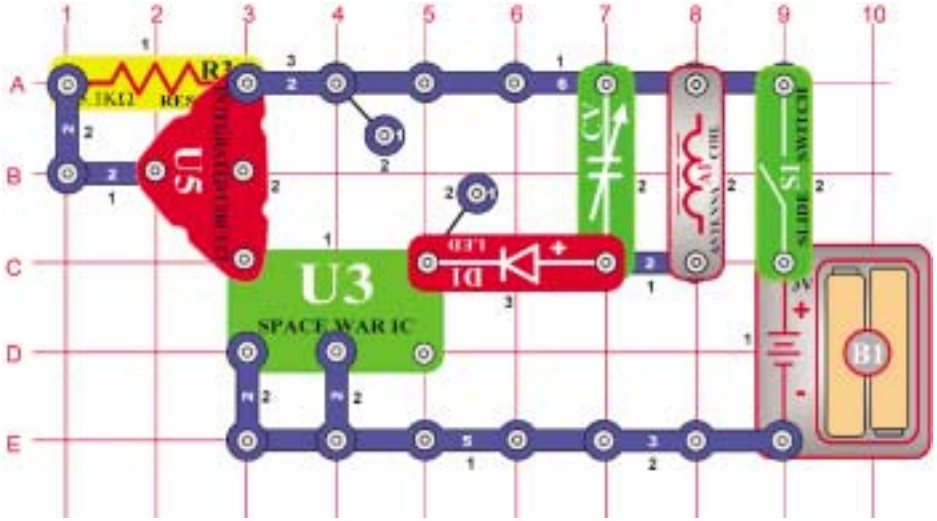
Modify the preceding circuit to look like the one shown on the left.

The space war IC (U3) will play a sound continuously. Block the light from the photosensitive resistor (RP) with your hand. The sound will stop. Remove your hand and a different sound is played. Wave your hand over the photosensitive resistor to hear all the different sounds.

Press the press switch down and now two space war sounds are played. If you hold the press switch down the sound repeats. Press the press switch again and a different sound is played. Keep pressing the press switch to hear all the different combinations of sounds.

Project #122

Space War Radio



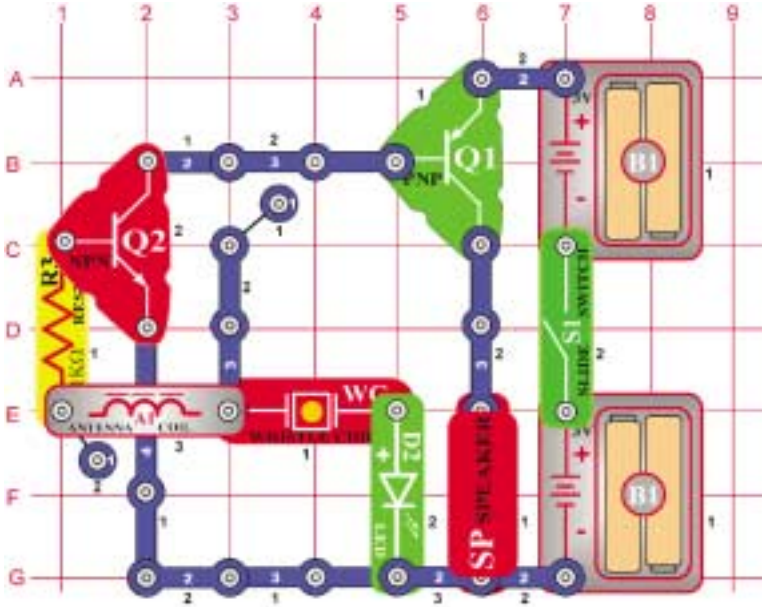
OBJECTIVE: To transmit Space War sounds to a AM

Place the circuit next to an AM radio. Tune the radio so no stations are heard and turn on the slide switch (S1). You should hear the space war sounds on the radio. The red LED should also be lit. Adjust the variable capacitor (CV) for the loudest signal.

You have just performed the experiment that took Marconi (who invented the radio) a lifetime to invent. The technology of radio transmission has expanded to the point that we take it for granted. There was a time, however, when news was only spread by word of mouth.

Project #123

The Lie Detector



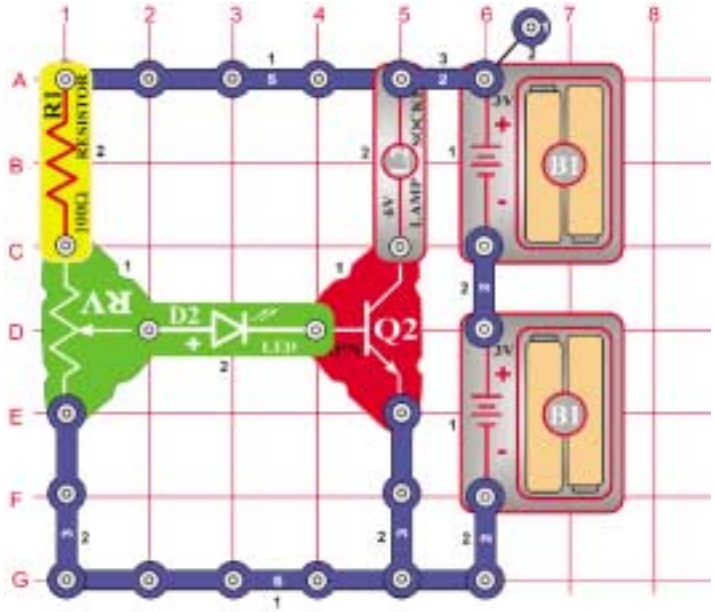
OBJECTIVE: To show how sweat makes a better

Turn on the slide switch (S1) and place your finger across point A and B. The speaker will output a tone and the LED will flash at the same frequency. Your finger acts as a conductor connecting points A and B. When a person is lying, one thing the body starts to do is sweat. The sweat makes the finger a better conductor by reducing its resistance.

As the resistance drops, the frequency of the tone increases. Lightly wet your finger and place it across the two points again. Both the output tone and LED flashing frequency increase. Now change the wetness of your finger by drying it and see how it affects the circuit. This is the same principle used in lie detectors that are sold commercially.

Project #124

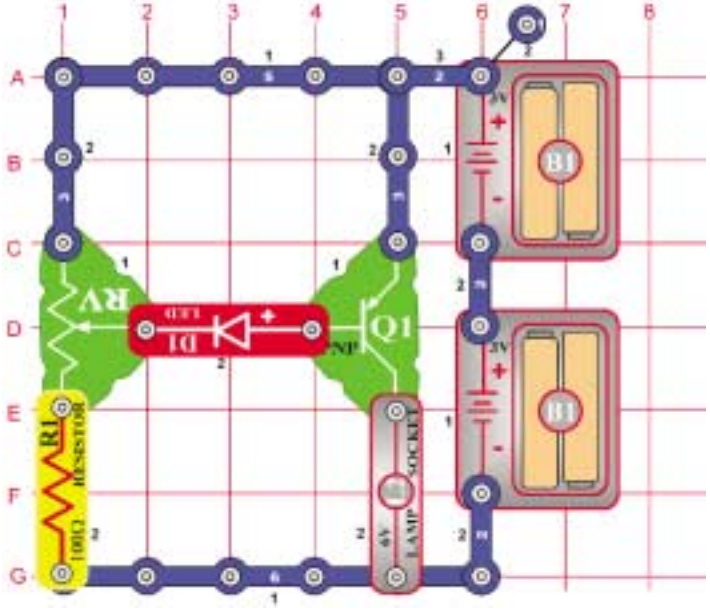
NPN Amplifier



There are three connection points on an NPN transistor, called base (marked B), emitter (marked E), and collector (marked C). When a small electric current flows from the base to the emitter, a larger (*amplified*) current will flow from the collector to the emitter. Build the circuit and slowly move up the adjustable resistor control. When the LED becomes bright, the lamp will also turn on and will be much brighter.

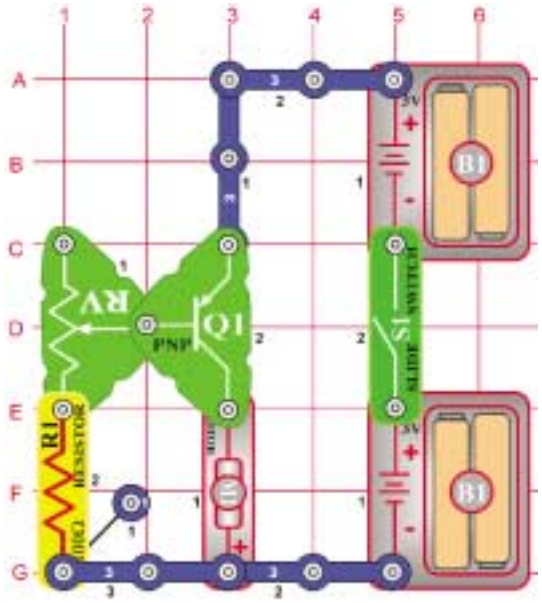
Project #125

PNP Amplifier



The PNP transistor is similar to the NPN transistor in Project 166 except that the electric currents flow in the opposite directions. When a small electric current flows from the emitter to the base, a larger (*amplified*) current will flow from the emitter to the collector. Build the circuit and slowly move up the adjustable resistor control. When the LED becomes bright, the lamp will also turn on and will be much brighter.

Project #126 Sucking Fan



Build the circuit, and be sure to orient the motor with the positive (+) side down as shown. Turn it on, and set the adjustable resistor for the fan speed you like best. If you set the speed too fast then the fan may fly off the motor. Due to the shape of the fan blades and the direction the motor spins, air is sucked into the fan and towards the motor. Try holding a piece of paper just above the fan to prove this. If this suction is strong enough then it can lift the fan blades, just like in a helicopter.

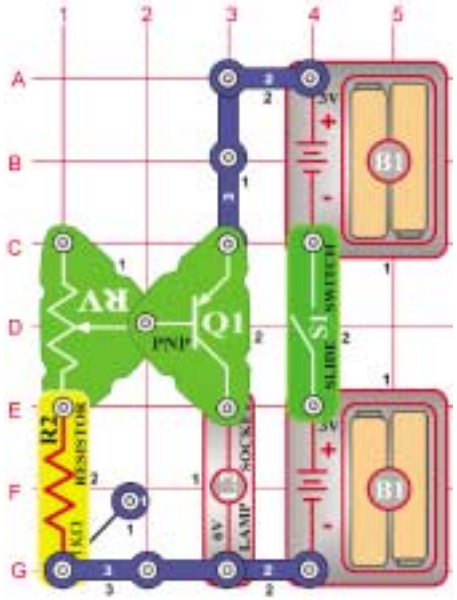
The fan will not move on all settings of the resistor, because the resistance is too high to overcome friction in the motor.

Project #127 Blowing Fan

OBJECTIVE: To build a fan

Modify the circuit from Project 126 by reversing the position of the motor (so the positive (+) side is towards the PNP (Q1). Turn it on, and set the adjustable resistor for the fan speed you like best. Set it for full speed and see if the fan flies off - it won't! The fan is blowing air upward now! Try holding a piece of paper just above the fan to prove this.

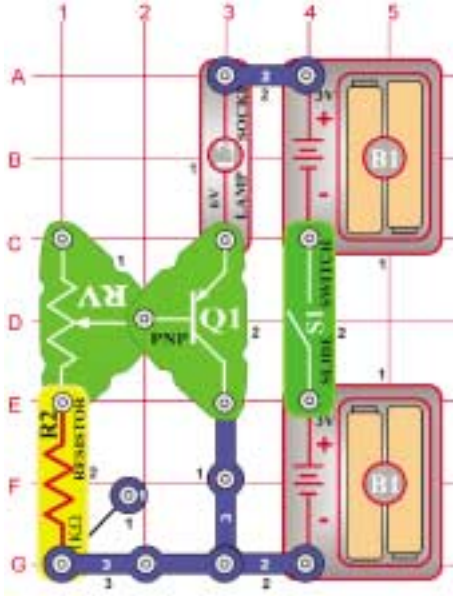
Project #128 PNP Collector



OBJECTIVE: To demonstrate adjusting the gain of a transistor

Build the circuit and vary the lamp brightness with the adjustable resistor, it will be off for most of the resistor's range. The point on the PNP that the lamp is connected to (point E4 on the base grid) is called the collector, hence the name for this project.

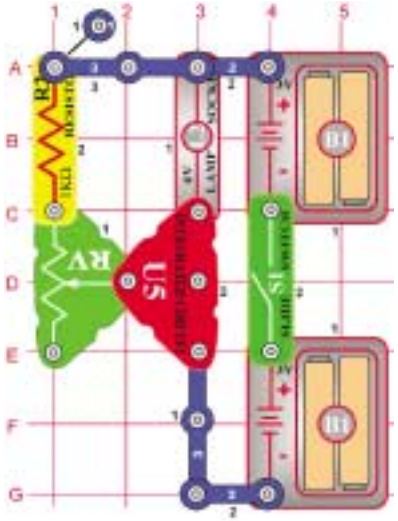
Project #129 PNP Emitter



OBJECTIVE: To compare

Compare this circuit to that in Project 128. The maximum lamp brightness is less here because the lamp resistance reduces the emitter-base current, which contacts the emitter-collector current (as per Project 25). The point on the PNP that the lamp is now connected to (grid point C4) is called the emitter.

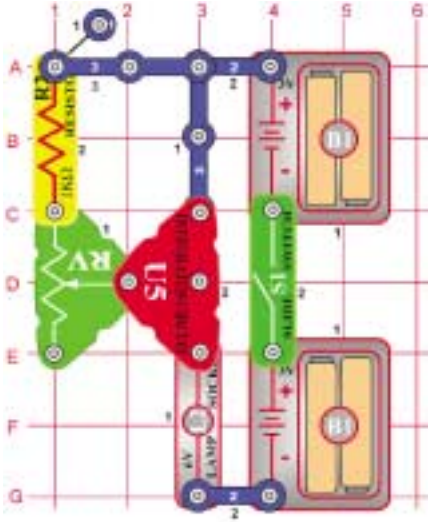
Project #130
NPN Collector



OBJECTIVE: To compare

Compare this circuit to that in Project 128, it is the NPN transistor version and works the same way. Which circuit makes the lamp brighter? (They are about the same because both transistors are made from the same materials).

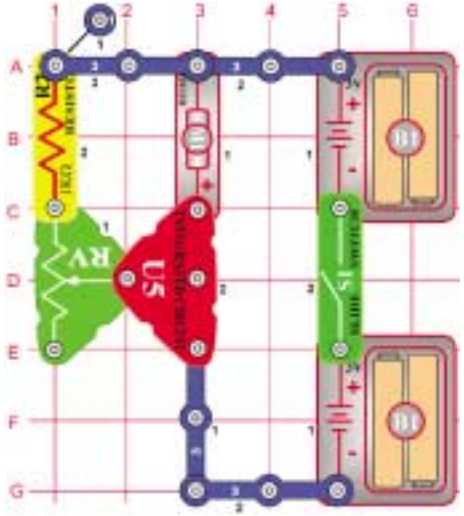
Project #131
NPN Emitter



OBJECTIVE: To compare

Compare this circuit to that in Project 129. It is the NPN transistor version and works the same way. The same principles apply here as in Projects 128-130, so you should expect it to be less bright than 130 but as bright as 129.

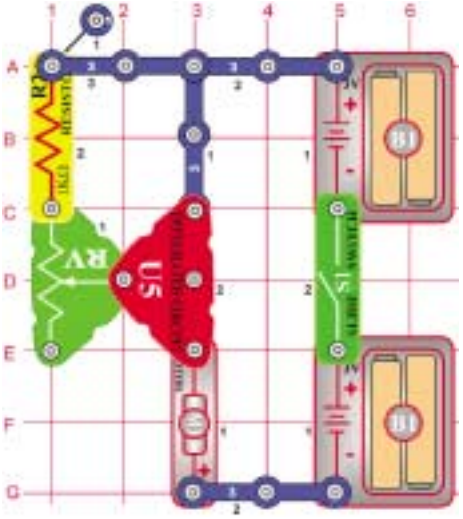
Project #132
NPN Collector - Motor



OBJECTIVE: To compare

This is the same circuit as in Project 130, except that it has the motor (M1) instead of the lamp. Place the motor with the positive (+) side touching the NPN and put the fan on it.

Project #133
NPN Emitter - Motor

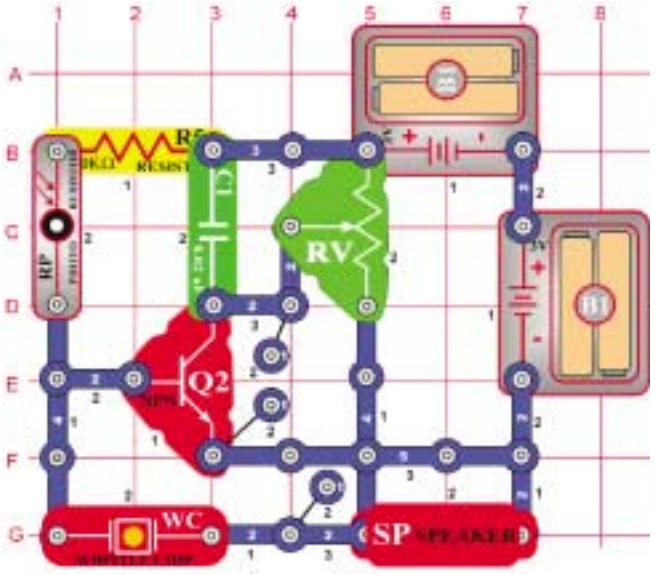


OBJECTIVE: To compare

This is the same circuit as in Project 131, except that it has the motor (M1) instead of the lamp. Place the motor with the positive (+) side down and put the fan on it. Compare the fan speed to that in Project 132. Just as the lamp was dimmer in the emitter configuration, the motor is not as fast now.

Project #134

Buzzing in the Dark



OBJECTIVE: To make a circuit

This circuit makes a high-frequency screaming sound when light shines on the photosensitive resistor, and makes a buzzing sound when you shield the photosensitive resistor.

Project #135

Touch Buzzer

OBJECTIVE: To build a human

Remove the photosensitive resistor (RP) from the circuit in Project 134 and instead touch your fingers across where it used to be (points B1 and D1 on the grid) to hear a cute buzzing sound.
The circuit works because of the resistance in your body. If you put back the photosensitive resistor and partially cover it, you should be able to make the same resistance your body did, and get the same sound.

Project #136

High Frequency Touch Buzzer

OBJECTIVE: To build a high

Replace the speaker (SP) with the 6V Lamp (L2). Now touching your fingers between B1 and D1 creates a quieter but more pleasant buzzing sound.

Project #137

High Frequency Water Buzzer

OBJECTIVE: To build a high

Now connect two (2) jumpers to points B1 and D1 (that you were touching with your fingers) and place the loose ends into a cup of water. The sound will not be much different now, because your body is mostly water and so the circuit resistance has not changed much.

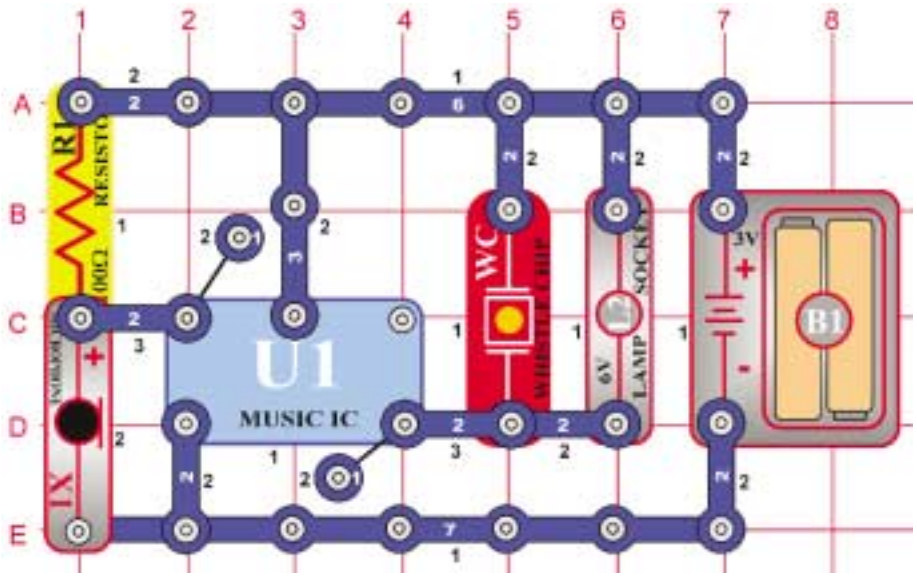
Project #138

Mosquito

OBJECTIVE: To make a buzz like a

Place the photosensitive resistor (RP) into the circuit in Project 137 across where you were connecting the jumpers (points B1 and D1 on the grid, and as shown in Project 134). Now the buzz sounds like a mosquito.

Project #139



High Sensitivity Voice Doorbell

OBJECTIVE: To build a highly sensitive voice-

Build the circuit and wait until the sound stops. Clap or talk loud a few feet away and the music plays again. The microphone (X1) is used here because it is very sensitive.

Project #140

Louder Doorbell

OBJECTIVE: To build a loud highly sensitive voice-

Replace the 6V lamp (L2) with the antenna coil (A1), the sound is louder now.

Project #141

Very Loud Doorbell

OBJECTIVE: To build a very loud highly sensitive

Replace the antenna coil (A1) with the speaker (SP), the sound is much louder now.

Project #142

Doorbell with Button

OBJECTIVE: To build a

Replace the microphone (X1) with the press switch (S2) and wait until the music stops. Now you have to press the slide switch (S1) to activate the music, just like the doorbell on your house.

Project #143

Darkness Announcer

OBJECTIVE: To play

Replace the press switch (S2) with the photosensitive resistor (RP) and wait until the sound stops. If you cover the photosensitive resistor now the music will play once, signaling that it has gotten dark. If the speaker (SP) is too loud then you may replace it with the antenna coil (A1).

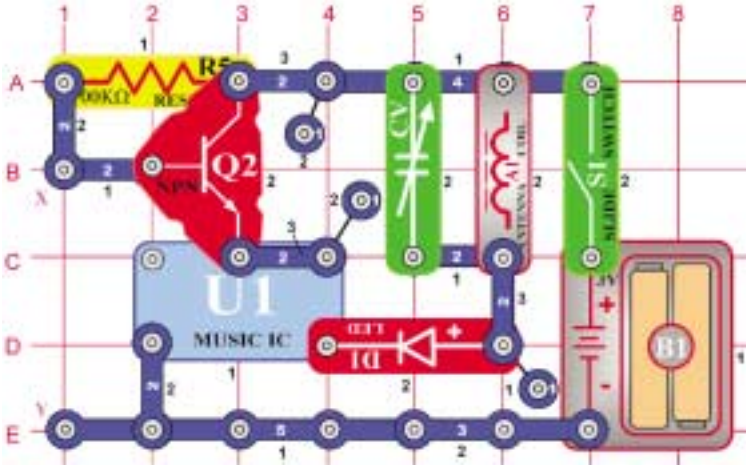
Project #144

Musical Motion Detector

OBJECTIVE: To detect when someone spins the

Replace the photosensitive resistor (RP) with the motor (M1), oriented in either direction. Now spinning the motor will re-activate the music.

Project #145 Radio Music Alarm



OBJECTIVE: To build a radio music

You need an AM radio for this project. Build the circuit on the left and turn on the switch. Place it next to your AM radio and tune the radio frequency to where no other station is transmitting. Then, tune the adjustable capacitor (CV) until your music sounds best on the radio. Now connect a jumper wire between X and Y on the drawing, the music stops.

If you remove the jumper now, the music will play indicating your alarm wire has been triggered. You could use a longer wire and wrap it around a bike, and use it as a burglar alarm!

Project #146 Daylight Music Radio

OBJECTIVE: To build a light-controlled radio

Remove the jumper wire. Replace the 100kΩ resistor (R5) with the photosensitive resistor (RP). Now your AM radio will play music as long as there is light in the room.

Project #147 Night Music Radio

OBJECTIVE: To build a dark-controlled radio

Put the 100kΩ resistor back in as before and instead connect the photosensitive resistor between X and Y (you also need a 1-snap and a 2-snap wire to do this). Now your radio plays music when it is dark.

Project #148 Night Gun Radio

OBJECTIVE: To build a dark-controlled radio

Replace the music IC (U1) with the alarm IC (U2). Now your radio plays the sound of a machine gun when it is dark.

Project #149 Radio Gun Alarm

OBJECTIVE: To build a

Remove the photosensitive resistor. Now connect a jumper wire between X and Y on the drawing.
If you remove the jumper now, the machine gun sound will play on the radio indicating your alarm wire has been triggered.

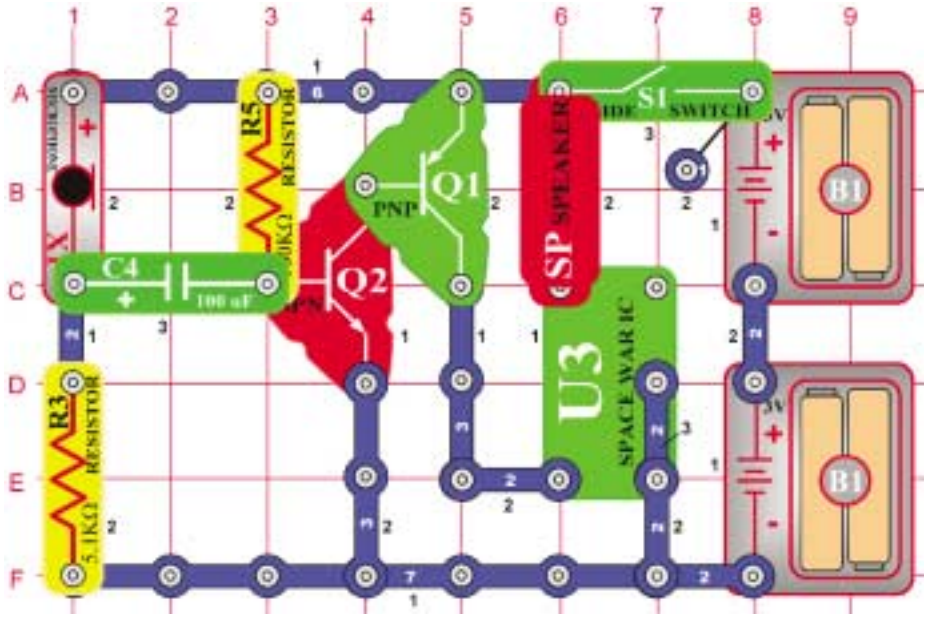
Project #150 Daylight Gun Radio

OBJECTIVE: To build a light-controlled radio

Remove the jumper wire. Replace the 100kΩ resistor (R5) with the photosensitive resistor (RP). Now your AM radio will play the machine gun sound as long as there is light in the room.

Project #151

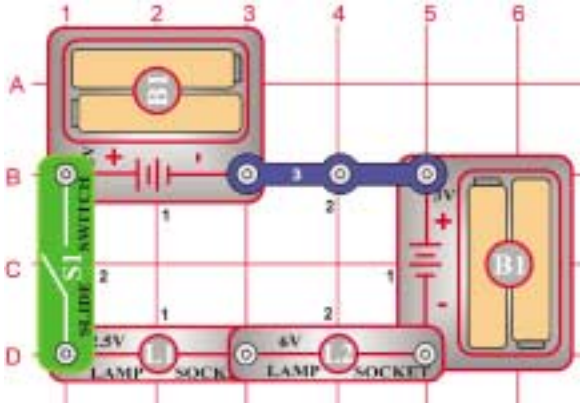
Blow Off a Space War



Build the circuit and turn it on, you hear a space war. Since it is loud and annoying, try to shut it off by blowing into the microphone (X1). Blowing hard into the microphone stops the sound, and then it starts again.

