SNAP CIRCUITS™

Projects 1-101

Instruction Manual

REV-B Revised 2002

PARTS LIST (Symbols and Numbers)

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
☐ 1		Base Grid (11.0" x 7.7")		6SC30055	☐ 1	D1	Red Light Emitting Diode (LED)		6SC30017
☐ 1	1	1-Snap Wire		6SC30001	☐ 1	L1	2.5V Lamp Socket 2.5V Bulb (2.5V, 0.3A) Type 14 or similar		6SC30018 6SC30118
☐ 1	2	2-Snap Wire		6SC30002	☐ 1	B1	Battery Holder - uses 2 1.5V type AA (not included)		6SC30019
☐ 1	3	3-Snap Wire		6SC30003	☐ 1	SP	Speaker		6SC30020
☐ 1	4	4-Snap Wire		6SC30004	☐ 1	U1	Music Integrated Circuit		6SC30021
☐ 1	5	5-Snap Wire		6SC30005	☐ 1	U2	Alarm Integrated Circuit		6SC30045
☐ 1	6	6-Snap Wire		6SC30006	☐ 1	U3	Space War Integrated Circuit		