Project #152

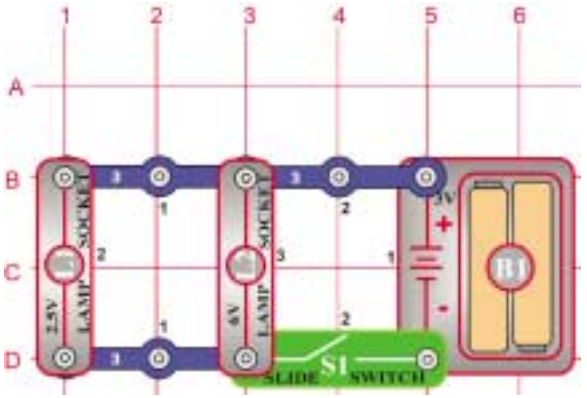
Series Lamps



Turn on the slide switch (S1) and both lamps will light. If one of the bulbs is broken then neither will be on, because the lamps are in series. An example of this is the strings of small Christmas lights; if one bulb is damaged then the entire string does not work.

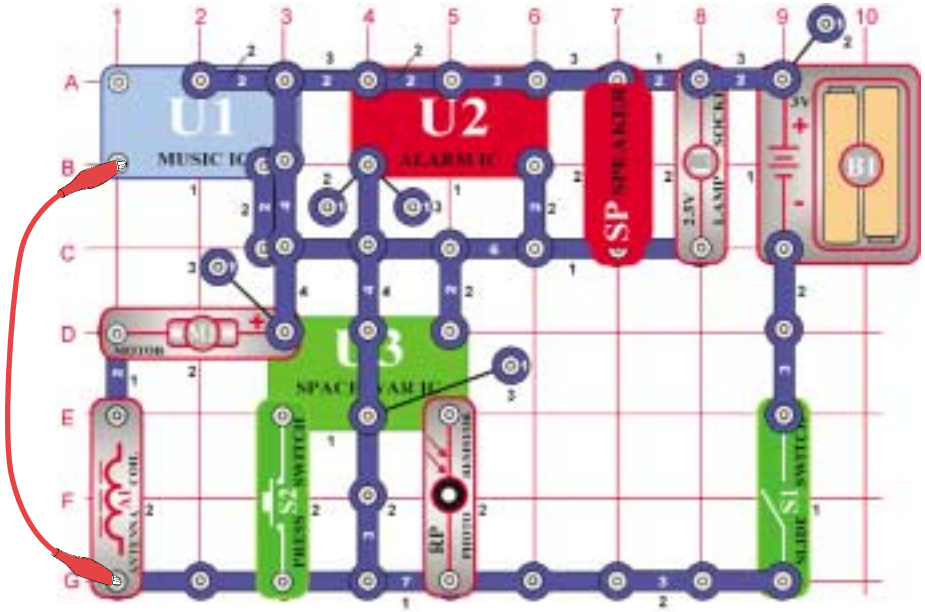
Project #153

Parallel Lamps



Turn on the slide switch (S1) and both lamps will light. If one of the bulbs is broken then the other will still be on, because the lamps are in parallel. An example of this is most of the lights in your house; if a bulb is broken on one lamp then the other lamps are not affected.

Project #154 Fire Fan Symphony



OBJECTIVE: ***To combine sounds from the music, alarm,***

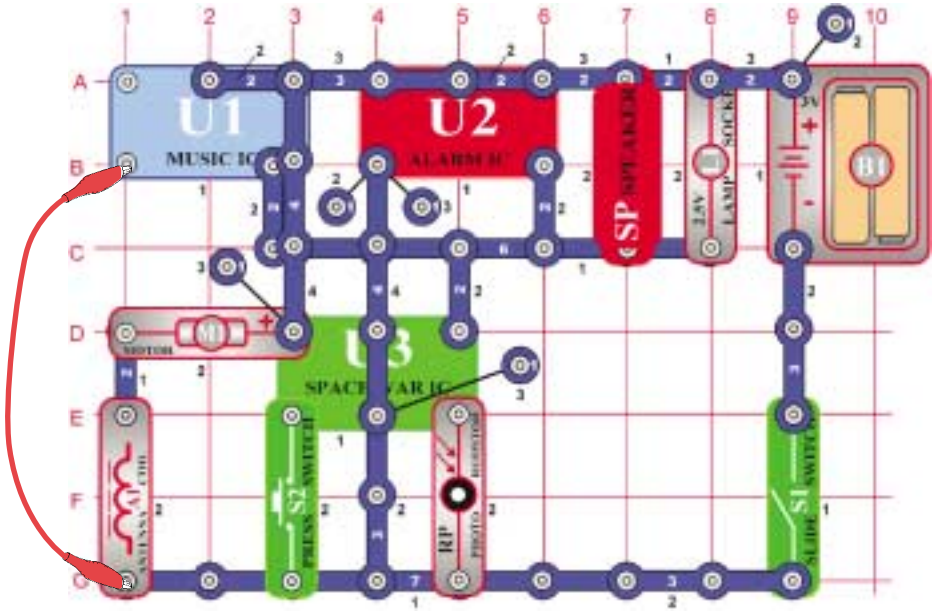
Build the circuit shown and add the jumper to complete it. Note that in one place two (2) single snaps are stacked on top of each other. Also, note that there is a 2-snap wire on layer 2 that does not connect with a 4-snap wire that runs over it on layer 4 (both touch the music IC). Turn it on and press the press switch (S2) several times and wave your hand over the photosensitive resistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

Project #155 Fire Fan Symphony (II)

OBJECTIVE:

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #156 Fan Symphony



OBJECTIVE: ***To combine sounds from the music, alarm,***

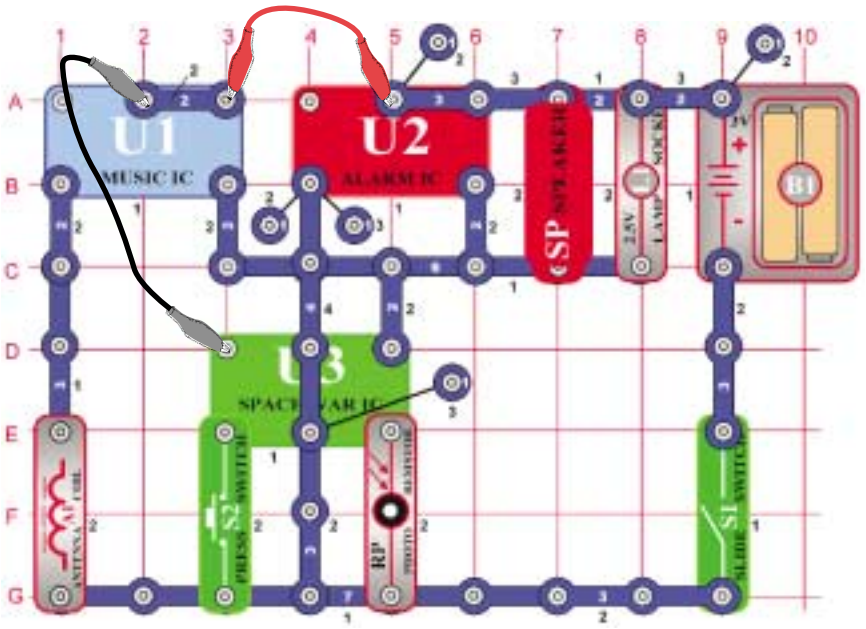
Modify the circuit from Project 154 to match the circuit shown on the left. The only differences are the connections around the alarm IC. It works the same way.

Project #157 Fan Symphony (II)

OBJECTIVE:

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #158 Police Car Symphony



OBJECTIVE: To combine sounds from the integrated

Build the circuit shown and add the two (2) jumper wires to complete it. Note that in one place two (2) single snaps are stacked on top of each other. Turn it on and press the press switch (S2) several times and wave your hand over the photosensitive resistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

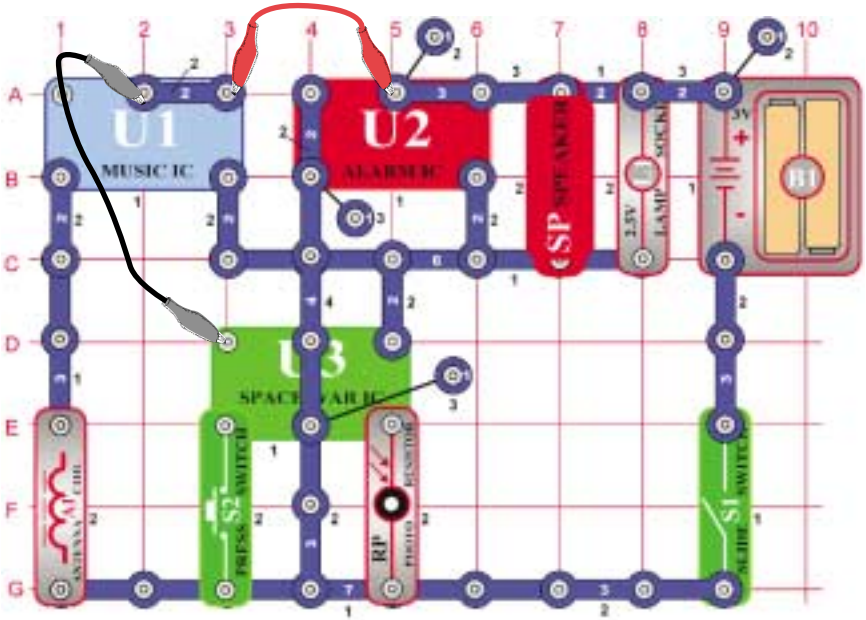
Do you know why the antenna (A1) is used in this circuit? It is being used as just a 3-snap wire, because it acts like an ordinary wire in low frequency circuits such as this. Without it, you don't have enough parts to build this complex circuit.

Project #159 Police Car Symphony (II)

OBJECTIVE:

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #160 Ambulance Symphony



OBJECTIVE: To combine sounds from the music, alarm,

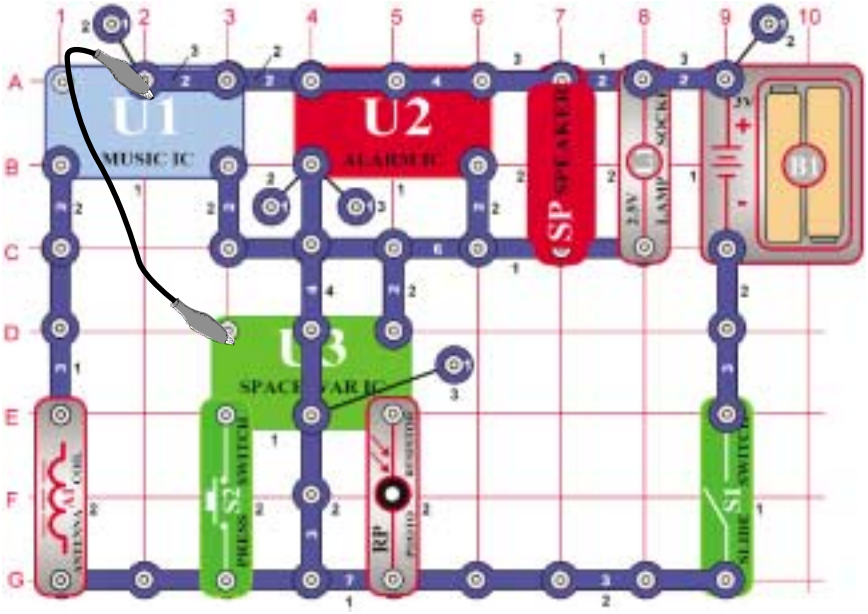
Modify the circuit from Project 158 to match the circuit shown on the left. The only differences are the connections around the alarm IC. It works the same way.

Project #161 Ambulance Symphony (II)

OBJECTIVE:

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Project #162 Static Symphony



OBJECTIVE: To combine sounds from the integrated

Build the circuit shown and add the jumper wire to complete it. Note that in one place 2 single snaps are stacked on top of each other. Turn it on and press the press switch several times and wave your hand over the photosensitive resistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

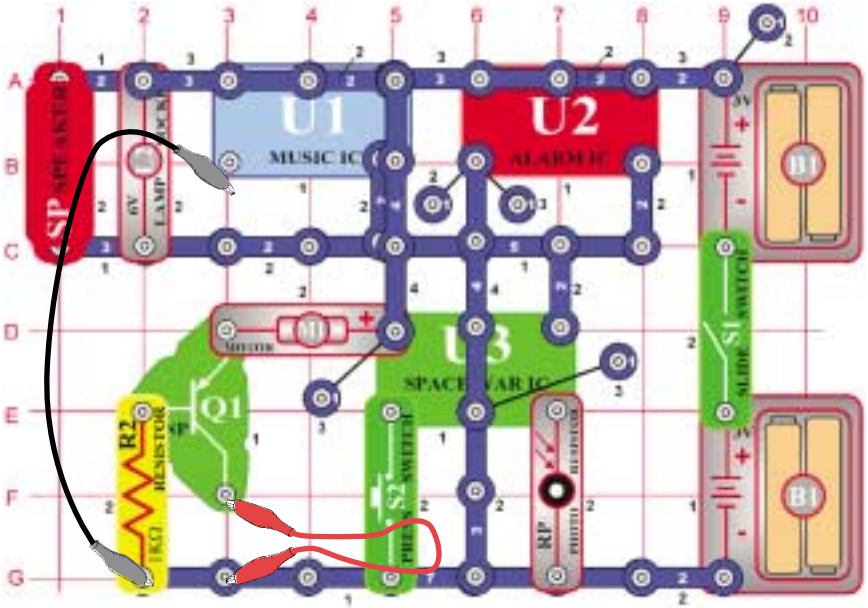
Project #163 Static Symphony (II)

OBJECTIVE: See Project

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Do you know why the antenna (A1) is used in this circuit? It is being used as just a 3-snap wire, because it acts like an ordinary wire in low frequency circuits such as this. Without it you don't have enough parts to build this complex circuit.

Project #164 High-Power Symphony



OBJECTIVE: To combine sounds from the music, alarm,

Build the circuit shown and place the fan on the motor. Be sure to use the 6V lamp, not the 2.5V one. Also, note that there is a 2-snap wire on layer 2 that does not connect with a 4-snap wire that runs over it on layer 4 (both touch the music IC). Turn it on and press the press switch (S2) several times and wave your hand over the photosensitive resistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

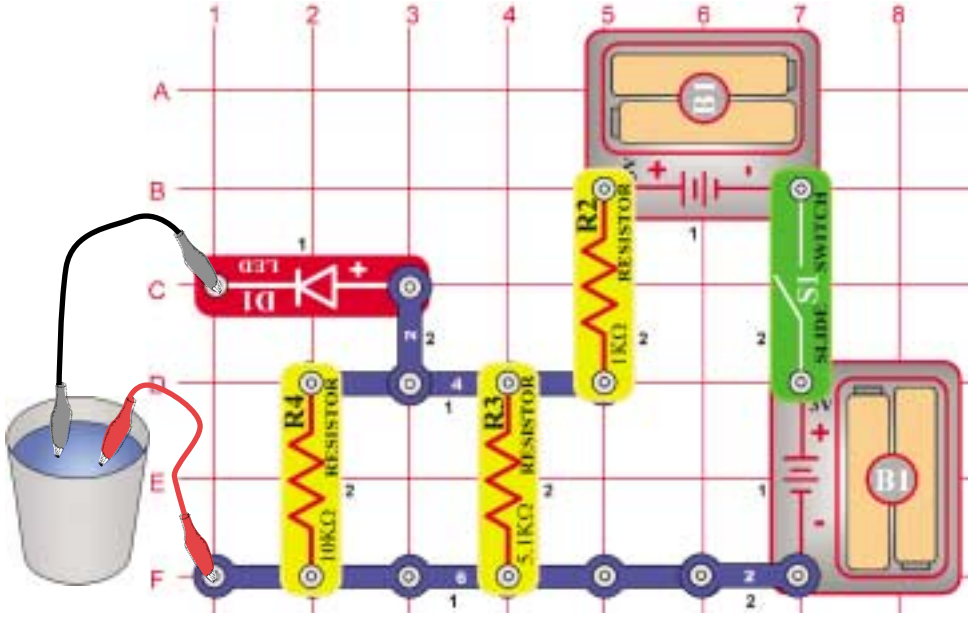
Project #165 High-Power Symphony (II)

OBJECTIVE: See Project

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC). In some cases, the fan may now be louder than the sound, so disconnect the jumper from F3 to G3 if desired.

Project #166

Water Detector



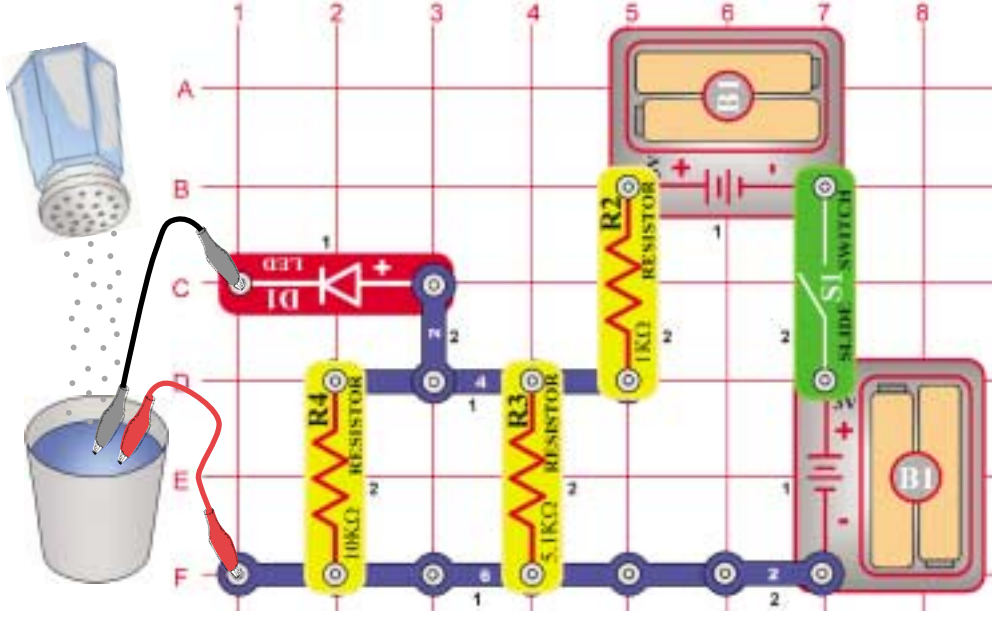
Build the circuit at left and connect the two jumpers to it, but leave the loose ends of the jumpers lying on the table initially. Turn on the switch - the LED (D1) will be dark because the air separating the jumpers has very high resistance. Touch the loose jumper ends to each other and the LED will be bright, because with a direct connection there is no resistance separating the jumpers.

Now take the loose ends of the jumpers and place them in a cup of water, without letting them touch each other. The LED should be dimly lit, indicating you have detected water!

For this experiment, your LED brightness may vary depending upon your local water supply. Pure water (like distilled water) has very high resistance, but drinking water has impurities mixed in that increase electrical conduction.

Project #167

Salt-Water Detector

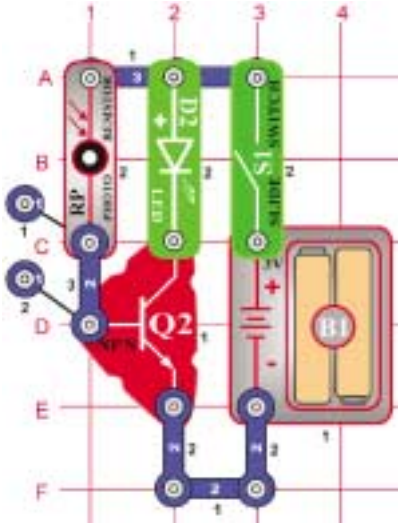


OBJECTIVE: ***To show how adding salt to water***

Place the jumpers in a cup of water as in the preceding project; the LED (D1) should be dimly lit. Slowly add salt to the water and see how the LED brightness changes, mix it a little so it dissolves. It will slowly become very bright as you add more salt. You can use this bright LED condition as a salt-water detector! You can then reduce the LED brightness by adding more water to dilute the salt.

Take another cup of water and try adding other household substances like sugar to see if they increase the LED brightness as the salt did.

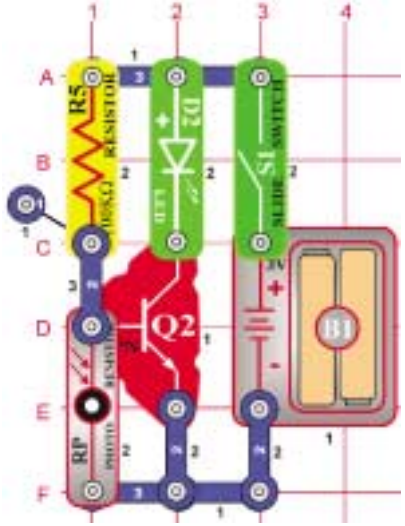
Project #168
NPN Light Control



OBJECTIVE: To compare

Put on the switch, the brightness of the LED depends on how much light shines on the photosensitive resistor. The resistance drops as more light shines, allowing more current to the NPN.

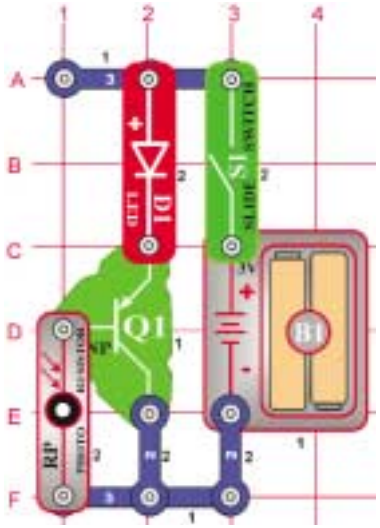
Project #169
NPN Dark Control



OBJECTIVE: To compare

Put on the switch, the brightness of the LED depends on how LITTLE light shines on the photosensitive resistor. The resistance drops as more light shines, diverting current away from the NPN.

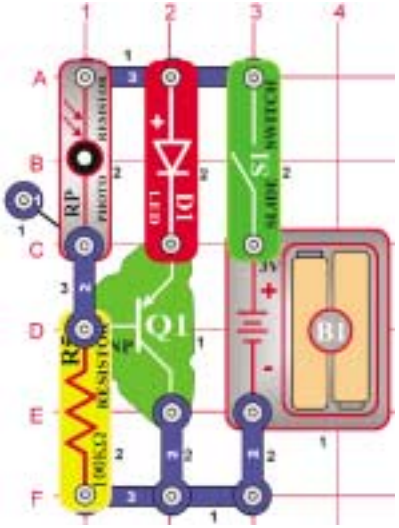
Project #170
PNP Light Control



OBJECTIVE: To compare

Put on the switch, the brightness of the LED depends on how much light shines on the photosensitive resistor. The resistance drops as more light shines, allowing more current through the PNP. This is similar to the NPN circuit above.

Project #171
PNP Dark Control

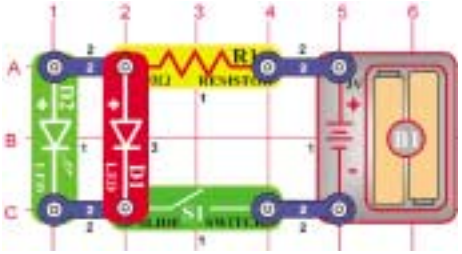


OBJECTIVE: To compare

Put on the switch, the brightness of the LED depends on how LITTLE light shines on the photosensitive resistor. The resistance drops as more light shines, so more current gets to the 100kΩ resistor from the photosensitive resistor path and less from the PNP-diode path. This is similar to the NPN circuit above.

Project #172
Red & Green

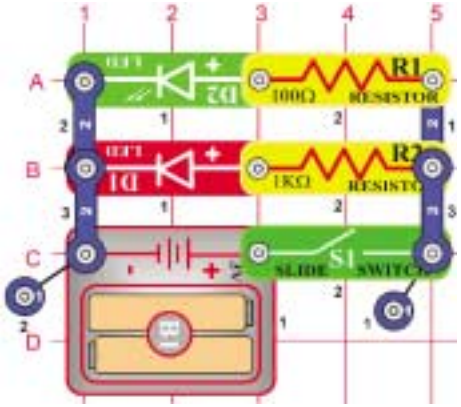
OBJECTIVE: To compare



Put on the switch and both LEDs will be on and equally bright. This is because the diodes are in *parallel*, and the electric current divides equally between them.

Project #173
Current Limiters

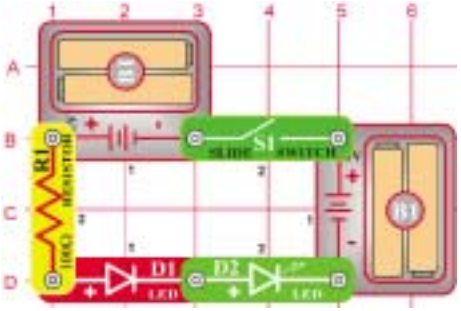
OBJECTIVE: To compare



Put on the switch and notice the difference in brightness between the two LEDs, this comes from the difference of their in-series resistance. The smaller the resistance, the stronger the electric current that is allowed to pass through. This is how resistance limits the current.

Project #174
Current Equalizing

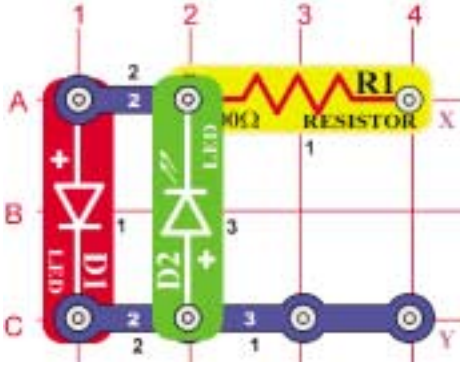
OBJECTIVE: To compare



Put on the switch and the two LEDs will have the same brightness. When connected in *series*, all components will have equal electric current through them.

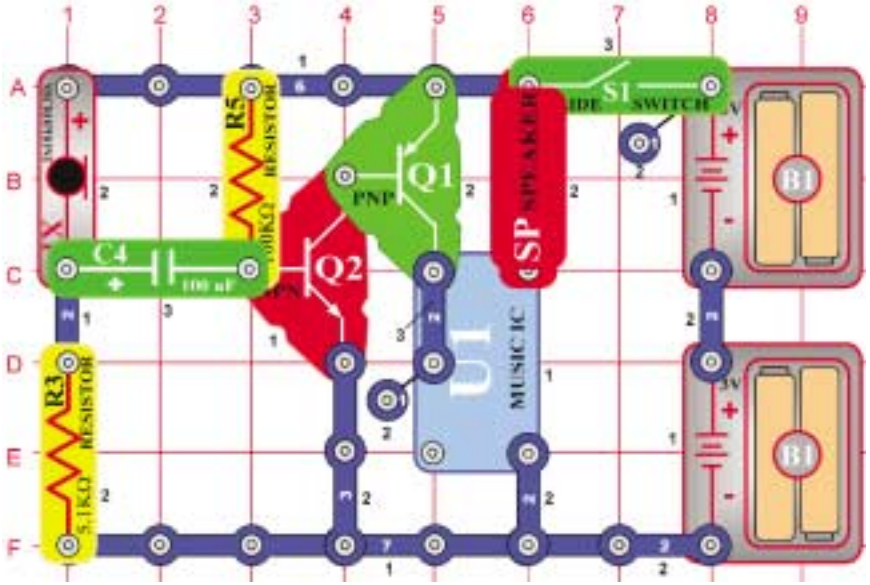
Project #175
Battery Polarity Tester

OBJECTIVE: To test the



Use this circuit to check the polarity of a battery. Connect your battery to X and Y on the drawing using the jumper cables (your 3V battery pack (B1) can also be snapped on directly instead). If the positive (+) side of your battery is connected to X, then the red LED will be on, if the negative (–) side is connected to X then the green diode will be on.

Project #176 Blow Off a Doorbell



OBJECTIVE: To turn off a

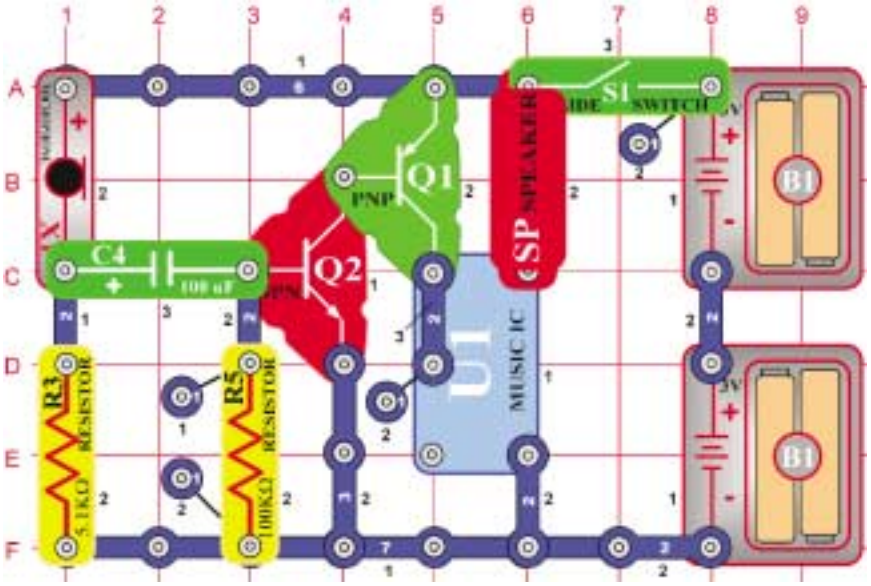
Build the circuit and turn it on, music plays. Since it is loud and annoying, try to shut it off by blowing into the microphone (X1). Blowing hard into the microphone stops the music, and then it starts again.

Project #177 Blow Off a Candle

OBJECTIVE: To turn off a

Replace the speaker (SP) with the light emitting diode (D1), with the positive (+) side on top. Blowing hard into the microphone stops the turns off the light briefly, and then it comes on again.

Project #178 Blow On a Doorbell



OBJECTIVE: To turn on a

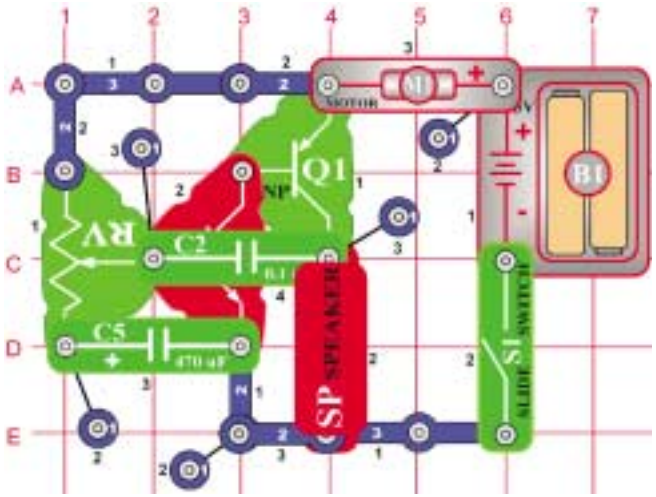
Build the circuit and turn it on, music plays for a few moments and then stops. Blow into the microphone (X1) and it plays; it plays as long as you keep blowing.

Project #179 Blow On a Candle

OBJECTIVE: To turn on a

Replace the speaker (SP) with the LED (D1), with the positive (+) side on top. Blowing into the microphone turns on the light, and then it goes off again.

Project #180 Screaming Fan



OBJECTIVE: To have an adjustable resistance control a

Build the circuit on the left; note that the 0.1µF capacitor (C2) is above the NPN (Q2). Turn on the switch and move the setting on the adjustable resistor across its range. You hear screaming sounds and the fan spins.

Project #181 Whining Fan

OBJECTIVE: To make different

Replace the 0.1µF capacitor (C2) with the 0.02µF capacitor (C1). The sounds are now a high-pitch whine and the motor starts a little sooner.

Project #182 Light Whining

OBJECTIVE: To make different

Replace the 3-snap wire at the upper-left of the circuit (points A1 and A3 on the base grid) with the photosensitive resistor (RP), and wave your hand over it. The whining sound has changed a little and can now be controlled by light.

Project #183 More Light Whining

OBJECTIVE: To make different

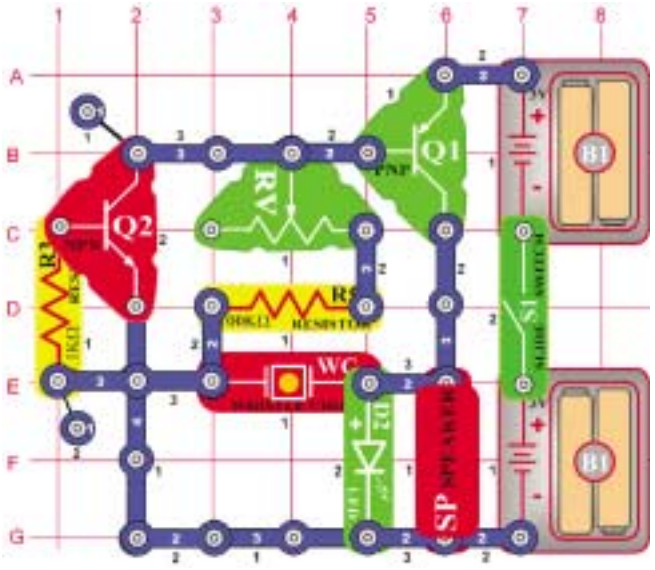
Replace the 0.02µF capacitor (C1) with the 0.1µF capacitor (C2). The sounds are lower in frequency and you can't make the fan spin now.

Project #184 Motor That Won't Start

OBJECTIVE: To make different

Replace the 0.1µF capacitor (C2) with the 10µF capacitor (C3), put the positive (+) side towards the left). It now makes clicking sounds and the fan moves only in small bursts, like a motor that won't start.

Project #185 Whiner



OBJECTIVE: To build a circuit

Build the circuit, turn it on, and move the setting on the adjustable resistor. It makes a loud, annoying whine sound. The green LED (D2) appears be on, but it is actually flashing at a very fast rate.

Project #186 Lower Pitch Whiner

OBJECTIVE: To show how adding

Place the 0.02µF capacitor (C1) above the whistle chip (WC) and vary the adjustable resistance again. The frequency (or pitch) of the whine has been reduced by the added capacitance and it sounds more like music now.

Project #187 Hummer

OBJECTIVE: To show how adding

Now place the 0.1µF capacitor (C2) above the whistle chip (WC) and vary the adjustable resistor again. The frequency (or pitch) of the whine has been reduced by the greater added capacitance and it sounds more like a hum now.

Project #188 Adjustable Metronome

OBJECTIVE: To build an

Now place the 10µF capacitor (C3, in either orientation) above the whistle chip (WC) and vary the adjustable resistor again. There is no hum now but instead there is a click and a flash of light repeating about once a second, like the "beat" of a sound. It is like a metronome, which is used to keep time for the rhythm of a song.

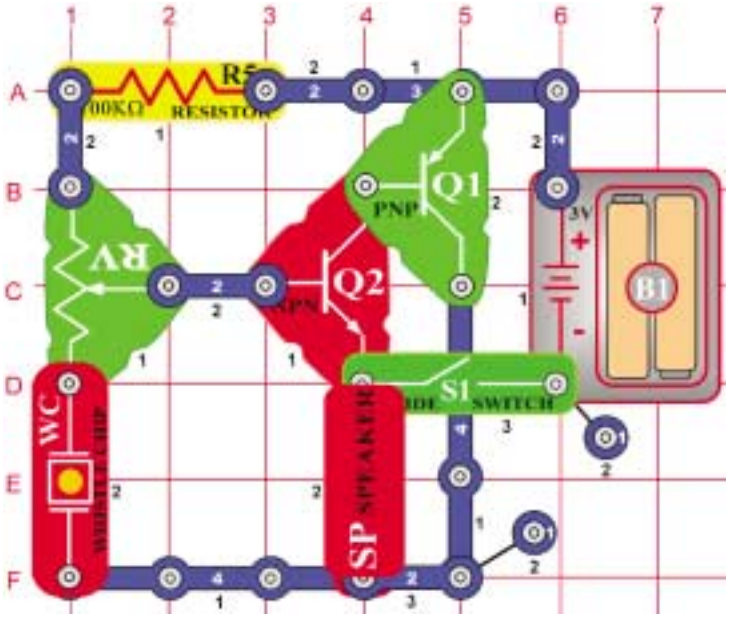
Project #189 Quiet Flasher

OBJECTIVE: To make a blinking

Leave the 10µF capacitor connected but replace the speaker (SP) with the 6V Lamp.

Project #190

Hissing Foghorn



OBJECTIVE: To build a transistor oscillator that can

Build the circuit on the left and move the adjustable resistor setting. Sometimes it will make a foghorn sound, sometimes it will make a hissing sound, and sometimes it will make no sound at all.

Project #191

Hissing & Clicking

Modify the circuit in Project 190 by replacing the 100kΩ resistor (R5) with the photosensitive resistor (RP).
Move the adjustable resistor setting until you hear hissing sounds, and then shield the photosensitive resistor while doing so and you hear clicking sounds.

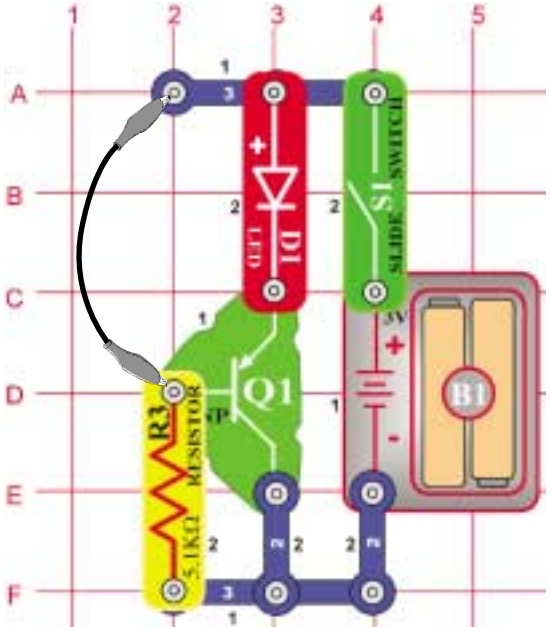
Project #192

Video Game Engine Sound

Remove the photosensitive resistor (RP) from the circuit in Project 191 and instead touch your fingers between the contacts at points A4 and B2 on the base grid while moving the adjustable resistor. You hear a clicking that sounds like the engine sound in auto-racing video games.

Project #193

Light Alarm



OBJECTIVE: To build a

Build the circuit with the jumper connected as shown, and turn it on. Nothing happens. Break the jumper connection and the light turns on. You could replace the jumper with a longer wire and run it across a doorway to signal an alarm when someone enters.

Project #194

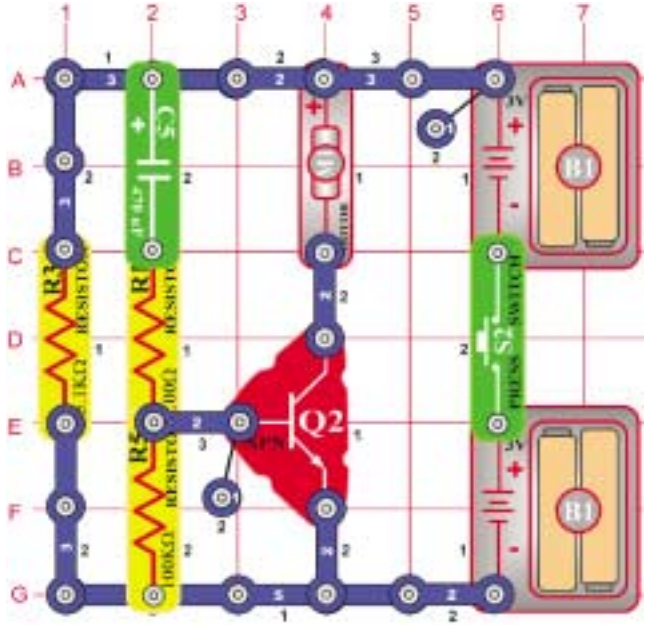
Brighter Light Alarm

OBJECTIVE: To build a

Modify the circuit in Project 193 by replacing the LED (D1) with the 2.5V lamp (L1) and replacing the 5.1kΩ resistor with the 100Ω resistor (R1). It works the same way but is brighter now.

Project #195

Lazy Fan



OBJECTIVE: To build a fan

Press the press switch (S2) and the fan will be on for a few turns. Wait a few moments and press again, and the fan will make a few more turns.

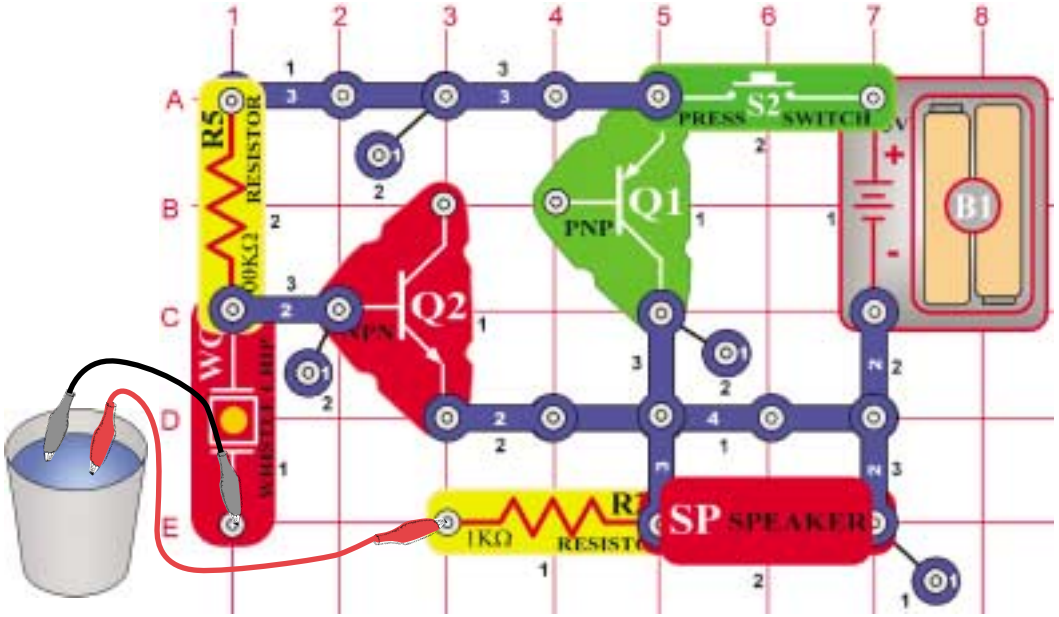
Project #196

Laser Light

OBJECTIVE: To build a simple

Replace the Motor (M1) with the 6V Lamp (L2). Now pressing the press switch (S2) creates a blast of light like a laser.

Project #197 Water Alarm



OBJECTIVE: To sound an alarm when water is detected, tone will vary with salt

Build the circuit at left and connect the two (2) jumpers to it, place the loose ends of the jumpers into an empty cup (without them touching each other). Press the press switch (S2) - nothing happens. Add some water to the cup and an alarm sound will sound. Add salt to the water and the tone changes.

You can also test different liquids and see what tone they produce.

Project #198 Drawing Resistors

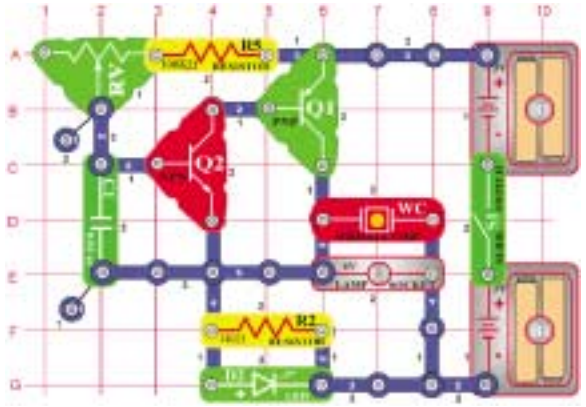
Use the circuit from Project 197, but replace the press switch (S2) with the slide switch (S1) and you don't need the cup of water. There is one more part that you need and you are going to draw it. Take a pencil (No. 2 lead is best but other types will also work). **SHARPEN IT**, and fill in the shape below. You will get better results if you place a **hard**, flat surface directly beneath this page while you are drawing. Press **hard** (but don't rip the paper), and fill in the shape **several times** to be sure you have a **thick, even layer** of pencil lead.

Turn on the switch and take the loose ends of the jumpers, press them to the shape and move them around over the drawing. The tone of the sound should have a higher pitch if the ends are farther apart in the shape. If you don't hear any sound then move the ends closer together and move over the drawing, add another layer of pencil lead, or put a drop of water on the jumper ends to get better contact.

Now you can draw your own shapes and see what kinds of sounds you can make!

Project #199

Pitch



OBJECTIVE: To show how to change the pitch

Build the circuit on the left, turn it on, and vary the adjustable resistor (RV). The *frequency* or *pitch* of the sound is changed. Pitch is the musical profession's word for frequency. If you've had music lessons, you may remember the music scale using chords such as A3, F5, and D2 to express the *pitch* of a sound. Electronics prefers the term *frequency*, as in when you adjust the frequency on your radio.

Project 200

Pitch (II)

OBJECTIVE:

Since we've seen we can adjust the frequency by varying the resistance in the adjustable resistor, are there other ways to change frequency? You can also change frequency by changing the capacitance of the circuit. Place the 0.1µF capacitor (C2) on top of the 0.02µF capacitor (C1); notice how the sound has changed.

Project 201

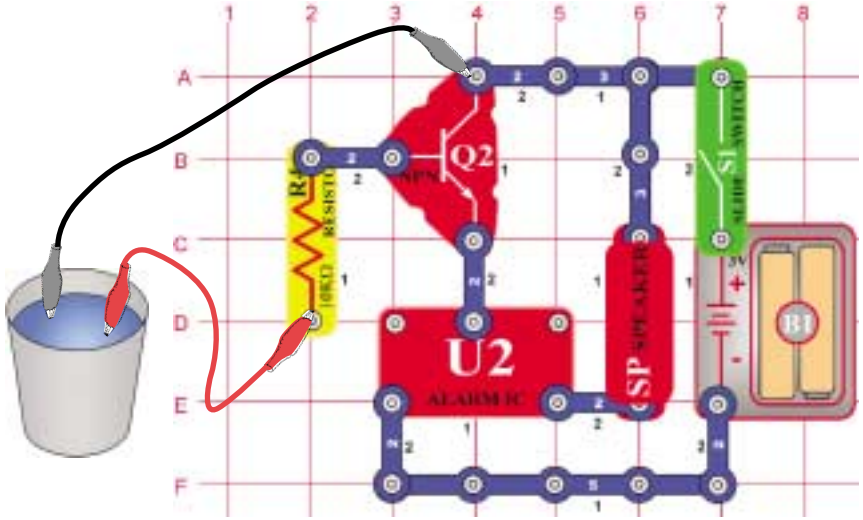
Pitch (III)

OBJECTIVE:

Remove the 0.1uF capacitor and replace the 100kΩ resistor (R5) wth the photoresistor (RP). Wave your hand up and down over the photoresistor to change the sound. Changing the light on the photoresistor changes the circuit resistance just like varying the adjustable resistance does. **Note:** If you have the adjustable resistor set to the right and light shining on the photoresistor, then you may not get any sound because the total resistance is too low for the circuit to operate.

Project #202

Flooding Alarm



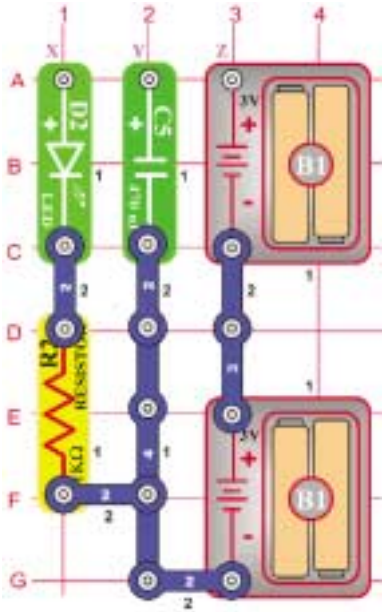
OBJECTIVE: To sound an alarm when water is

Build the circuit at left and connect the two (2) jumpers to it, place the loose ends of the jumpers into an empty cup (without them touching each other). Turn on the switch - nothing happens. This circuit is designed to detect water and there is none in the cup. Add some water to the cup - an alarm sounds!

You can use longer jumper wires and hang them near your basement floor or next to your sump pump to give a warning if your basement is being flooded. Note that if the loose jumper ends accidentally touch then you will have a false alarm.

Project #203

Make Your Own Battery



OBJECTIVE: To demonstrate how batteries can store

Build the circuit, then connect points Y and Z (use a 2-snap wire) for a moment. Nothing appears to happen, but you just filled up the 470µF capacitor with electricity. Now disconnect Y and Z and instead touch a connection between X and Y. The green light emitting diode will be lit and then go out after a few seconds as the electricity you stored in it is discharged through the diode and resistor.

Notice that a capacitor is not very efficient at storing electricity - compare how long the 470µF kept the LED lit for with how your batteries run all of your projects! That is because a capacitor stores electrical energy while a battery stores chemical energy.

Project #204

Make Your Own Battery (II)

OBJECTIVE: To demonstrate how batteries can store

In the preceding circuit, replace the 470µF capacitor (C5) with the 100µF capacitor (C3) and repeat the test. You see that the LED goes out faster, because the 100µF capacitor does not store as much electricity as the 470µF.

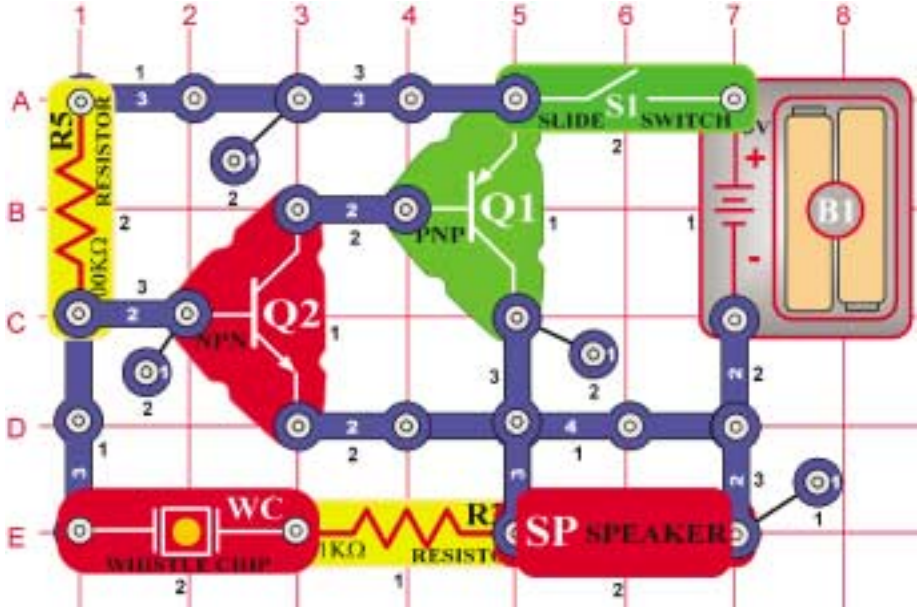
Project #205

Make Your Own Battery (III)

OBJECTIVE: To demonstrate how batteries can store

Now replace the 1kΩ resistor (R2) with the 100Ω resistor (R1) and try it. The LED gets brighter but goes out faster because less resistance allows the stored electricity to dissipate faster.

Project #206 Tone Generator



Build the circuit and turn it on, you hear a high-frequency sound.

Project #207 Tone Generator (II)

OBJECTIVE: To lower the frequency of a tone by increasing

Place the 0.02µF capacitor (C1) on top of the whistle chip (WC) in the preceding circuit, you hear a middle-frequency sound. Why? The whistle chip is used here as a capacitor and by placing the 0.02µF on top (in parallel) we have increased the capacitance, and doing so lowers the frequency.

Project #208 Tone Generator (III)

OBJECTIVE: To lower the frequency of a tone by increasing

Next, replace the 0.02µF capacitor and the whistle chip with the larger 0.1µF capacitor (C2). You now hear a low frequency sound, due to yet more capacitance.

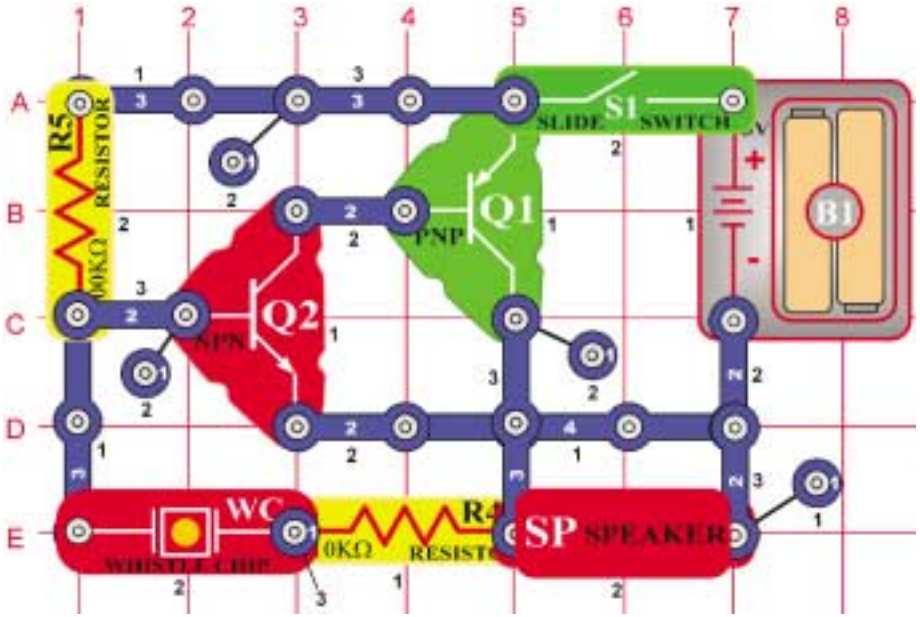
Project #209 Tone Generator (IV)

OBJECTIVE: To lower the frequency of a tone by increasing

Now replace the 0.1µF with the much larger 10µF capacitor (C3), (orient with the positive (+) side towards the left); the circuit just clicks about once a second. There isn't a constant tone anymore due to other transistor properties. You need a different type of circuit to create very low frequency tones.

Project #210

More Tone Generator



Build the circuit, as the name suggests this circuit is similar to that in Project 206. Turn it on, you hear a middle-frequency sound.

Project #211

More Tone Generator (II)

OBJECTIVE: To raise the frequency of a tone by

Now place the 1kΩ resistor (R2) on top of the 10kΩ resistor (R4), you now hear a high-frequency sound. By placing the 1kΩ resistor on top of the 10kΩ (in parallel), we have decreased the resistance, and doing so raises the frequency.

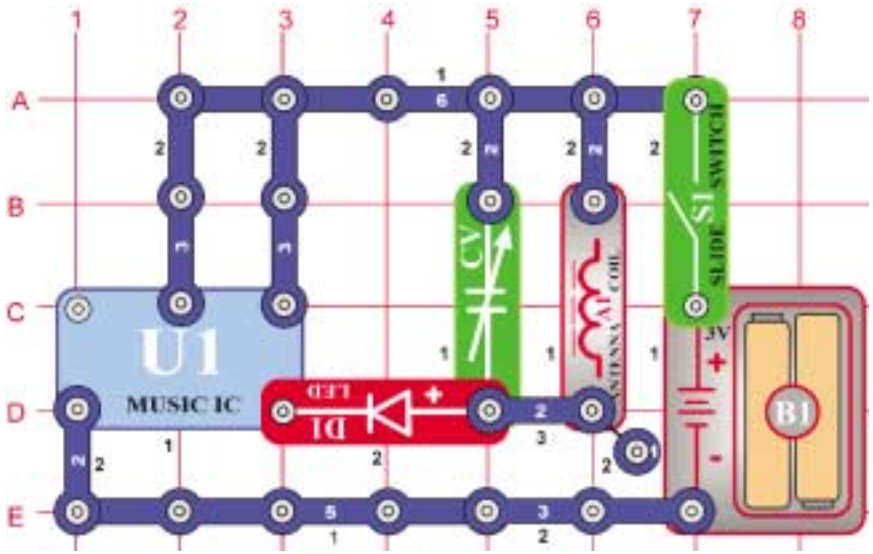
Project #212

More Tone Generator (III)

OBJECTIVE: To raise the frequency of a tone by

Next, replace the 1kΩ resistor (R2) with the 100Ω resistor (R1). You now hear a very high frequency sound, due to even less resistance.

Project #213 Music Radio Station



OBJECTIVE: To create music

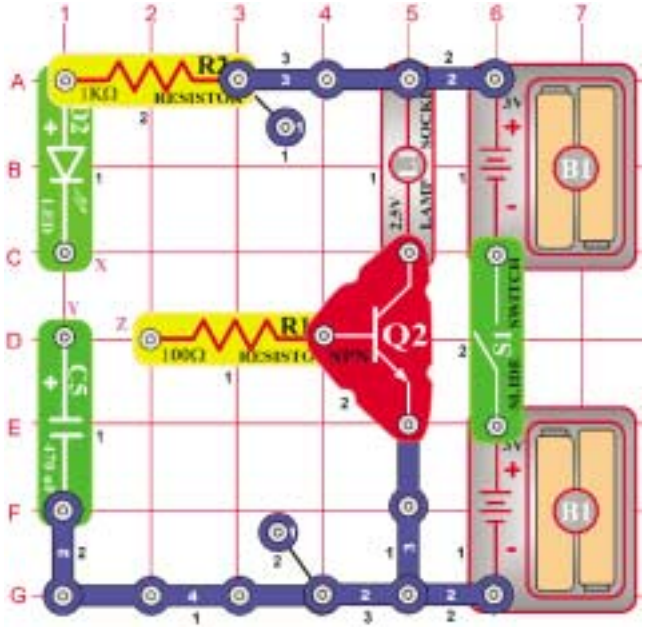
You need an AM radio for this project. Build the circuit shown on the left and turn on the switch. Place it next to your AM radio and tune the radio frequency to where no other station is transmitting.
Then, tune the adjustable capacitor (CV) until your music sounds best on the radio.

Project #214 Alarm Radio Station

OBJECTIVE: To create music and transmit it to a

Replace the music IC (U1) with the alarm IC (U2), and then you will hear a machine gun sound on the radio. You may need re-tune the adjustable capacitor.

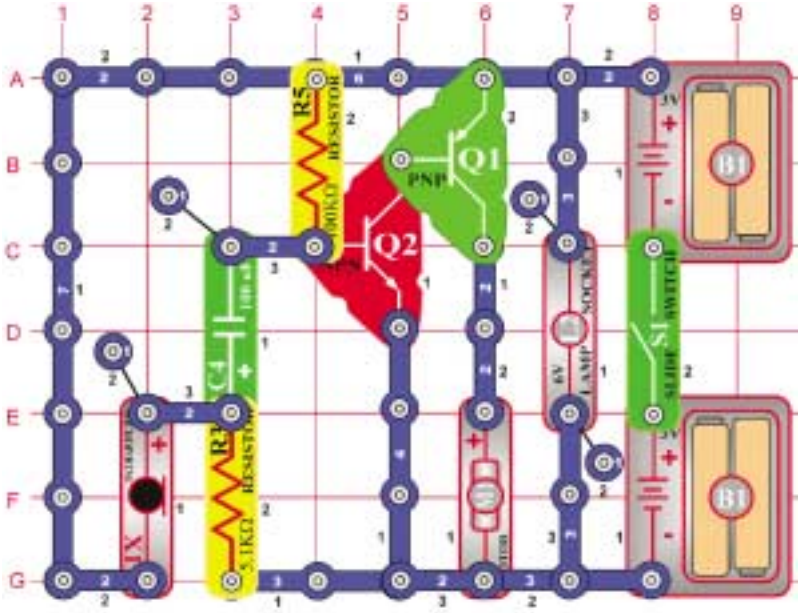
Project #215 Saved Electricity



Put on the switch, then connect points X and Y (use a 2-snap wire). The green LED will flash and then go out, as the 470µF capacitor is charged with electricity. Now disconnect X and Y and instead make a connection between Y and Z. The 6V bulb will flash as the electricity stored in the 470µF discharges through the resistor and transistor. The capacitor was storing electricity to be used at a later time, just like a battery does!

Project #216

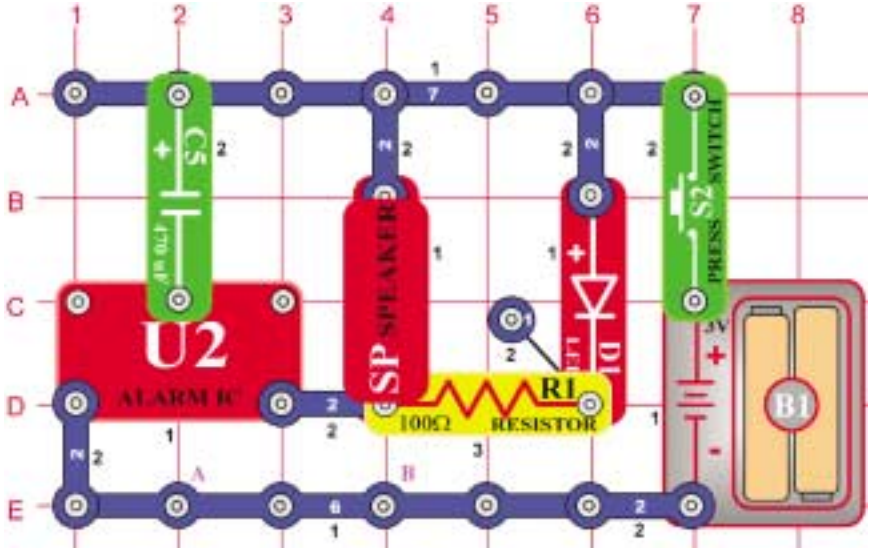
Motor & Lamp by Sound



Turn the switch on, the motor spins and the lamp lights. As you move your hand over the photosensitive resistor, the motor slows. Now place finger onto of the photosensitive resistor to block the light. The motor slows down. In a few seconds, the motor speeds up again.

Project #217

Fading Siren



OBJECTIVE: To produce sound of a siren driving away

Press the switch (S2), the integrated circuit should make the sound of an up-down siren that gets weaker with time. The fading is produced by the charging of the 470µF capacitor (C5), After it is charged the current stops and the sound is very weak.

To repeat this effect you must release the press switch (S2), remove the capacitor (C5), and discharge it by placing it across the snaps on the bottom bar marked A & B. Then, replace the capacitor (C5) and press the switch again.

Project #218

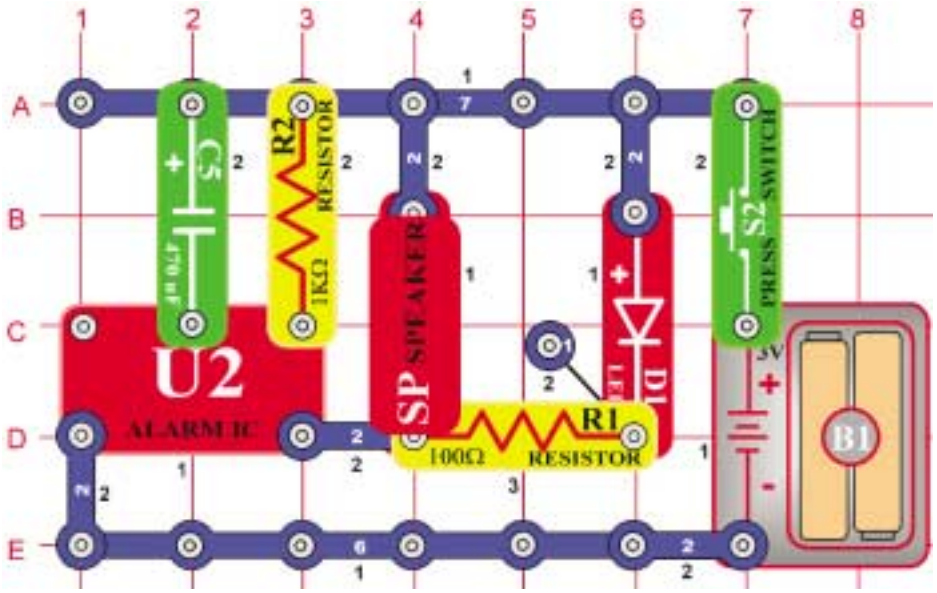
Fast Fade Siren

OBJECTIVE: To produce sound of a siren driving

Replace the 470µF capacitor (C5) with the 100µF capacitor (C4), the siren fades faster.

Project #219

Laser Gun with Limited Shots

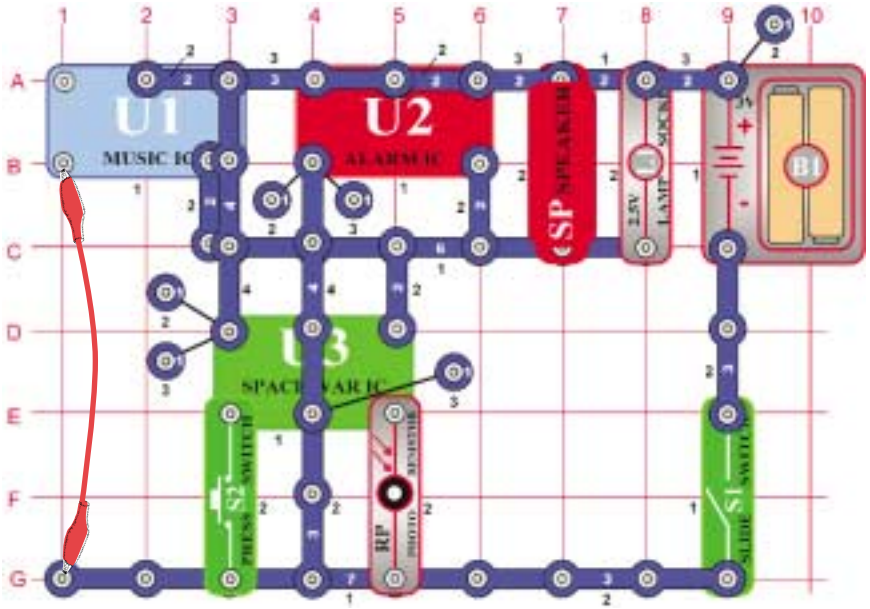


OBJECTIVE: To build the circuit used in a toy laser gun with flashing laser light and trigger and limited

When you close the press switch (S2), the integrated circuit should start sounding a very loud laser gun sound. The red LED will flash simulating a burst of laser light. You can shoot long repeating laser burst, or short zaps by tapping the trigger switch. But be careful, this gun will run out of energy and you will have to wait for the energy pack (C5) to recharge. This type of gun is more like a real life laser gun because power would run out after a few shots due to energy drain. In a real laser, the energy pack would have to be replaced. Here you only have to wait a few seconds for recharge.

Project #220

Symphony of Sounds



OBJECTIVE: To combine sounds from the music, alarm,

Build the circuit shown and add the jumper to complete it. Note that in two places two (2) single snaps are stacked on top of each other. Also, note that there is a 2-snap wire on layer 2 that does not connect with a 4-snap wire that runs over it on layer 4 (both touch the music IC). Turn it on and press the press switch (S2) several times and wave your hand over the photosensitive resistor (RP) to hear the full symphony of sounds that this circuit can create. Have fun!

Project #221

Symphony of Sounds (II)

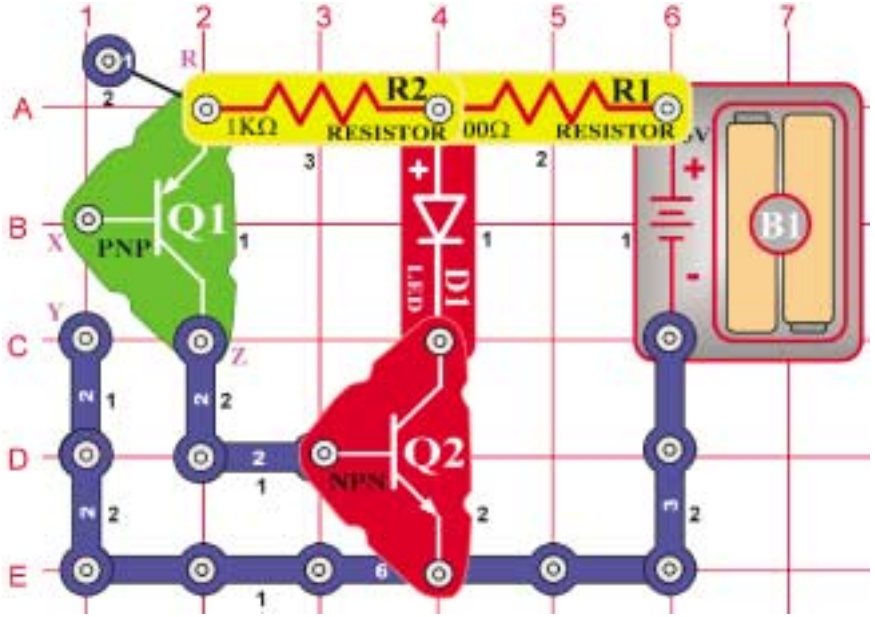
OBJECTIVE:

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Can you guess why the jumper is used in this circuit? It is being used as just a 3-snap wire because without it you don't have enough parts to build this complex circuit.

Project #222

Transistor Amplifiers



OBJECTIVE: To learn about the most important

When you place one or more fingers across the two snaps marked X & Y you will notice the light comes on. The two transistors are being used to amplify the very tiny current going through your body to turn on the LED. Transistors are actually electrical current amplifiers. The PNP transistor has the arrow pointing into the transistor body. The NPN transistor has the arrow pointing out of the transistor body. The PNP amplifies the current from your fingers first, then the NPN amplifies it more to turn on the LED.

Project #223

Pressure Meter

OBJECTIVE: To show how electronic amplifiers can

Use the circuit from Project 222 shown above.

When you placed your fingers across the two snaps marked X & Y you noticed the LED came on in Project 222. Repeat this process, but this time press very lightly on the two snaps marked X and Y. Notice how the brightness of the LED is dependent on the amount of pressure you use. Pressing hard makes the LED bright while pressing very gently makes it dim or even flash. This is due to what technicians call contact resistance. Even switches made to turn your lights on and off have some resistance in them. When large currents flow this resistance, will drop the voltage and produce the undesirable side effect of heat.

Project #224

Resistance Meter

OBJECTIVE: To show how electronic amplifiers can

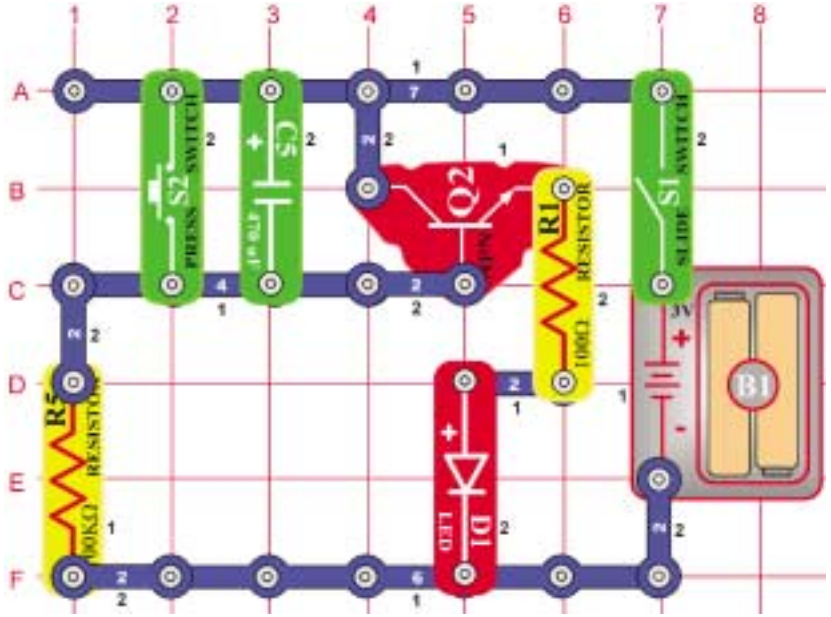
Use the circuit from Project 222 shown above

When you placed your fingers across the two snaps marked X & Y you noticed the LED came on in Project 222. In this project, you will place different resistors across R and Z and see how bright the LED glows. Do not snap them in; just press them up against the snaps labeled R and Z in the diagram above.

First, place the 100kΩ resistor across the R & Z snaps and note the brightness of the LED. Next, press the 5.1kΩ resistor across R & Z. Notice how the LED gets brighter when the resistance is less. This is because the NPN amplifier gets more current at its input when the resistance is lower. The PNP amplifier is not used in this test.

Project #225

Auto-Off Night-Light



OBJECTIVE: To learn about one device that is used to

When you turn on the slide switch (S1) the first time the light will come on and very slowly get dimmer and dimmer. If you turn the slide switch (S1) off and back on after the light goes out it will NOT come on again. The 470µF capacitor (C5) has charged up and the NPN transistor amplifier (U2) can get no current at its input to turn it on.

This circuit would make a good night-light. It would allow you to get into bed, and then it would go out. No further current is taken from the battery so it will not drain the batteries even if left on all night.

Project #226

Discharging Caps

OBJECTIVE: To show how capacitor delays can be

Use the circuit from Project 225 shown above.

When you first turned on the slide switch (S1) in Project 225, the LED came on and very slowly get dimmer and dimmer. When you turned the slide switch (S1) off and back on after the light went out, it did NOT come on again. The 470µF capacitor (C5) was charged and everything stopped. This time turn the slide switch (S1) off. Then press press switch (S2) for a moment to discharge the 470µF capacitor. Now when you turn the slide switch (S1) back on the delay repeats. Shorting a capacitor with a low resistance will allow the charges on the capacitor to leave through the resistance. In this case, the low resistance was the press switch.

Project #227

Changing Delay Time

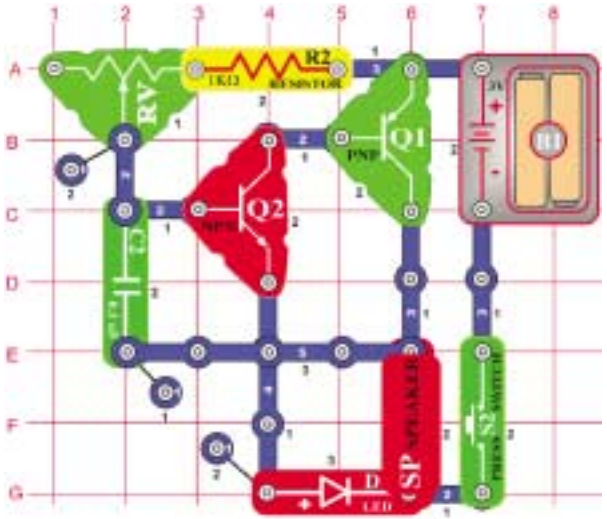
OBJECTIVE: To show how the size of the capacitor

Use the circuit from Project 225 shown above.

Change the 470µF capacitor (C5) to the 100µF capacitor (C4). Make sure the capacitor (C4) is fully discharged by pressing the press switch (S2) before closing the on-off slide switch (S1). When slide switch (S1) is closed, notice how much quicker the LED goes out. Since 100µF is approximately 5 times smaller than 470µF, the light will go out 5 times faster. The bigger the capacitor the longer the delay.

In electronics, capacitors are used in every piece of equipment to delay signal or tune circuits to a desired frequency.

Project #228



Morse Code Generator

OBJECTIVE: To make a Morse code generator and

When you press down on the press switch (S2) you will here a tone. By pressing and releasing the press switch you can generate long and short tones called Morse code. For International code, a short tone is represented by a "+", and a long tone by a "–". See the chart below for letter or number followed by code.

A +–	**G** ––+	**M** ––	**S** +++	**Y** –+––	**5** +++++
B –+++	**H** ++++	**N** –+	**T** –	**Z** ––++	**6** –++++
C –+–+	**I** ++	**O** –––	**U** ++–	**1** +––––	**7** ––+++
D –++	**J** +–––	**P** +––+	**V** +++–	**2** ++–––	**8** –––++
E +	**K** –+–	**Q** ––+–	**W** +––	**3** +++––	**9** ––––+
F ++–+	**L** +–++	**R** +–+	**X** –++–	**4** ++++–	**0** –––––

Project #229
LED Code Teacher

OBJECTIVE: A method of learning the Morse code

Use the circuit from Project 228 shown above. Replace the speaker with a 100Ω resistor (R1) so you can practice generating the Morse code without the loud speaker. Have someone transmit code and watch the LED. Tell them the letter or number after each is generated. When you have learned code, replace the speaker.

Project #230
Ghost Shriek Machine

OBJECTIVE: To make a ghost like special effect from

Use the circuit from Project 228 shown above, but change the 1kΩ resistor (R2) to a 10kΩ resistor (R4), and .1µF capacitor (C2) to the variable capacitor (C5). While holding the press switch (S2) down adjust both the variable resistor (RV) and the variable capacitor (CV) for a ghost like sound. At certain settings, sound may stop or get very faint.

Project #231
LED & Speaker

OBJECTIVE: To improve Morse code skills and

Use the circuit from Project 228 shown above. Try and find a person that already knows the Morse code to send you a message with both sound and LED flashing. Try in a dark room first so LED is easier to see. Morse code is still used by many amateur radio operators to send messages around the world.

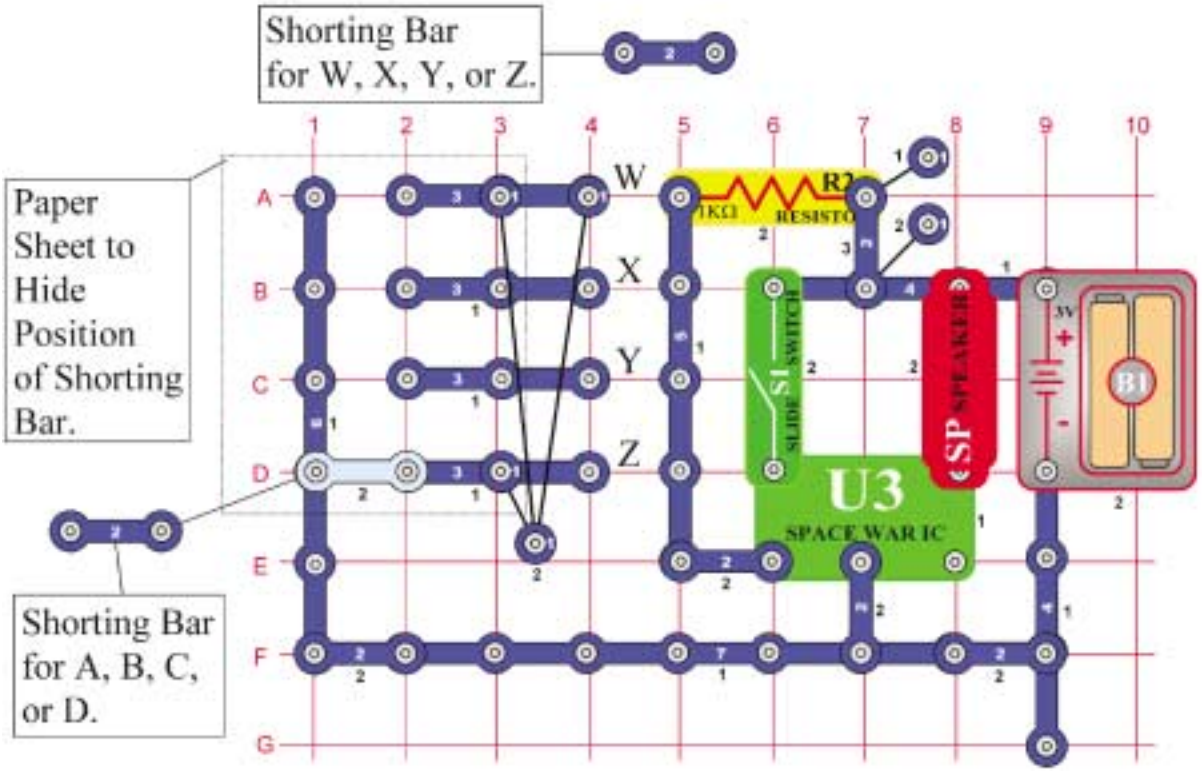
Project #232
Dog Whistle

OBJECTIVE: To make an oscillator that only a dog

Use the circuit from Project 228 shown above, but change the 100kΩ resistor (R5) to a 1kΩ resistor (R2). While holding down the press switch (S2) slowly move the slider on the adjustable resistor (RV) toward the 1kΩ resistor. If the frequency goes low again, snap the 100µF capacitor (C4) on top of the 1kΩ resistor (R2) and try again.

Project #233

Mind Reading Game



Build the circuit shown on the left. It uses two (2) 2-snap wires as shorting bars.

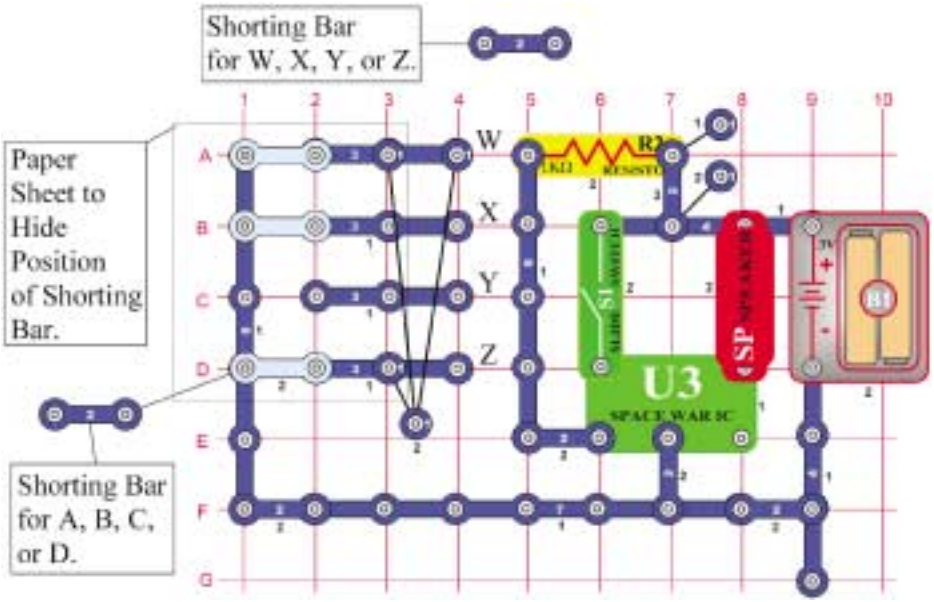
Setup: Player 1 sets up by placing one shorting bar under the paper on row A, B, C, or D. Player 2 must **NOT** know where the shorting bar is located under the paper.

The object is for Player 2 to guess the location by placing his shorting bar at positions W, X, Y, or Z. In the drawing on the left, Player 1 set up at position "D". If Player 2 places his shorting bar across "Z" on the first try, then he guessed correctly and marks a 1 on the score card sheet under that round number. If it takes three tries, then he gets a three.
Player 2 then sets the A, B, C, D side and Player 1 tries his luck. Each player records his score for each round. When all 18 rounds have been played, the player with the lowest score wins. Additional players can play. Use the score card below to determine the winner.

Round #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
Player 1	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	_____
Player 2	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	_____
Player 3	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	_____
Player 4	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	_____

Project #234

Enhanced Quiet Zone Game



OBJECTIVE: Make and play the electronic game of

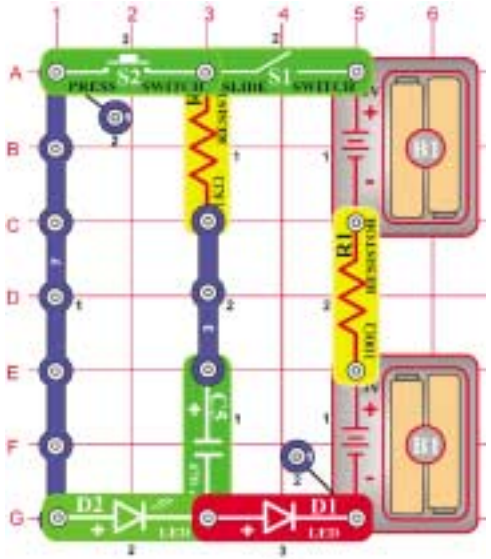
Use the circuit from Project 233, but place three (3) 2-snap wires ("shorting bars") under paper as shown on left.

Setup: Player 1 sets the "Quiet Zone" by placing three (3) shorting bars under the paper on row A, B, C, or D, leaving only one open. Player 2 must **NOT** know where the shorting bars are located under the paper.

Both Player 1 and Player 2 are given 10 points. The object is for Player 2 to guess the location of the "Quiet Zone" by placing his shorting bar at positions W, X, Y, or Z. In the drawing on the left Player 1 set up the "Quiet Zone" at position "C". If Player 2 places his shorting bar across "Z" on the first try, the sounds played mean he has not found the "Quiet Zone" and he loses 1 point. He has 3 tries to find the zone on each turn. Each time sounds are made he loses a point.
Player 2 then sets the A, B, C, D side and Player 1 starts searching. Play continues until one player is at zero points and makes sound during that players turn.

Project #235

Capacitor Charge & Discharge



OBJECTIVE: To show how capacitors store and

Turn on the slide switch (S1) for a few seconds, then turn it off. The red light emitting diode (LED, D1) is initially bright but goes dim as the batteries charge up the capacitor (C5). The capacitor is storing electrical charge.

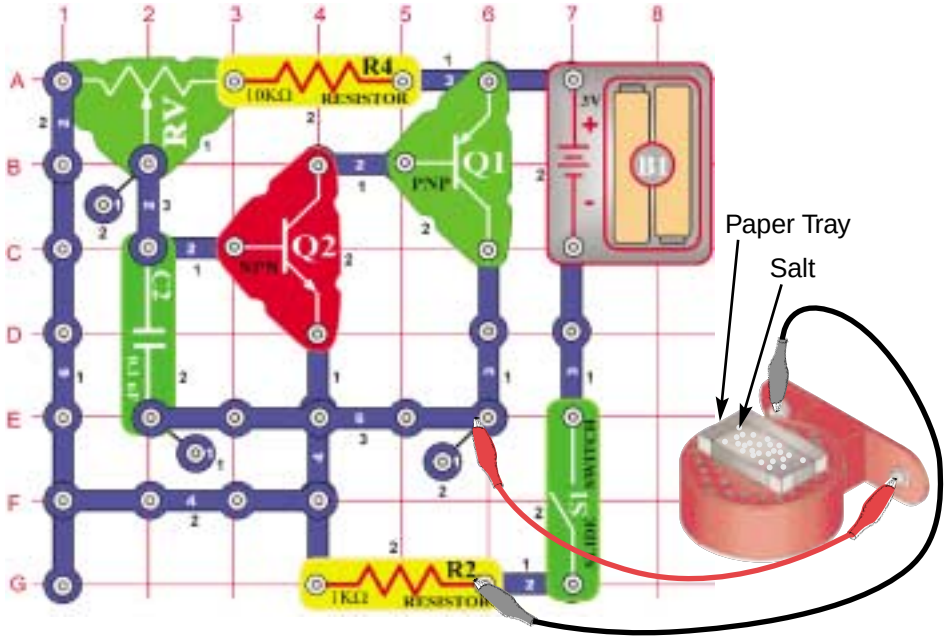
Now press the key (S2) for a few seconds. The green LED (D2) is initially bright but goes dim as the capacitor discharges itself through it.

The capacitor value (470µF) sets how much charge can be stored in it, and the resistor value (1kΩ) sets how quickly that charge can be stored or released.

Project #236

Sound Wave Magic

OBJECTIVE: To show how sound waves travel on a

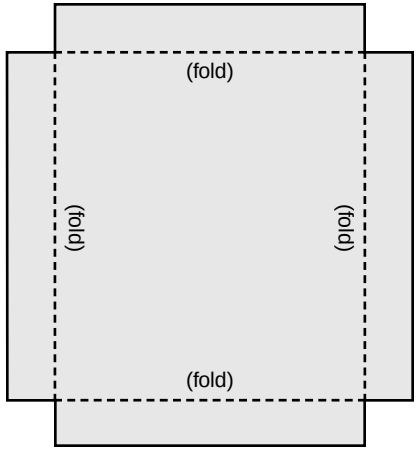


Build the circuit shown on the left and connect the speaker using the two (2) jumper wires. Then, lay the speaker on a flat hard surface.

Setup: Use some paper and scissors to cut out a rectangular pattern. Use the one shown below as a guide. Use colored paper if available. Fold at the points shown. Scotch tape the corners so the tray has no cracks at the corners. Place the tray over the speaker and sprinkle a small amount of white table salt in the tray. There should be enough salt to cover the bottom with a little space between each salt grain.

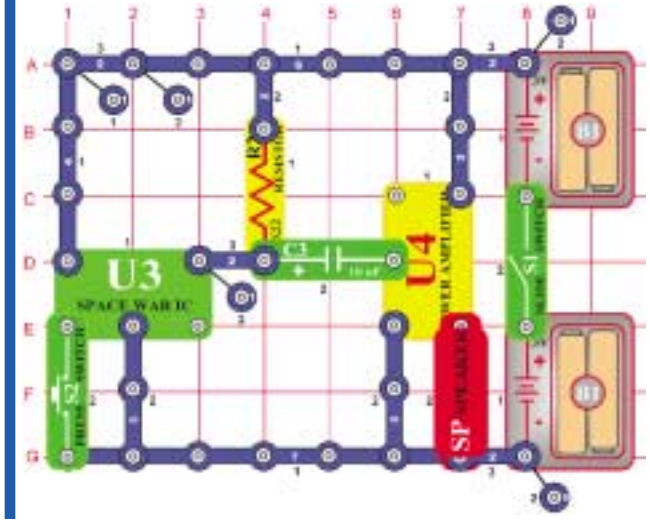
Sound Magic: Turn on the circuit by closing slide switch (S1). Adjust the adjustable resistor (RV) for different pitches and watch the salt particles. Particles that bounce high are directly over the vibrating paper and ones that do not move are in the nodes where the paper is not vibrating. Eventually, all the salt will move to the areas that have no vibration, and stay there.
Change the position of the tray and the material used to create different patterns due to the sound. Try sugar and coffee creamer, for example, to see if they move differently due to the sound waves.

Sample Cut-out Pattern



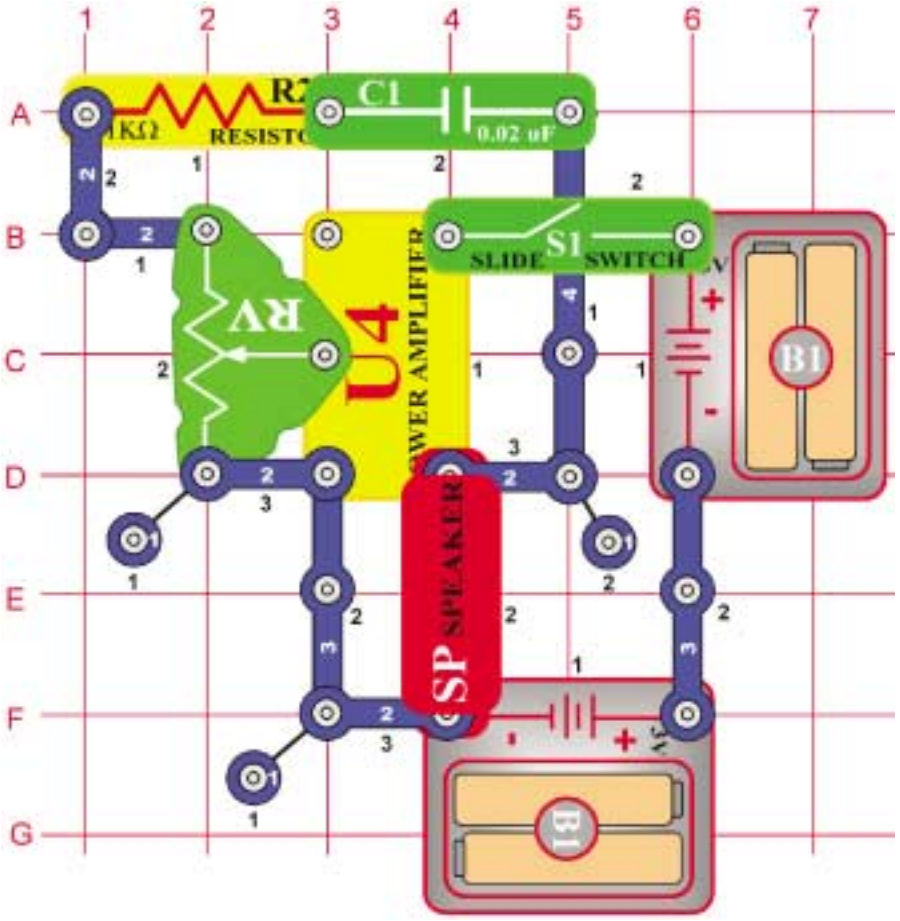
Project #237

Space War Amplifier



OBJECTIVE: To amplify sounds from the

Build the circuit, turn on the switch, and press the press switch (S2) several times. You will hear loud space war sounds, since the sound from the space war integrated circuit is amplified by the power amplifier integrated circuit. Nearly all toys that make sound use a power amplifier of some sort.



Project #238
Trombone

OBJECTIVE: ***To build an electronic trombone that***

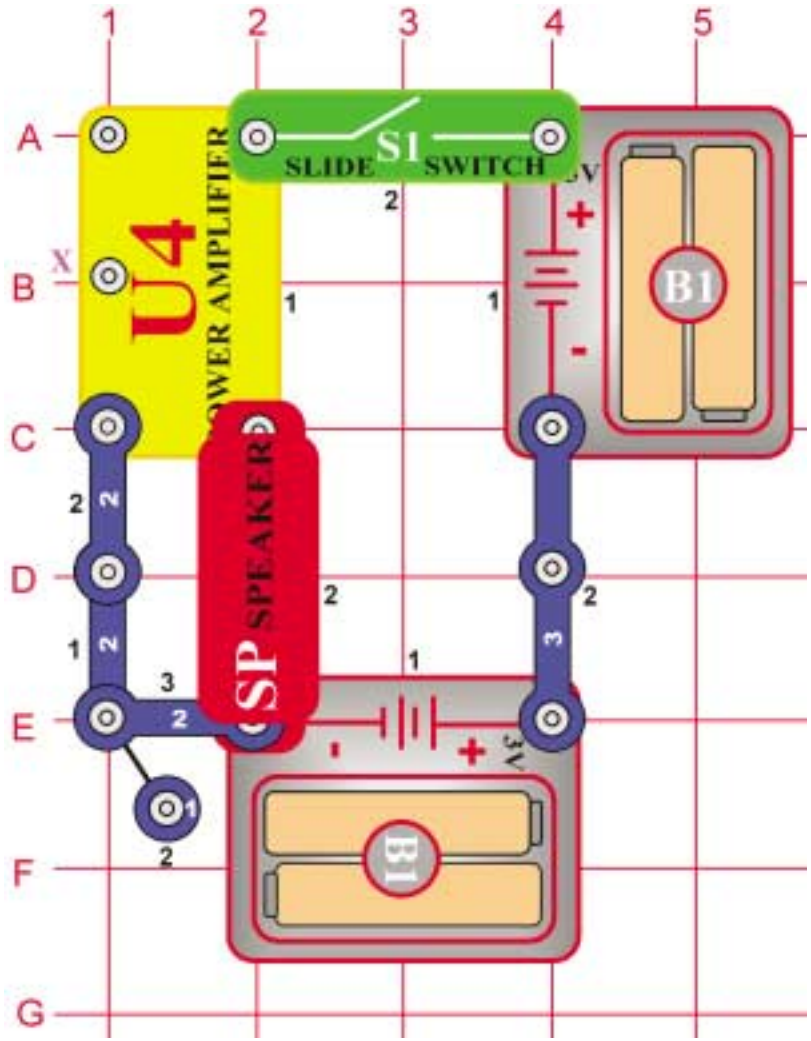
When you turn on the slide switch (S1) the trombone should start playing. To change the pitch of the note, simply slide the adjustable resistor control (RV) back and forth. By turning the slide switch (S1) on and off and moving the slider, you will be able to play a song much like a trombone player makes music. The switch represents air going through the trombone, and the control is same as trombone slider bar. The circuit may be silent at some positions of the resistor control.

Project #239
Race Car Engine

OBJECTIVE: ***To show how changing frequency changes***

Use the circuit from Project 238 shown on the left, but change the 0.02µF capacitor (C1) to a 10µF capacitor (C3). Make sure the positive (+) mark on the capacitor is **NOT** on the resistor (R2) side when you snap it in.

When the switch is turn on, you should hear a very low frequency oscillation. By sliding the adjustable resistor control (RV) up and down, you should be able to make the sound of a race car engine as it's motor speeds up and slows down.



Project #240
Power Amp

OBJECTIVE: To check stability of power amplifier with

When you turn on the slide switch (S1), the power amplifier should not oscillate. You should be able to touch point X with your finger and hear static. If you do not hear anything, then try touch point X with one of the snaps on any part. High frequency clicks or static should be coming from speaker indicating that the amplifier is powered on and ready to amplify signals.

The power amplifier may oscillate on its own. Do not worry, this is normal with high gain high-powered amplifiers.

Project #241
Electronic Kazoo

OBJECTIVE: To show how electronic feedback can be

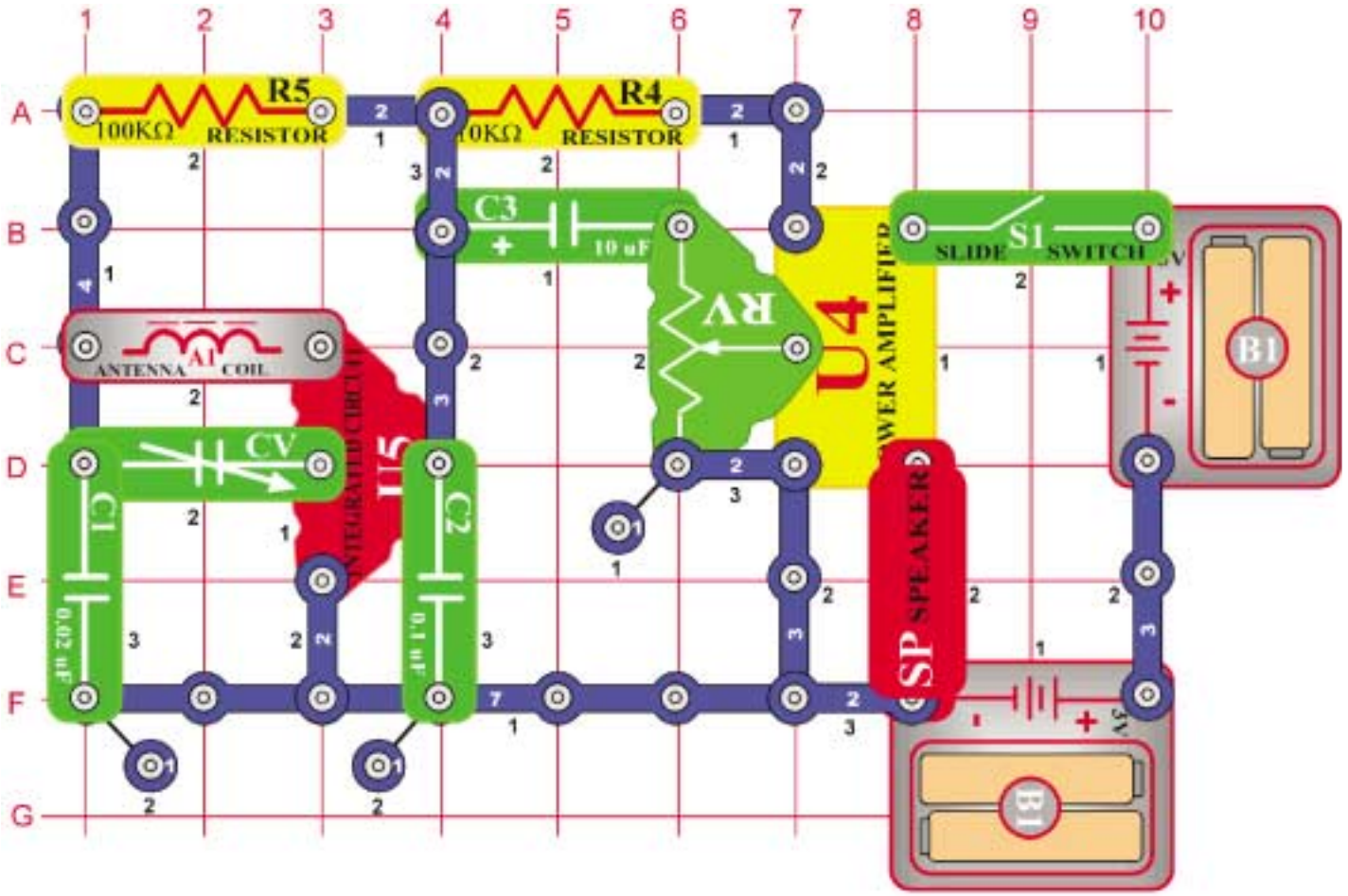
Use the circuit from Project 240 shown on the left.

When you place one finger on point X and a finger from your other hand on the speaker (SP) snap that is not connected to the battery, what happens? If the amplifier starts to oscillate it is due to the fact that you just provided a feed back path to make the amplifier into an oscillator. You may even be able to change the pitch of the oscillation by pressing harder on the snaps.

This is the principle used to make an electronic Kazoo. If you practice and learn the amount of pressure required to make each note, you may even be able to play a few songs.

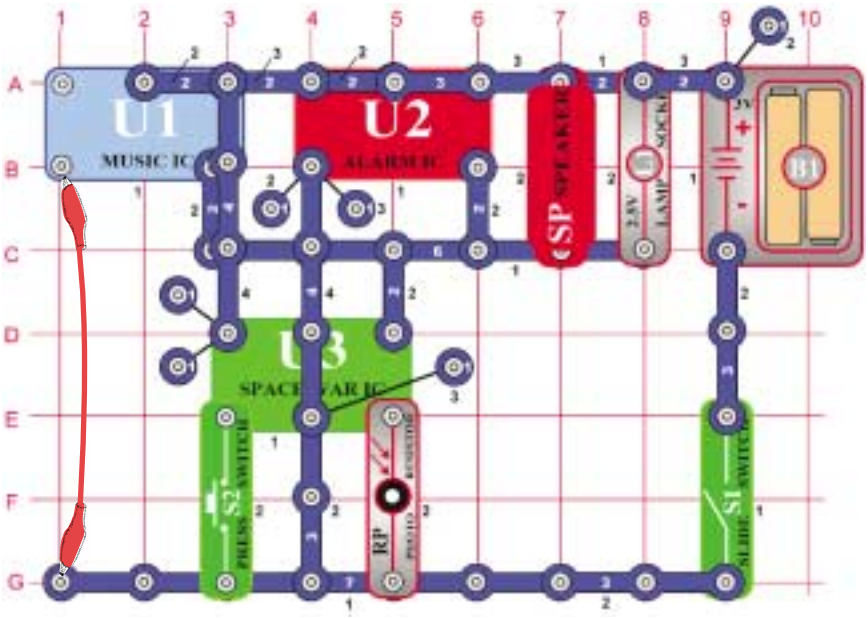
Project #242

AM Radio



When you close the slide switch (S1), the integrated circuit (U5) should amplify and detect the AM radio waves all around you. The variable capacitor (VC) can be tuned to the desirable station. Varying the adjustable resistor (RV) will make the audio louder or softer. The power amplifier (U4) drives the speaker (SP) to complete the AM radio project.

Project #243 Fire Engine Symphony



OBJECTIVE: To combine sounds from the music, alarm, and space war integrated

Build the circuit shown and add the jumper to complete it. Note that in two places two (2) single snaps are stacked on top of each other. Also, note that there is a 2-snap wire on layer 2 that does not connect with a 4-snap wire that runs over it on layer 4 (both touch the music IC). Turn it on and press the press switch (S2) several times and wave your hand over the photosensitive resistor (RP) to hear the full spectrum of sounds that this circuit can create. Have fun!

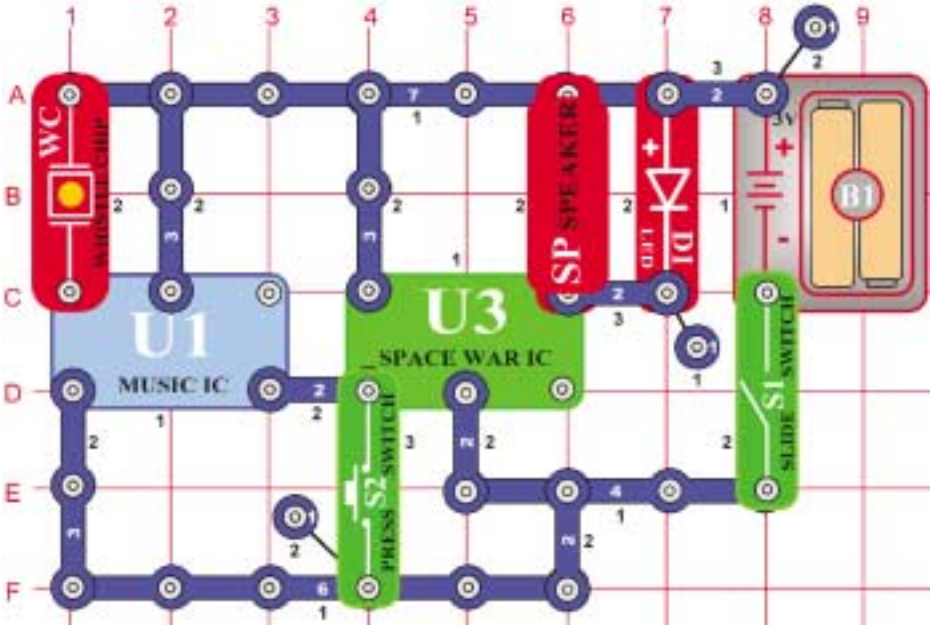
Project #244 Fire Engine Symphony (II)

OBJECTIVE:

The preceding circuit may be too loud, so replace the speaker (SP) with the whistle chip (WC).

Can you guess why the jumper is used in this circuit? It is being used as just a 3-snap wire, because without it you don't have enough parts to build this complex circuit.

Project #245 Vibration or Sound Indicator

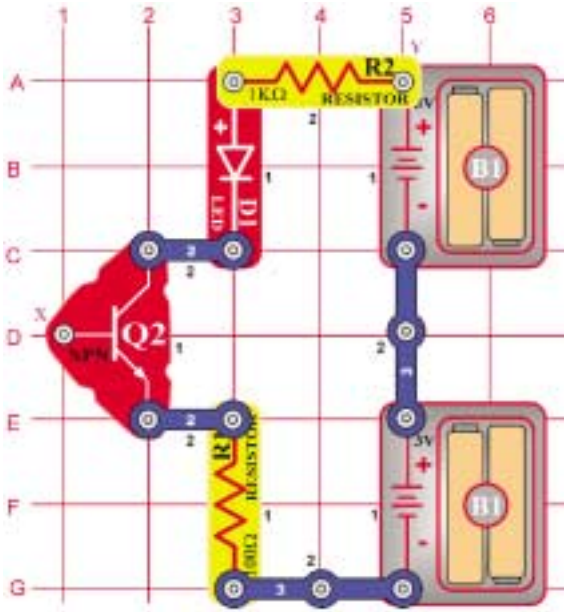


OBJECTIVE: To build a circuit that is activated by

Set the slide switch (S1) on, the war sounds start playing and the LED flashes. When all of the sounds are played, the circuit stops. Clap your hands next to the whistle chip or tap on it. Any loud sound or vibration, the whistle chip produces a small voltage and activates the circuit. You can repeat a sound by holding down the press switch (S2) while it is playing.

Project #246

Two-Finger Touch Lamp



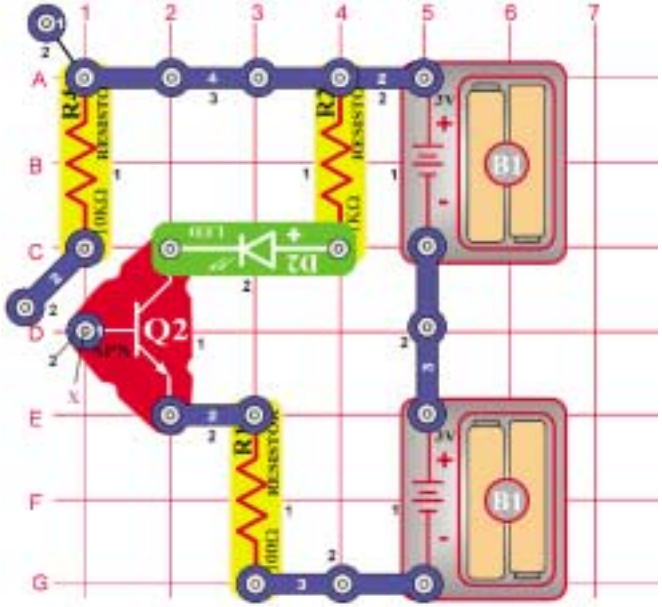
OBJECTIVE: To show that your body can be used as

Build the circuit on the left. You're probably wondering how it can work, since one of the points on the NPN transistor (Q2) is unconnected. It can't, but there is another component that isn't shown. That component is you.

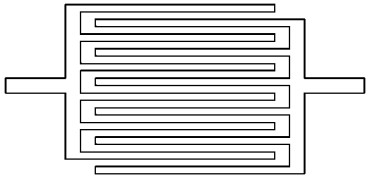
Touch points X and Y with your fingers. The LED may be dimly lit. The problem is your fingers aren't making good enough electrical contact with the metal. Wet your fingers with water or saliva and touch the points again. The LED should be very bright now. Think of this circuit as a touch lamp since when you touch it the light emitting diode lights. You may have seen such a lamp in the store or already have one in your home.

Project #247

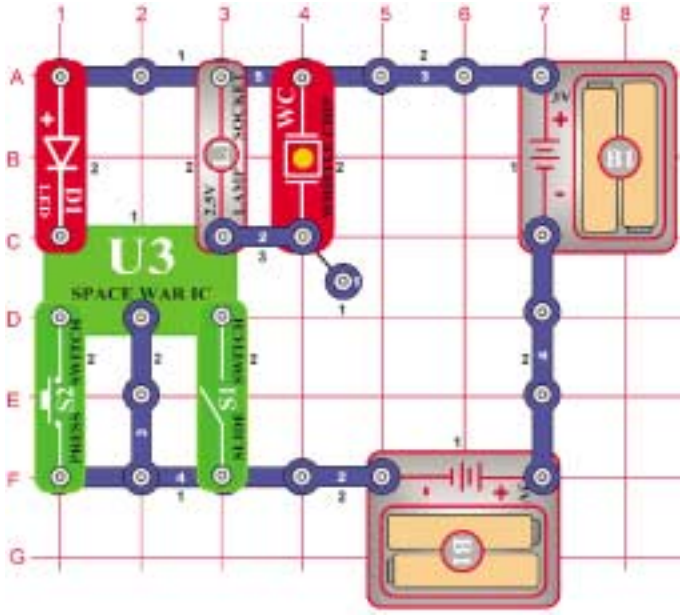
One-Finger Touch Lamp



The touch lamps you see in stores only need to be touched by one finger to light, not two. So let's see if we can improve the last circuit to only need one finger. Build the new circuit, note that near point X there is a 2-snap wire that is only mounted on one side, swing it so the plastic touches point X. Wet a large area of one of your fingers and touch it to both metal contacts at point X at the same time; the LED lights. To make it easier for one finger to touch the two contacts, touch lamps or other touch devices will have the metal contacts interweaved as shown below and will also be more sensitive so that you don't have to wet your finger to make good contact.



Project #248 Space Battle



OBJECTIVE: To show how sound

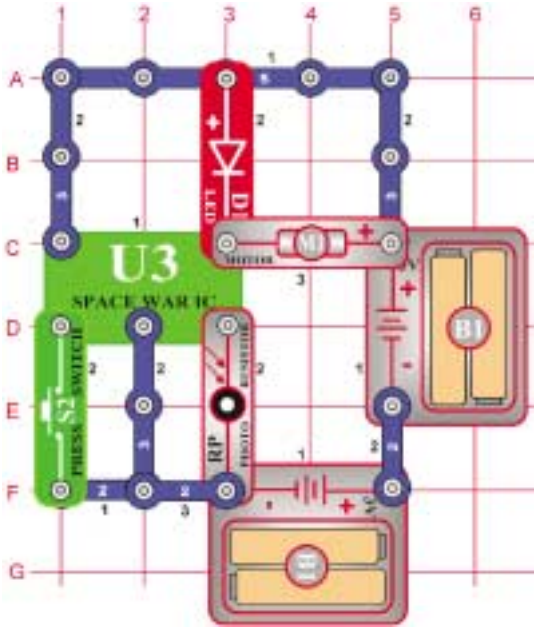
Build the circuit shown on the left. Activate the circuit by flipping the switch or pressing the press switch (S2), do both several times and in combination. You will hear exciting sounds and see flashing lights, as if a space battle is raging!

Project #249 Space Battle (II)

OBJECTIVE: To show how light can turn "ON" an

Replace the slide switch (S1) with the photosensitive resistor (RP). Now covering and uncovering the photosensitive resistor will change the sound.

Project #250 Multi-Speed Light Fan



OBJECTIVE: To vary the speed of a fan

Build the circuit shown on the left, with the fan on the motor.

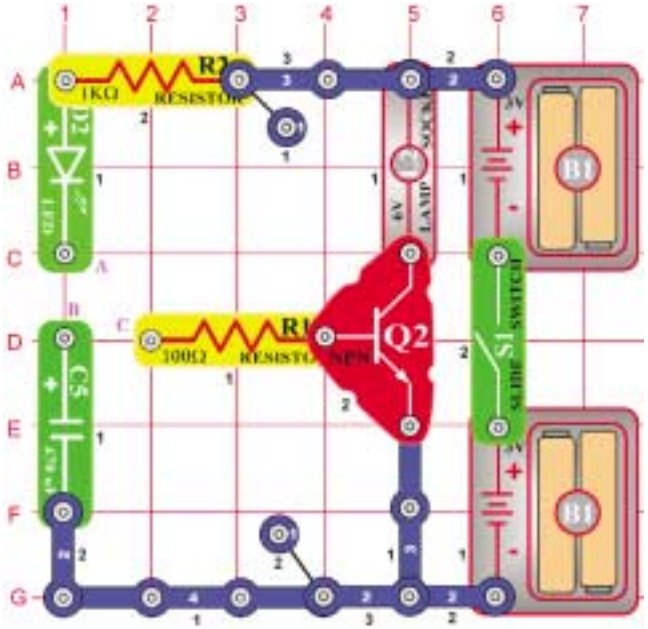
This circuit is activated by light on the photosensitive resistor, though the fan will barely turn at all. Press the press switch (S2) and the fan will spin. If you hold the press switch down, the fan will spin faster. If you cover the photosensitive resistor, the fan will stop even if the press switch is pressed.

Project #251 Light & Finger Light

OBJECTIVE: To show another way the Space War IC

In the circuit at left, replace the motor (M1) with a 2.5V lamp shown below. Vary the brightness of the lamp by covering the photosensitive resistor and holding down the press switch (S2) in various combinations. Notice that pressing the press switch when the photosensitive resistor is covered still turns on the lamp, while in Project 250, doing this would turn off the motor.

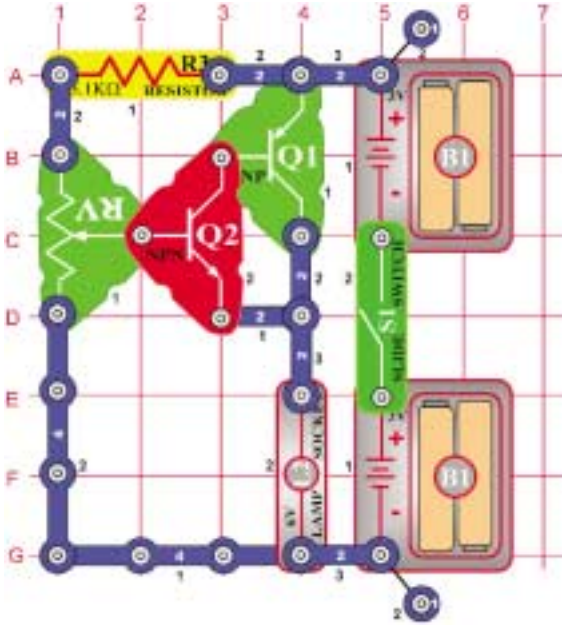
Project #252 Storing Electricity



Turn the switch on and connect point A and B with a 2-snap wire. The green LED will flash and the capacitor will be charged with electricity. The electricity is now stored in the capacitor. Disconnect point A and B. Connect point B and C and there will be a flash from the 6V lamp.

The capacitor discharges through the resistor to the base of the NPN transistor. The positive current turns on the transistor like a switch, connecting the lamp to the negative (–) side of the batteries. The light will go out after the capacitor discharges, because there is no more current at the base of the transistor.

Project #253 Lamp Brightness Control



OBJECTIVE:

To use a transistor combination

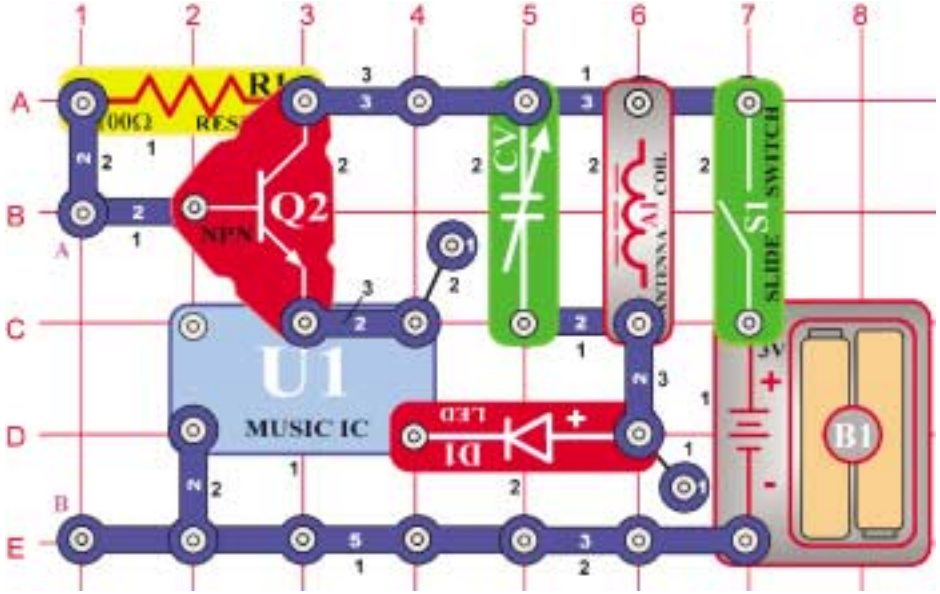
Here is a combination with two transistors. This combination increases the amplifying power. By changing the resistance, the current at the base of the transistor is also changed. With this amplifying ability of the combination, there is a greater change of current to the lamp. This changes the brightness.

Project #254 Electric Fan

OBJECTIVE: To make an electric fan using a

Use the circuit from Project 253. Replace the lamp (L2) with the motor (M1) and install the fan. By controlling the adjustable resistor, the speed of the fan changes. Now you can make your own speed changing electric fan.

Project #255



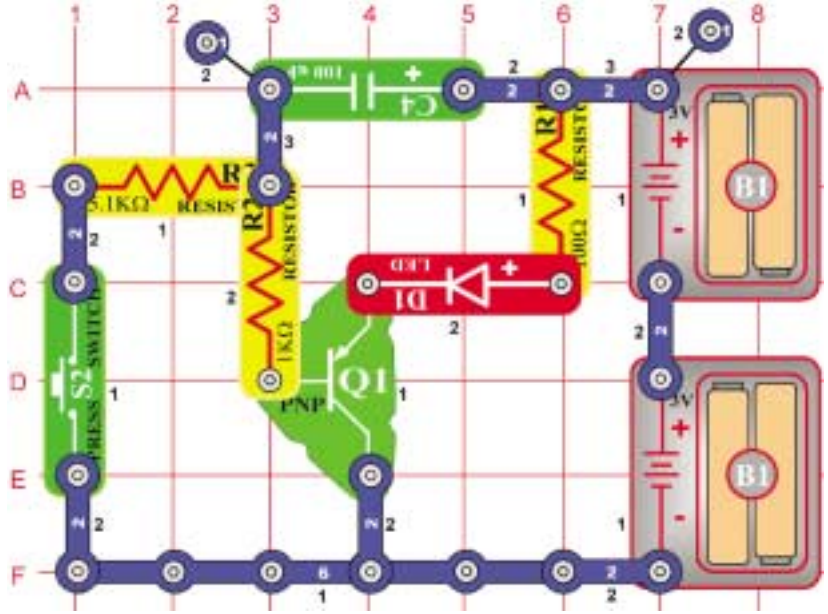
Radio Music Burglar Alarm

OBJECTIVE: To build an alarm that plays music on

Place the circuit next to an AM radio. Tune the radio so no stations are heard. Set the slide switch (S1) on. You should hear the song play. The red LED should also be lit. Adjust the variable capacitor (CV) for the loudest signal.

Connect a jumper wire across points A and B and the music stops. The transistor acts like a switch connecting power to the music IC. Positive voltage on the base closes the switch and negative voltage opens it. Connect a string to the jumper wire and the other end of the string to a door or window. Set the switch on. If a thief comes in through the door or window, the string pulls the jumper off and the music plays on the radio.

Project #256

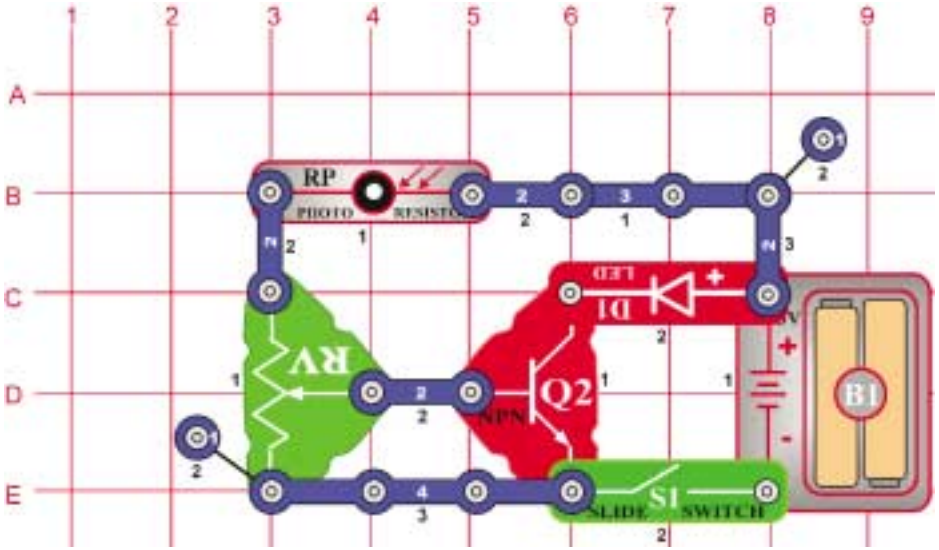


Light Dimmer

Press the press switch (S2) to complete the current's path flow. You might expect the LED to light instantly but it doesn't. The charging current flows into the capacitor (C4) first. As the capacitor charges, the charging current decreases, input current to the PNP transistor (Q1) increases. So current begins to flow to the LED and the LED gradually brightens.

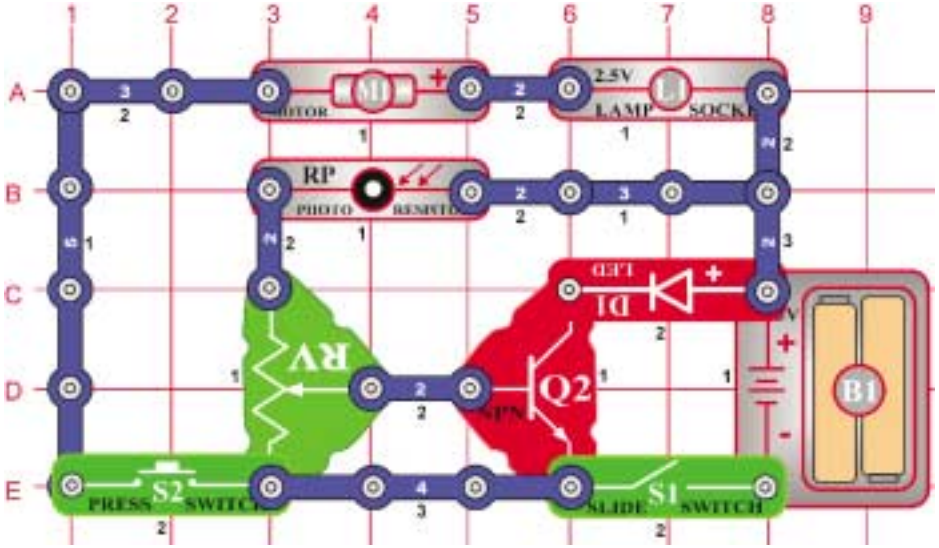
Now release the press switch. The capacitor begins to discharge, sending input current to the transistor. As the capacitor discharges, the input current reduces to zero and gradually turns off the LED and the transistor.

Project #257 Motion Detector

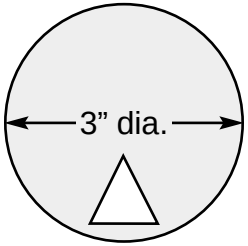


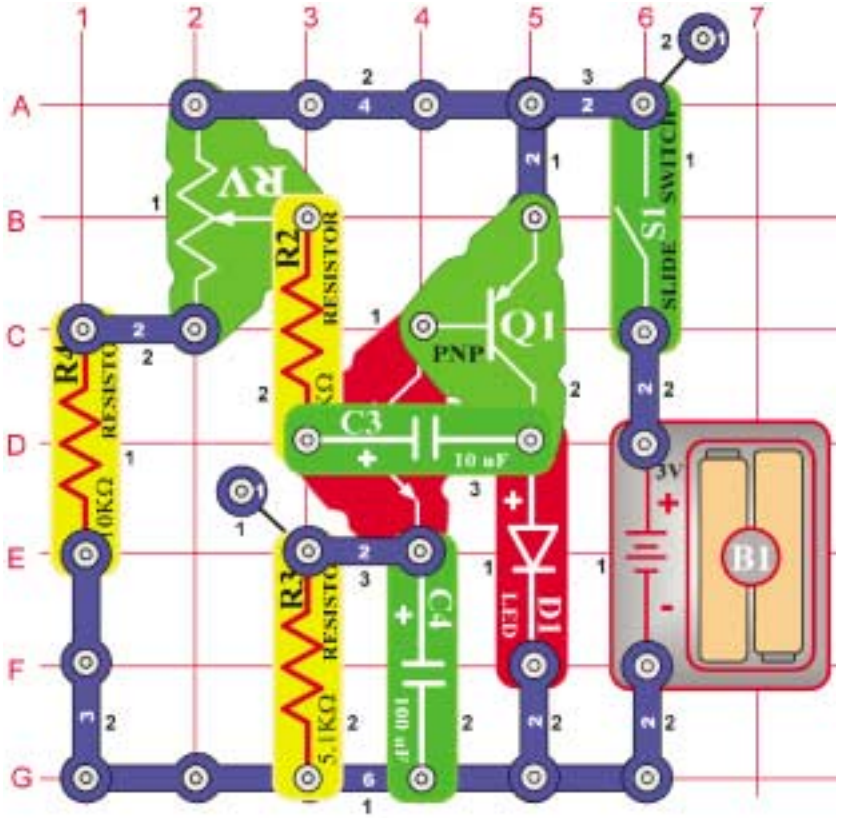
Set the adjustable resistor (RV) to the center position. Turn the switch on and the LED lights. Wave your hand over the photosensitive resistor (RP) and the LED turns off and on. The resistance changes as the amount of light strikes the photosensitive resistor. As the light decreases, the resistance increases. The increased resistance lowers the voltage at the base of the NPN transistor (Q2). This turns off the transistor, preventing current flowing through the LED to the negative (–) side of the battery. Wave your hand over photosensitive resistor at different distances. The LED gets brighter the farther away your hand is.

Project #258 Fan Modulator



Using the fan outline as a guide, cut a 3" circle out of a piece of paper. Then, cut a small triangle in it as shown. Tape the circle onto the fan and then place it onto the motor. Set the adjustable resistor (RV) to the center position and turn the switch on. Press the press switch (S2), the fan spins and the lamp lights. As the triangle opening moves over the photosensitive resistor, more light strikes it. The brightness of the LED changes, or is *modulated*. As in AM or FM radio, modulation uses one signal to modify the amplitude or frequency of another signal.





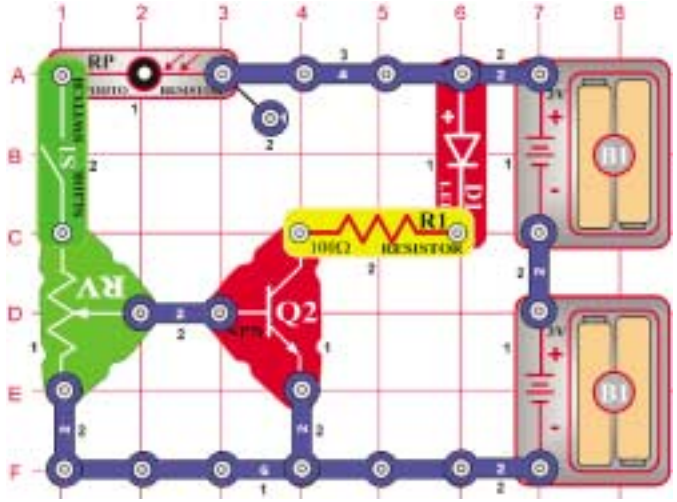
Project #259
Oscillator 0.5 - 30Hz

Set the adjustable resistor (RV) to the bottom position and then turn the switch on. The LED will start flashing at a frequency of 0.5Hz (once every two seconds). Slowly adjust the adjustable resistor and the LED flashes faster. As the frequency increases, the LED flashes faster. Eventually, the LED flashes so fast, it looks like it is on all of the time.

Project #260
Sound Pulse Oscillator

Use the circuit from Project #259.
Connect a single snap under the speaker and then connect it across the LED (on level 4). Turn the switch on and now you can hear the oscillator. Adjust the adjustable resistor (RV) to hear the different frequencies. Now you can hear and see the frequencies.

Project #261
Motion Detector (II)



OBJECTIVE: To build a motion detector that senses an

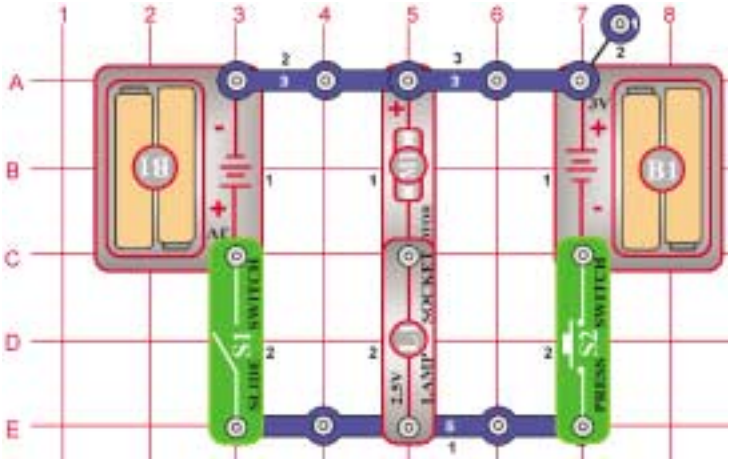
Turn the switch on and move the adjustable resistor (RV) control all the way up. The brightness of the LED is at maximum. Now, move the adjustable resistor control down until the LED goes out. Set the control up a little and the LED lights dimly.

Move your hand from side to side over the photosensitive resistor (RP). As your hand blocks the light, the LED goes out.

The amount of light changes the resistance of the photosensitive resistor and the current flow to the base of the NPN transistor (Q2). The transistor acts like a switch. Its base current is supplied through the photosensitive resistor. As the base current changes, so does the current flow through the LED. With no base current, the LED goes out.

Project #262

Motor Rotation

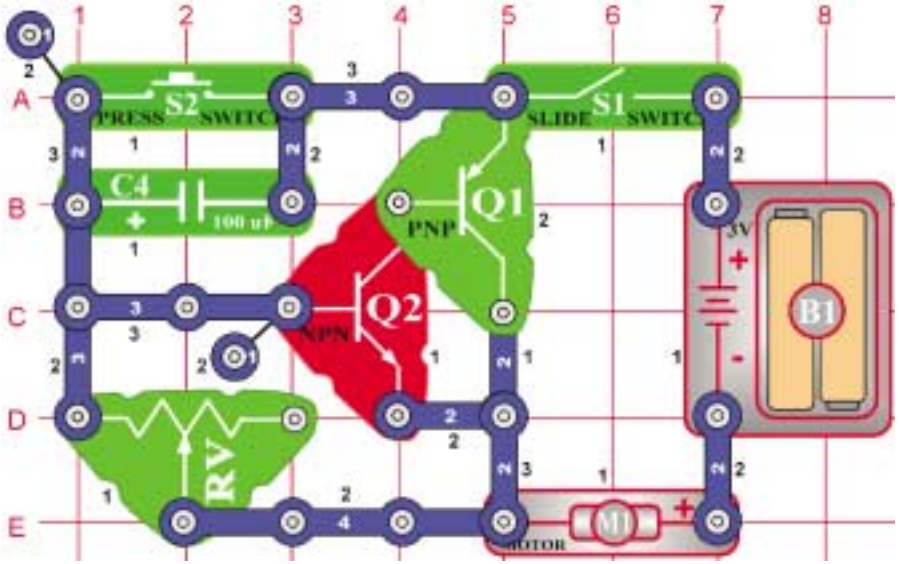


OBJECTIVE: ***To show how voltage polarity affects a***

Place the fan onto the motor. Turn the slide switch (S1) on. The fan rotates clockwise. When you connect the positive (+) side of the battery to the positive (+) side of the motor, it spins clockwise. Turn the switch off and press down the key switch. Now the fan spins the other way. The positive (+) side of the battery is connected to the negative (–) side of the motor. The polarity on the motor determines which way it rotates. Notice that the lamp lights in both polarities. It is not effected by the polarity changes.

Project #263

Motor Delay Fan



Place the fan onto the motor and set the adjustable resistor control to the far right. Turn the slide switch (S1) on and then press the press switch (S2) once. The motor will spin and then stop. Now set the resistor control to the far left and press the press switch again. The time the fan spins is much less now.

When the press switch is pressed, the current flows through the circuit and the fan spins. The capacitor charges up also. When the switch is released, the capacitor discharges and supplies the current to keep the transistors on. The transistor acts like a switch connecting the fan to the battery. When the capacitor fully discharges, the transistors turn off and the motor stops. The adjustable resistor controls how fast the capacitor discharges. The more resistance, the longer the discharge time.

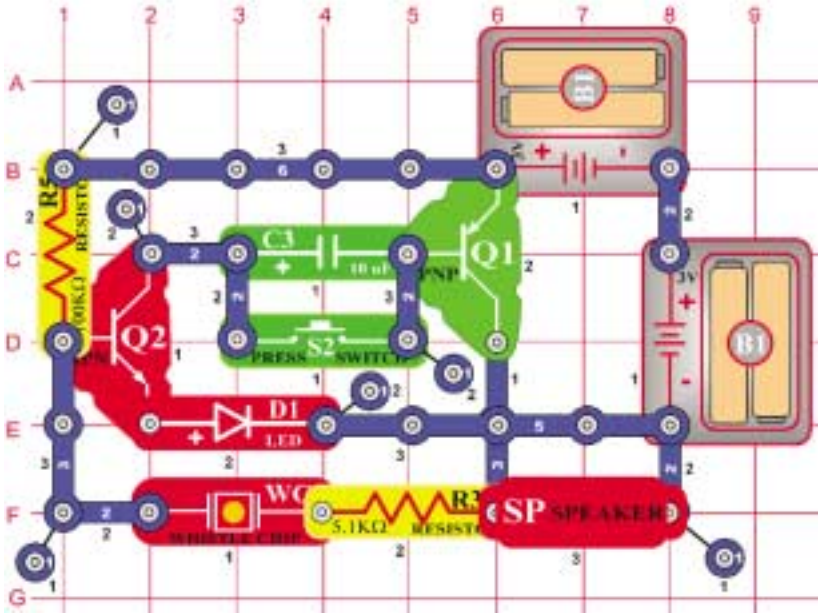
Project #264

Motor Delay Fan (II)

Use the circuit from Project #263. Connect a single snap under one side of the 470µF capacitor (C5) and then connect it over the top of the 100µF capacitor. Turn the switch on and press the press switch (S2). Notice that the fan spins longer now. When capacitors are in parallel, the values are added, so now you have 570µF. The time it takes to discharge the capacitors is longer now, so the fan keeps spinning.

Project #265

High Pitch Bell



Build the circuit shown and press the press switch (S2). The circuit starts to oscillate. This generates the sound of a high pitch bell.

Project #266

Steamboat Whistle

Using the circuit in Project #265, connect the 0.02µF capacitor (C1) across the whistle chip. Press the press switch (S2). The circuit now generates the sound of a steamboat.

Project #267

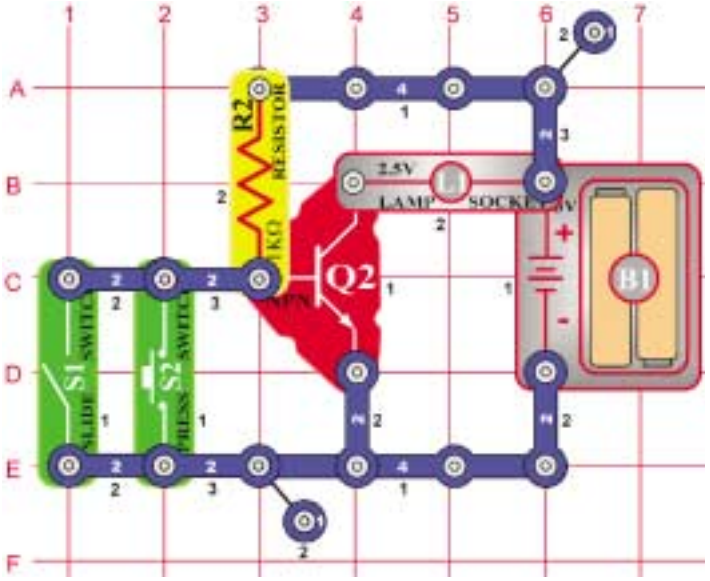
Steamship

OBJECTIVE: To generate the

Using the circuit in Project #265, connect the 0.1µF capacitor (C2) across the whistle chip. Press the press switch (S2). The circuit now generates the sound of a steamship.

Project #268

Light NOR Gate

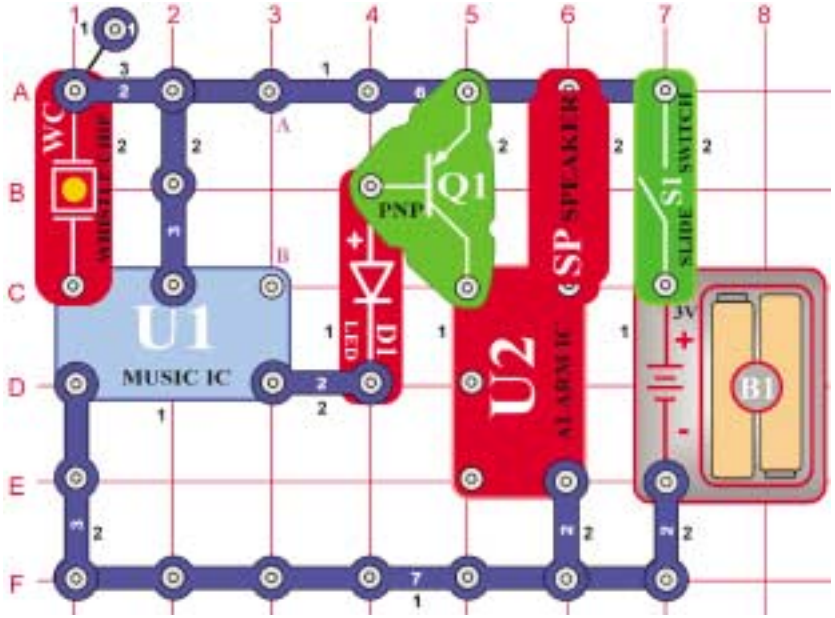


Build the circuit on the left. You will find that the lamp is on when neither the slide switch (S1) NOR the press switch (S2) are on. This is referred to as an NOR gate in electronics and is important in computer logic.

Example: If neither condition X NOR condition Y are true, then execute instruction Z.

Project #269

Noise-Activated Burglar Alarm



Set the switch on and wait for the sound to stop. Place the circuit into a room you want guarded. If a thief comes into the room and makes a loud noise, the speaker will sound again.

If you find that the sound does not turn off, then vibrations created by the speaker may be activating the whistle chip. Set the speaker on the table near the circuit and connect it to the same locations using the jumper wires to prevent this.

Project #270

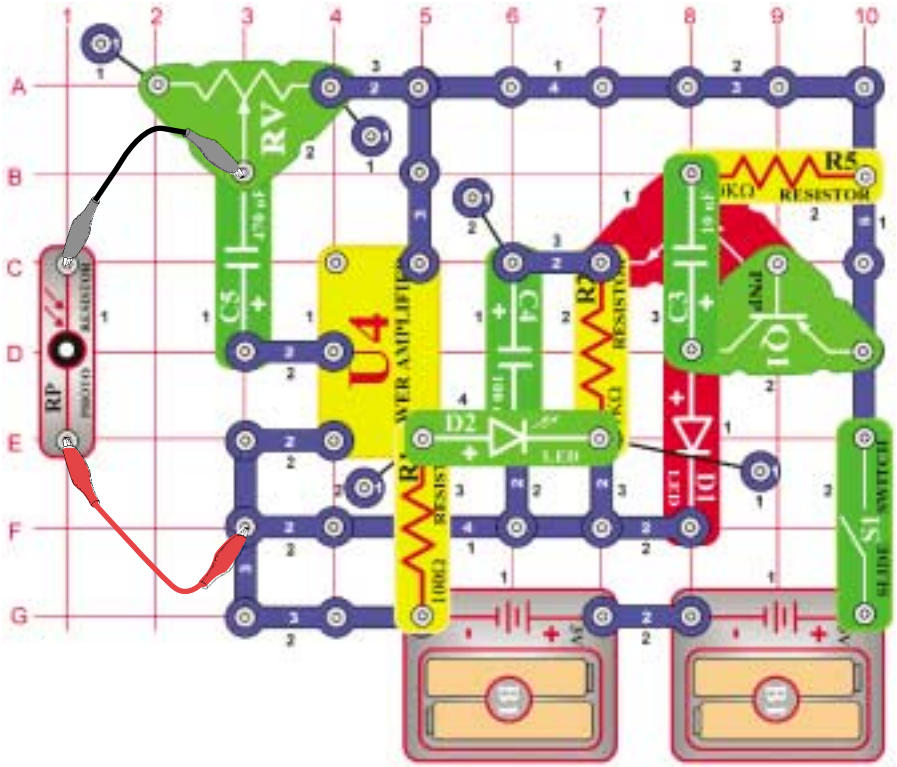
Motor-Activated Burglar Alarm

Use the circuit from Project #269 shown above.
Replace the whistle chip with the motor. Wind a piece of string around the axis of the motor so when you pull it the axes spins. Connect the other end of the string to a door or window. Set the switch on and wait for the sound to stop. If a thief comes in through the door or window the string pulls and axes spins. This will activate the sound.

Project #271

Light-Activated Burglar Alarm

Use the circuit from Project #269 shown above.
Connect a photosensitive resistor (RP) across points A and B and cover it or turn off the lights. Set the switch on and wait for the sound to stop. At night, when the thief comes in and turns on the light, the speaker makes the sound of a machine gun.



Project #272
Optocoupler with LED

OBJECTIVE: To build an optocoupler circuit to light an

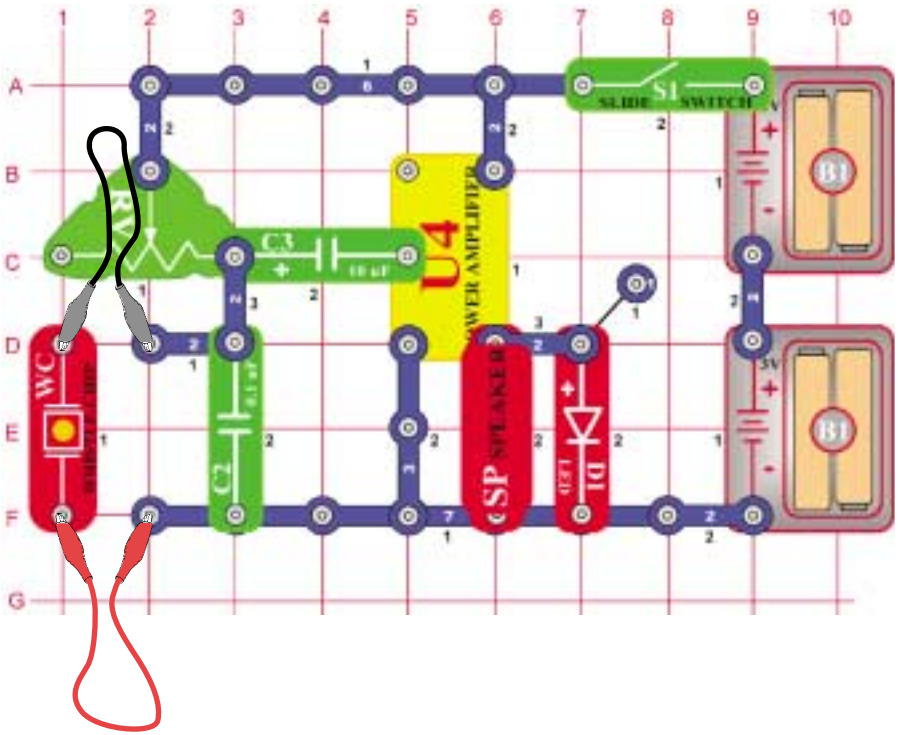
Connect two jumper wires to the photosensitive resistor (RP) as shown. Set the adjustable resistor (RV) control to the far-left side. Turn the switch on and the red LED starts flashing. Hold the photosensitive resistor over the red LED so it is facing it. As the red LED lights, so will the green. This is an example of an optocoupler/opto-isolator. An electric device that transmits signals without an electrical connection between the light source (input) and the light detector (output).

Project #273
Optocoupler with Speaker

OBJECTIVE: To build an optocoupler circuit to drive a

Use the circuit from Project #272.

Remove the green LED and replace the 100Ω resistor (R1) with the speaker. Set the adjustable resistor to the far-left side. Connect two jumper wires to the photosensitive resistor (RP) as shown. Turn the switch on and the red LED starts flashing. Hold the photosensitive resistor over the red LED so it is facing it. Now when the red LED lights, the speaker outputs a tone.



Project #274

Pressure Alarm

Connect two jumper wires to the whistle chip (WC) as shown. Set the control of the adjustable resistor (RV) to the far left and turn on the switch. There is no sound from the speaker and the LED is off. Tap the center of the whistle chip. The speaker sounds and the LED lights. The whistle chip has a piezocrystal between the two metal plates. The sound causes the plates to vibrate and produce a small voltage. The voltage is amplified by the power amplifier (U4), which drive the speaker and LED.

Place a small object in the center of the whistle chip. When you remove the object the speaker and LED are activated. In alarm systems, a siren would sound to indicate the object has been removed.

Project #275

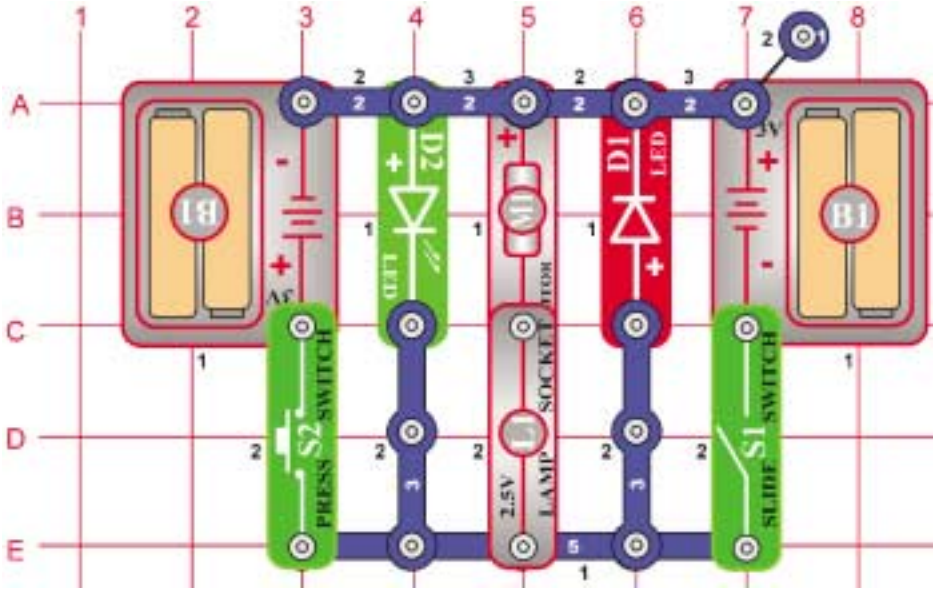
Power Microphone

Use the circuit from Project #274.

Replace the whistle chip with the microphone (X1), and hold it away from the speaker. Set the control of the adjustable resistor (RV) to the far left. Turn the switch on and talk into the microphone. You now hear your voice on the speaker. The sound waves from your voice vibrate the microphone and produce a voltage. The voltage is amplified by the power amplifier (U4) and your voice is heard on the speaker.

Project #276

LED Fan Rotation Indicator

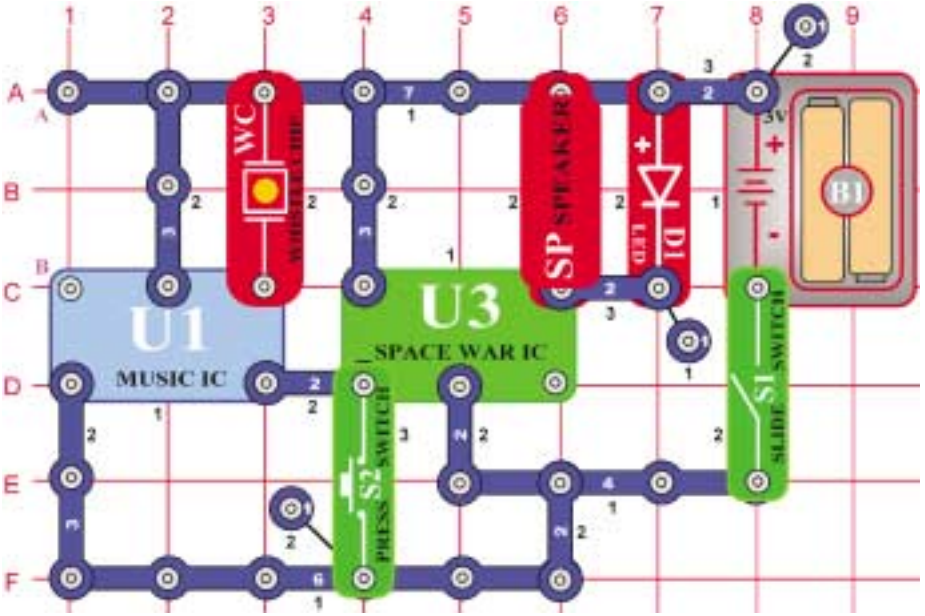


Place the fan onto the motor. Turn the slide switch (S1) on. The fan rotates clockwise, the green LED and the lamp light. When you connect the positive (+) side of the battery to the positive (+) side of the motor, it spins clockwise. Turn the switch off and press down the press switch (S2). Now the fan spins the other way and the red LED and lamp light. The positive (+) side of the battery is connected to the negative (–) side of the motor. The polarity on the motor determines which way it rotates. Notice that the lamp lights in both polarities.

Project #277

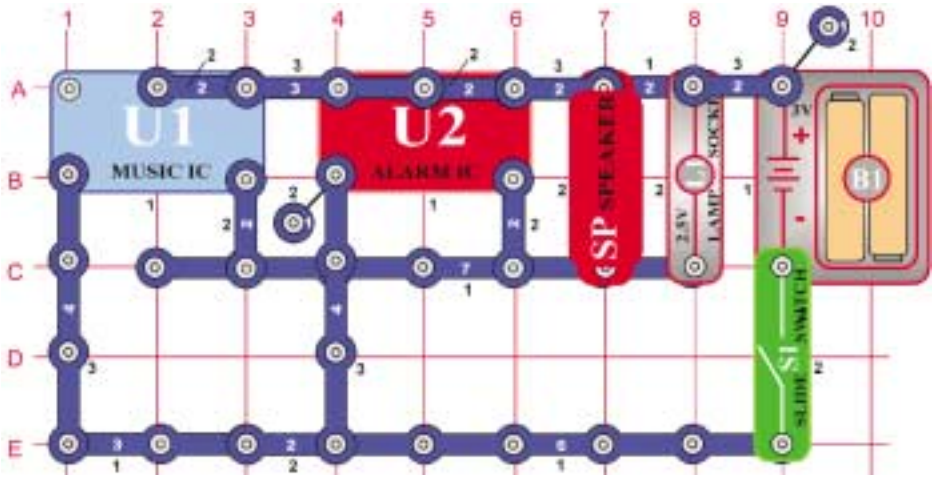
Space War Sounds with LED

OBJECTIVE: To build a circuit that uses a



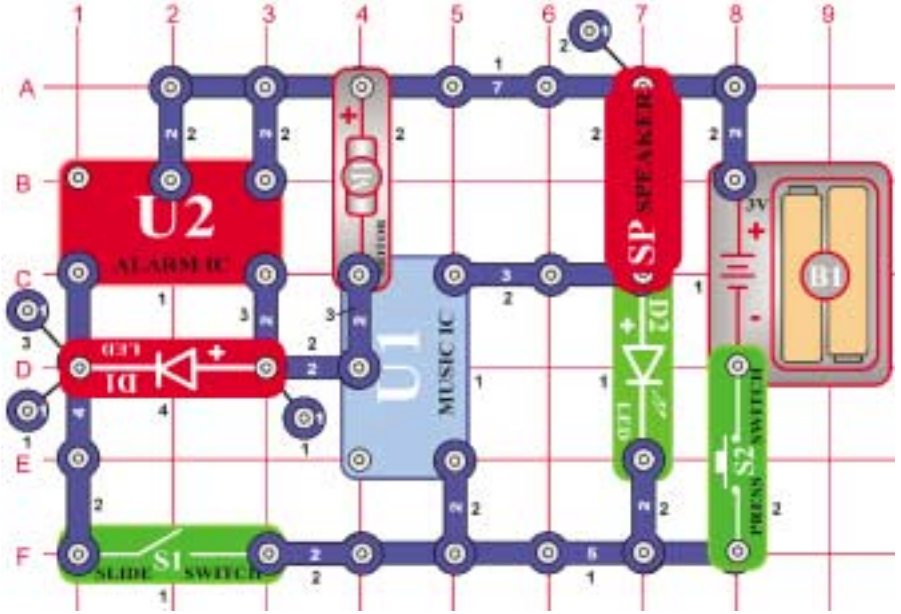
Build the circuit shown on the left, which uses the space war integrated circuit. Set the switch on. Press the press switch (S2) and a space war sound plays, and the LED flashes. Release the press switch and then press it down again. Now a different sound plays. See how many sounds are programmed into the space war sound IC (U3).
You can also play the sounds by tapping or blowing on the whistle chip (WC).

Project #278 Sound Mixer



In the circuit, the outputs from the alarm and music ICs are connected together. The sounds from both ICs are played at the same time.

Project #279 Sound Mixer Fan Driver



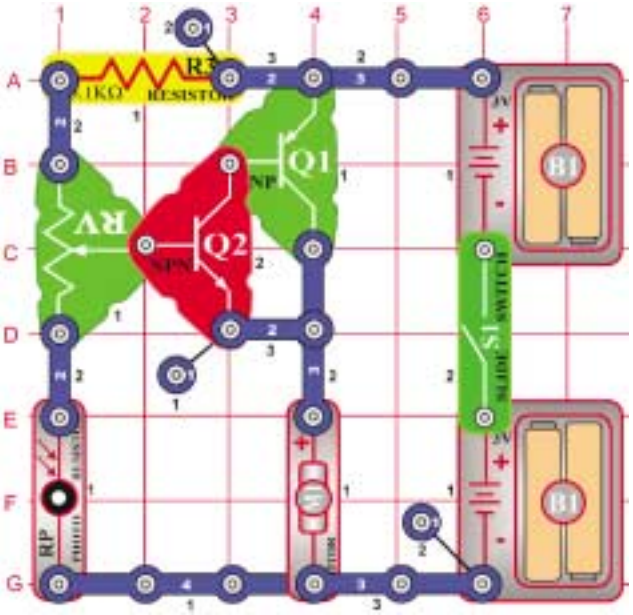
OBJECTIVE: ***To connect two sound ICs together to***

Build the circuit shown on the left. Place the fan onto the motor.

In the circuit, the alarm IC and the music IC are connected together. The sounds from both ICs can be played at the same time. Press the press switch (S2). The music IC plays and the green LED lights. Now set the switch on and press the press switch again. You should hear the sounds from both ICs playing. As the alarm IC plays, it also drives the fan and the red LED.

Project #280

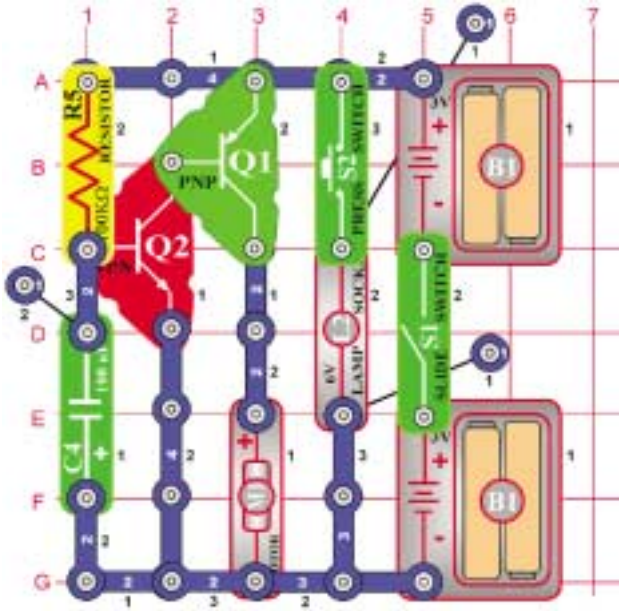
Electric Fan Stopped by Light



Turn the slide switch (S1) on and set the adjustable resistor (RV) control so the motor just starts spinning. Slowly cover the photosensitive resistor (RP) and the motor spins faster. By placing more light over the photosensitive resistor, the motor slows.

Project #281

Motor & Lamp

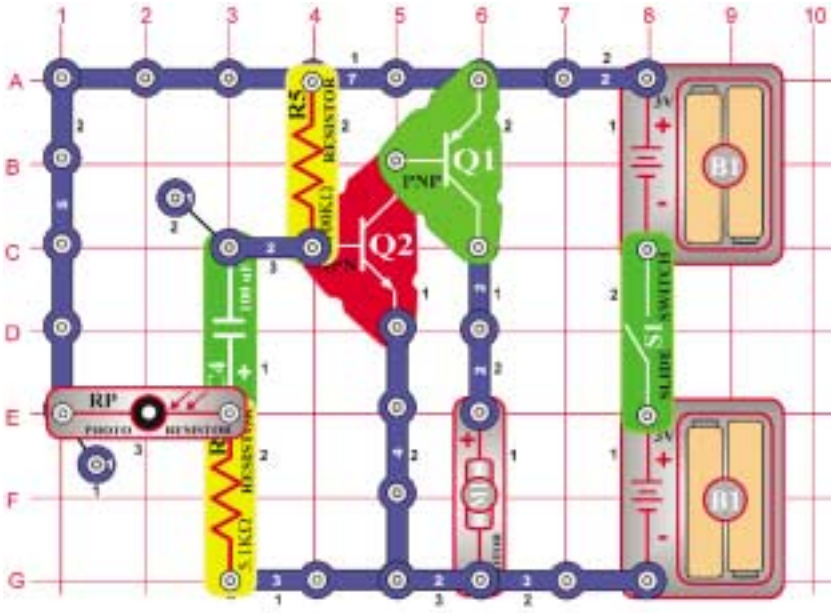


OBJECTIVE: ***To control large currents with a small***

Place the fan on the motor. Turn the slide switch (S1) on and the motor spins. The transistors are like two switches connected in series. A small current turns on the NPN transistor, which turns on the PNP transistor. The large current used to spin the motor now flows through the PNP. The combination allows a small current to control a much larger one.
Press the press switch (S2) and the lamp lights and slows the motor. When the lamp lights, the voltage across the motor decreases and slows it down.

Project #282

Start-Stop Delay

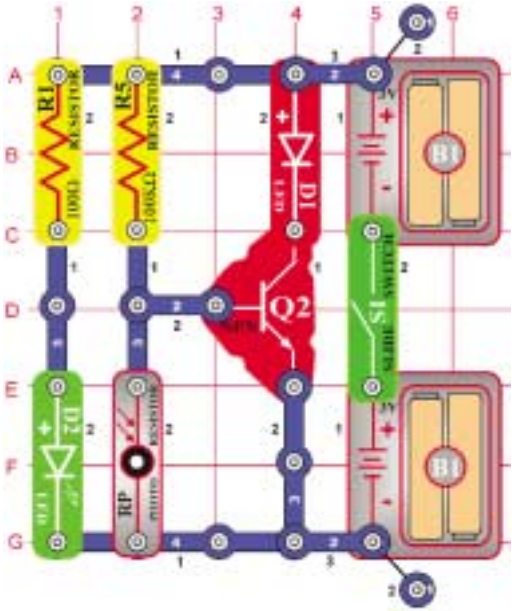


Place the fan on the motor. Turn the switch on, the motor starts spinning. As you move your hand over the photosensitive resistor, the motor slows. Now place a finger on top of the photosensitive resistor to block the light. The motor slows down. In a few seconds the motor speeds up again.

Project #283

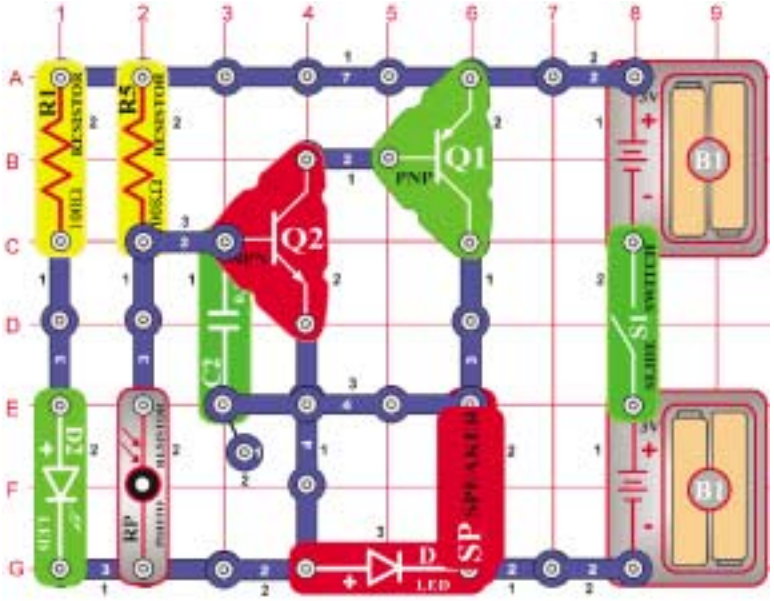
Mail Notifying System

OBJECTIVE: To build a circuit to indicate if you have



Turn the switch on. If there is light on the photosensitive resistor the red LED will not light. Place your finger over the resistor and now the red LED lights. A simple mail notifying system can be made using this circuit. Install the photosensitive resistor and the green LED inside the mailbox facing each other. Place the red LED outside the mailbox. When there is mail, the light is blocked from the photosensitive resistor and the red LED turns on.

Project #284 Mail Notifying Electronic Bell



OBJECTIVE: To build a circuit to indicate if you have

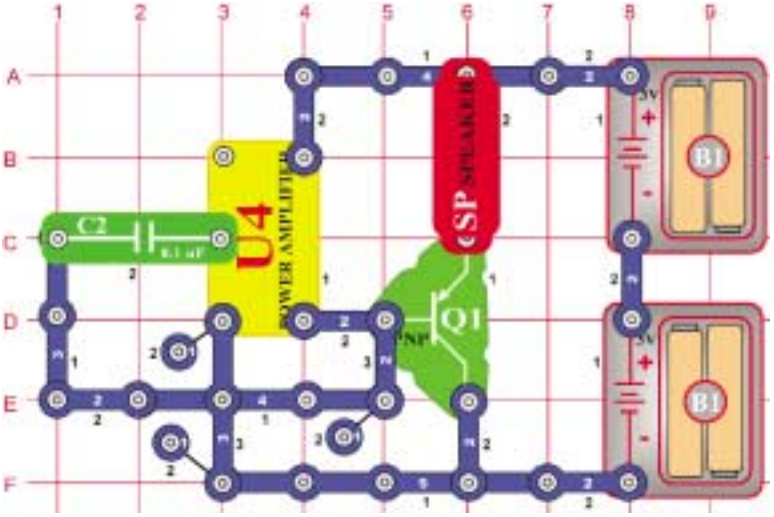
Turn the switch on. If there is light on the photosensitive resistor, the speaker will not make any sound. Place your finger over the resistor and now the speaker sounds. A simple mail notifying system can be made using this circuit. Install the photosensitive resistor and the green LED inside the mailbox facing each other. When there is mail, the light is blocked from the photosensitive resistor and the speaker turns on.

Project #285 Mail Notifying Electronic Fan

OBJECTIVE: To build a circuit to indicate if you have mail by

Replace the speaker with the motor and fan. When there is mail, the light is blocked from the photosensitive resistor and the motor spins.

Project #286 Twice-Amplified Oscillator



OBJECTIVE: To build an

The tone you hear is the frequency of the oscillator. Install different values of capacitors in place of the 0.1µF (C2) to change the frequency.

Project #287 Quick Flicking LED

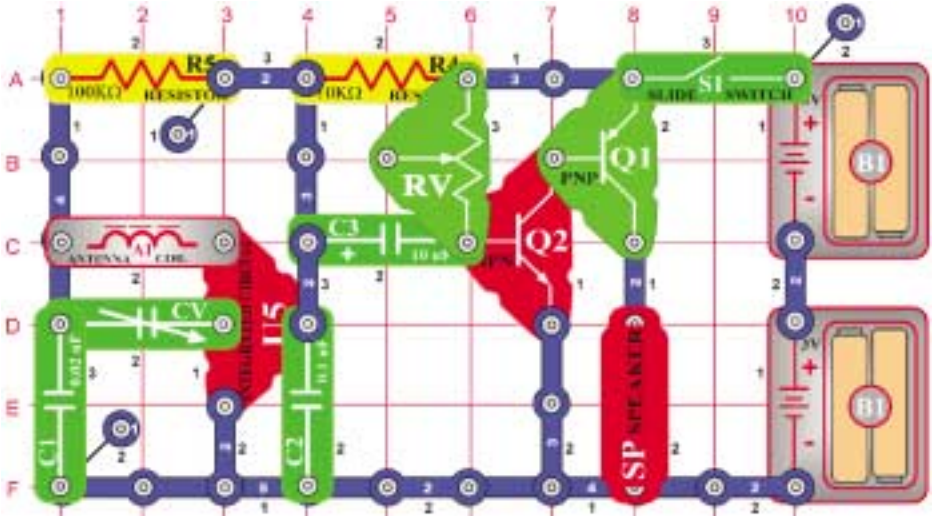
OBJECTIVE: To build a

Use the circuit from Project 286. Replace the speaker with a red LED (the + sign on top). Now you see the frequency of the oscillator. Install different values of capacitors to change the frequency.

Project #288

AM Radio with Transistors

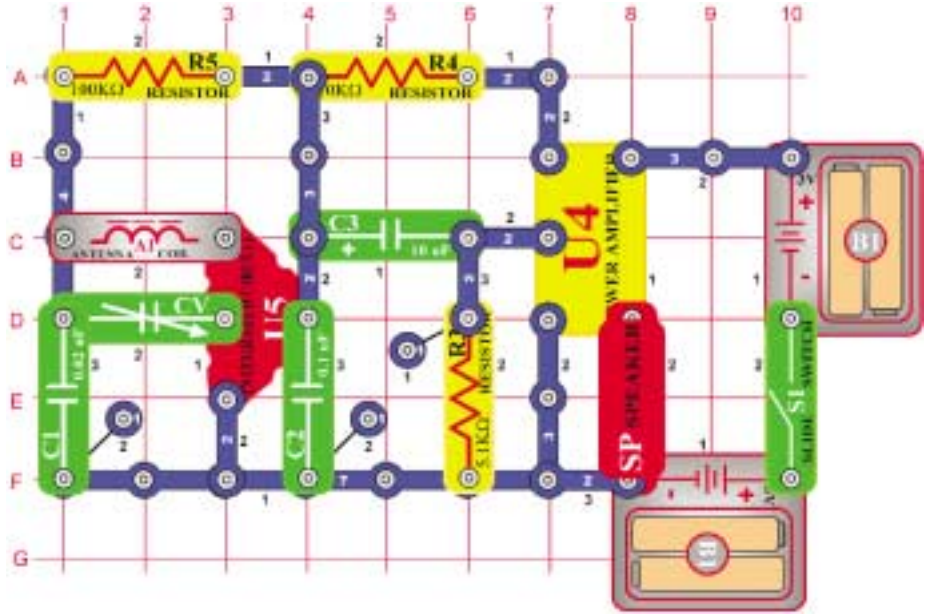
OBJECTIVE: ***To build a complete, working AM radio***



When you close the slide switch (S1), the integrated circuit (U5) should amplify and detect the AM radio waves. Tune the capacitor (CV) to the desirable station. The adjustable resistor (RV) is used as a simple resistor since the center tap is not used. The two transistors drive the speaker to complete the radio. The radio will not be very loud.

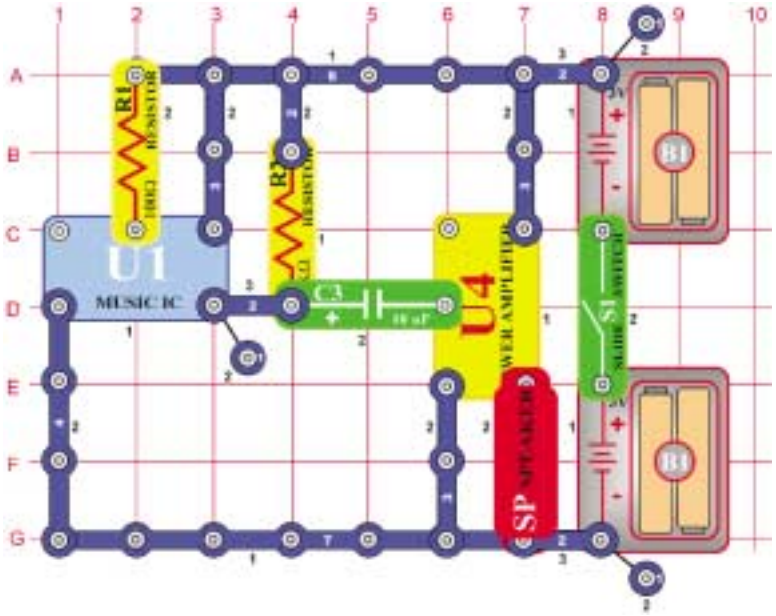
Project #289

AM Radio (II)



When you close the slide switch (S1), the integrated circuit (U5) should detect and amplify the AM radio waves. The signal is then amplified using the power amplifier (U4), which drives the speaker. Tune the capacitor (CV) to the desirable station.

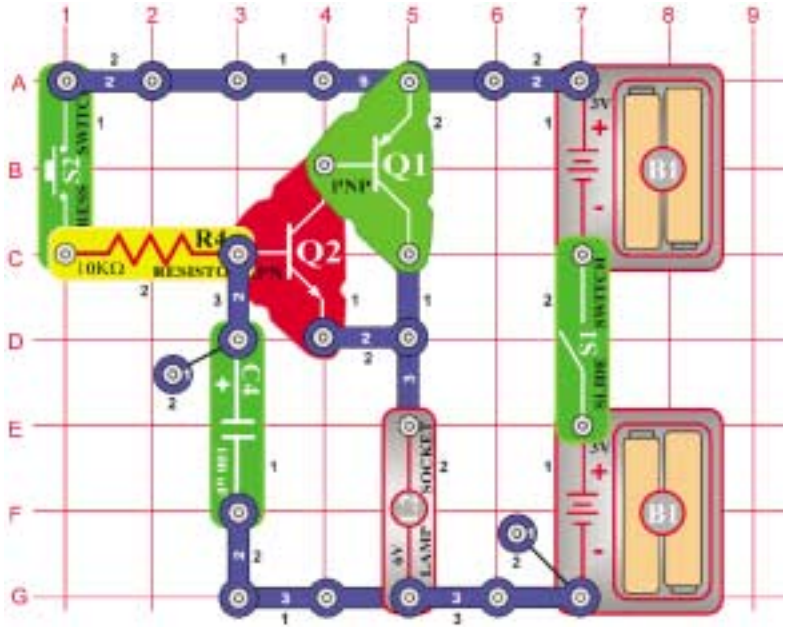
Project #290 Music Amplifier



OBJECTIVE: ***To amplify sounds from the music***

Build the circuit and turn on the switch. You will hear loud music, since the sound from the music integrated circuit is amplified by the power amplifier integrated circuit. All radios and stereos use a power amplifier.

Project #291 Delayed Action Lamp



OBJECTIVE: ***To build a lamp***

Be sure to use the 6V lamp (L2) for this circuit. Turn on the switch and press the press switch (S2). The lamp turns on slowly but stays on for a long while after you release the press switch.

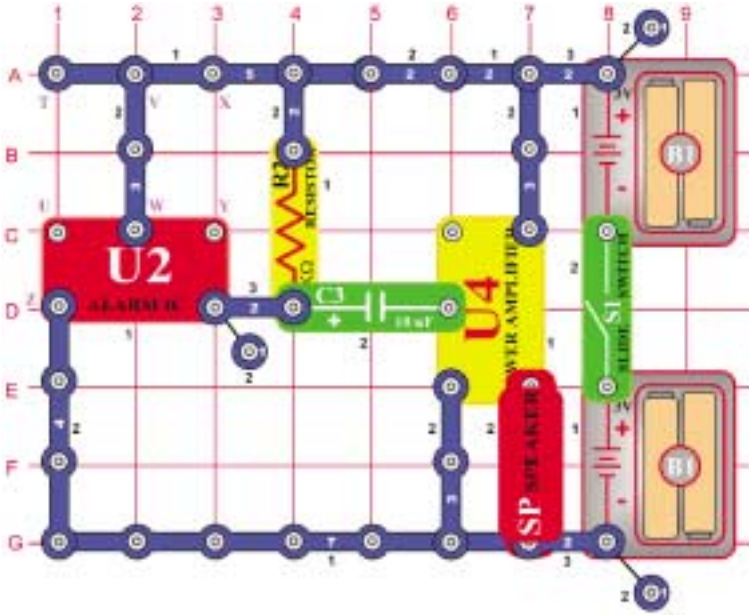
Project #292 Delayed Action Fan

OBJECTIVE: ***To build a fan that stays on for a***

Replace the lamp (L2) with the motor (M1), positive (+) side up. Be sure to put on the fan. Turn on the switch and press the press switch (S2). The fan turns on slowly but stays on for a while after you release the press switch.

Project #293

Police Siren Amplifier

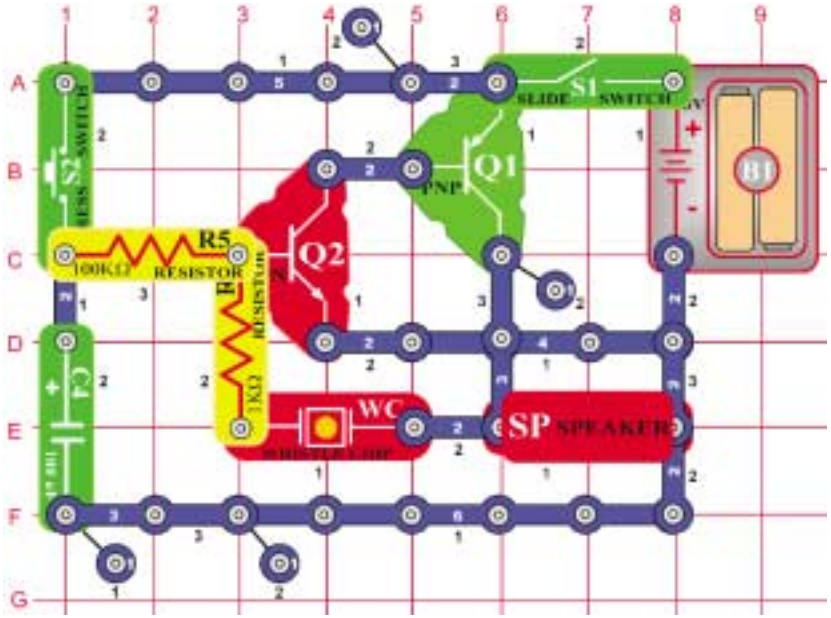


OBJECTIVE: To amplify sounds from the music

Build the circuit and turn on the switch. You will hear a very loud siren, since the sound from the alarm integrated circuit is amplified by the power amplifier integrated circuit. Sirens on police cars use a similar circuit, with an IC to create the sound and a power amplifier to make it very loud.

Project #294

Lasting Doorbell



OBJECTIVE: To build a doorbell that stays on for a

Build the circuit at left, note that there is a 4-snap wire on layer 1 that is not connected to a 3-snap wire that runs over it on layer 3. Turn on the slide switch (S1), then press and release the press switch (S2). There is a doorbell sound that slowly fades away.

When the press switch is pressed, the transistors are supplied with current for oscillation. At the same time, the capacitor is being charged. When the press switch is released, the capacitor discharges and keeps the oscillation going for a while.

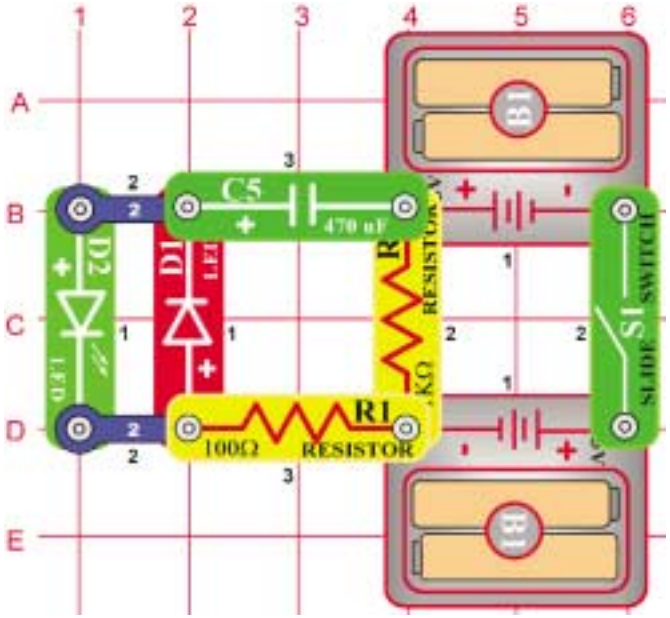
Project #295

Lasting Clicking

OBJECTIVE: To build a clicker that stays on for a

Place the 10µF capacitor (C3) on top of the whistle chip (WC). Press and release the press switch. It makes a clicking sound that repeats for a while.

Project #296 Leaky Capacitor



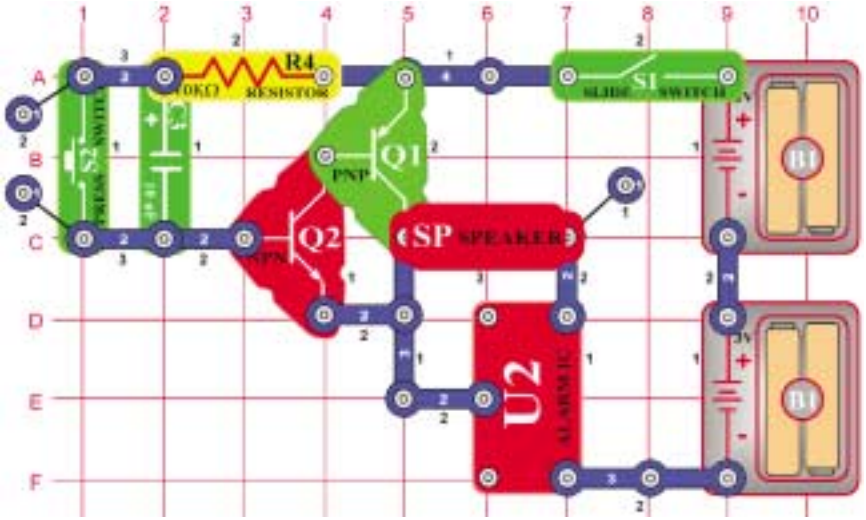
Build the circuit (be sure the positive (+) side of the capacitor is towards the left) and turn on the switch. The green light emitting diode (LED, D2) will flash brightly as the capacitor (C5) charges up and then becomes dim but will not be off. When you turn off the switch the red LED (D1) is initially bright but goes dim as the capacitor discharges itself through it.

Why doesn't the green LED go off after the capacitor becomes charged? It is because current is leaking through the 470µF capacitor. The positive (+) side of the capacitor should normally be facing towards the higher voltage side, in this circuit we have it facing away from the batteries. In most circuits this doesn't matter but in this case it does.

Reverse the position of the capacitor (so the positive (+) side is on the right) and turn on the switch again, now the green LED becomes totally off after the capacitor gets charged up. It doesn't leak now.

Project #297 Transistor Fading Siren

OBJECTIVE: To build a siren



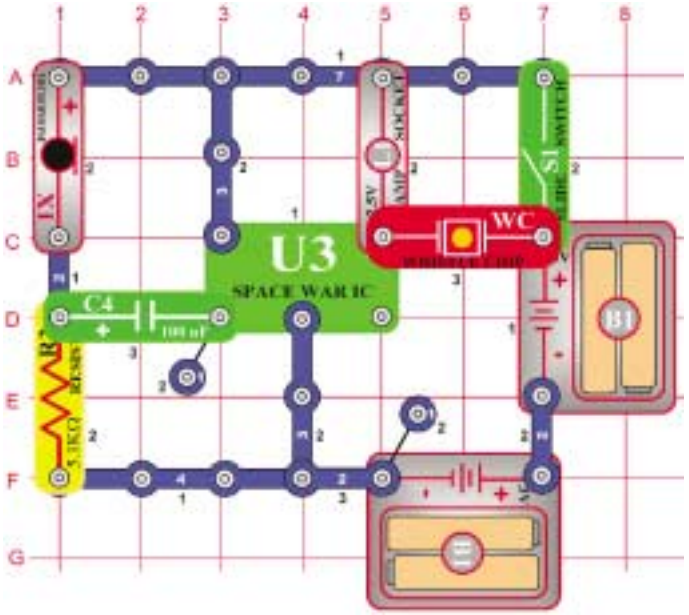
Turn on the switch, then press and release the press switch. You hear a siren that slowly fades away and eventually goes off. You can modify this circuit to make machine gun or ambulance sound instead like in the other projects. You can also replace the 10µF capacitor (C3) with the 100µF (C4) or 0.1µF (C2) to greatly slow down or speed up the fading.

Project #298 Fading Doorbell

OBJECTIVE: To build a doorbell that slowly fades

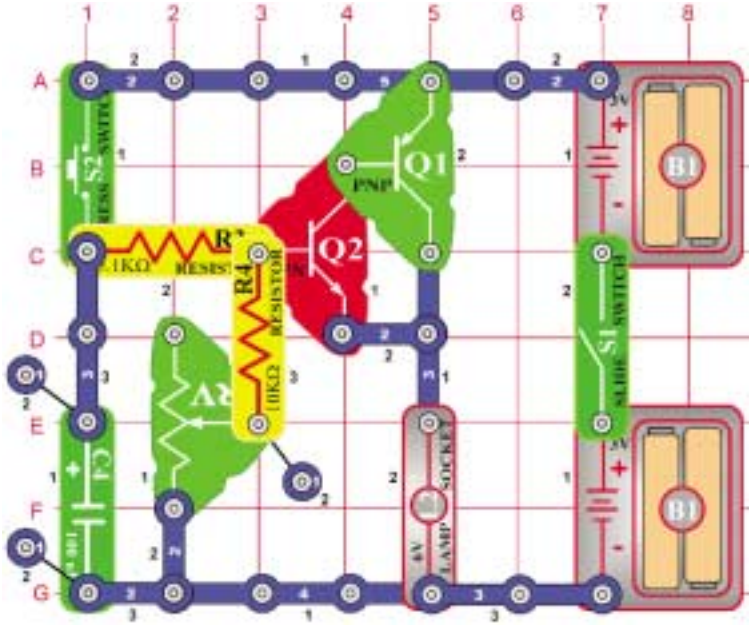
Replace the alarm IC (U2) with the music IC (U1). The circuit works the same way but now it has a doorbell sound.

Project #299 Blowing Space War Sounds



Turn on the switch and you will hear explosion sounds and the lamp is on or flashing. Blow into the microphone (X1) and you can change the sound pattern.

Project #300 Adjustable Time Delay Lamp



OBJECTIVE: To build a lamp

Be sure to use the 6V lamp (L2) for this circuit. Turn on the switch and press the press switch (S2). The lamp stays on for a while after you release the press switch. You can change the delay time with the adjustable resistor (RV).

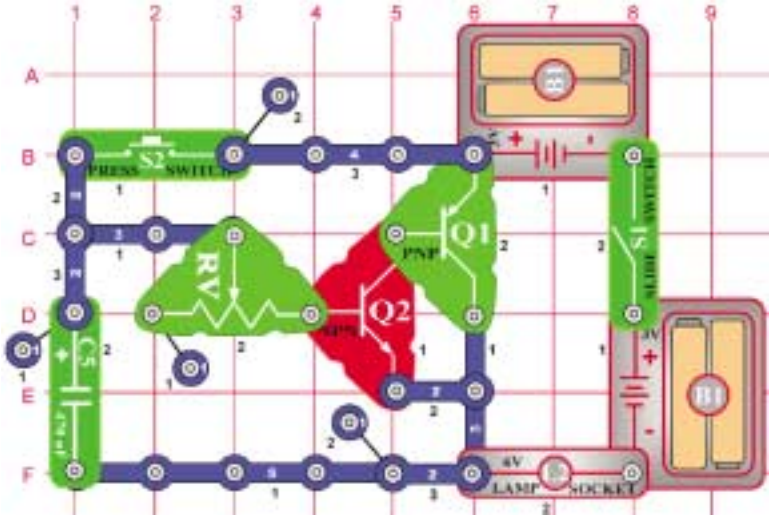
Project #301 Adjustable Time Delay Fan

OBJECTIVE: To build a

Replace the lamp (L2) with the motor (M1), be sure to put on the fan. Turn on the switch and press the press switch (S2). The fan stays on for a while after you release the press switch. You can change the delay time with the adjustable resistor (RV).

Project #302 Adjustable Time Delay Lamp (II)

OBJECTIVE: To build a lamp



Be sure to use the 6V lamp (L2) for this circuit. Turn on the switch and press the press switch (S2). The lamp stays on for a few seconds after you release the press switch. You can change the delay time with the adjustable resistor (RV).

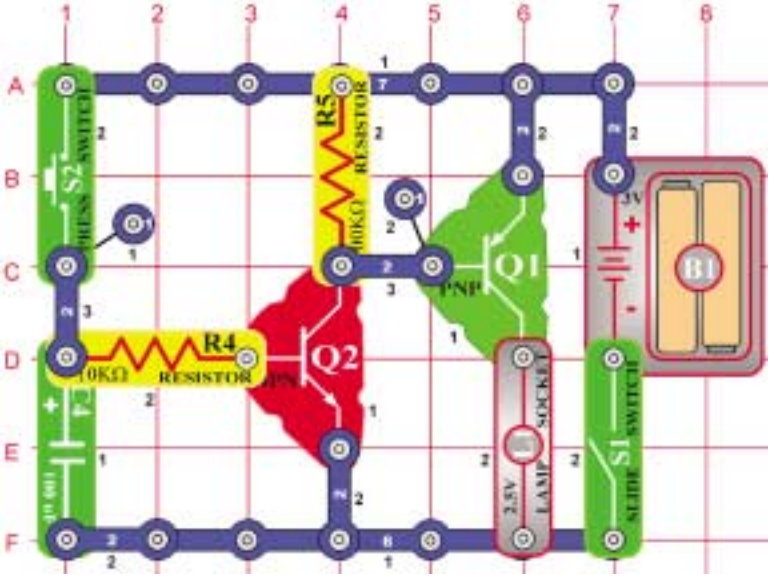
Project #303 Adjustable Time Delay Fan (II)

OBJECTIVE: To build a fan

Replace the lamp (L2) with the motor (M1), be sure to put on the fan. Turn on the switch and press the press switch (S2). The fan stays on for a while after you release the press switch. You can change the delay time with the adjustable resistor (RV).

Project #304 Watch Light

OBJECTIVE: To build a lamp



Turn on the switch and press the press switch (S2). The lamp stays on for a few seconds after you release the press switch.

A miniature version of a circuit like this might be in your wristwatch - when you press a light button on the watch to read the time in the dark, a light comes on but automatically turns off after a few seconds to avoid draining the battery.

Project #305 Delayed Bedside Fan

OBJECTIVE: To build a fan

Replace the lamp (L2) with the motor (M1, positive (+) side up), be sure to put on the fan. Turn on the switch and press the press switch (S2). The fan stays on for a while after you release the press switch. This could have a longer delay and be near your bed, to turn off after you fall asleep.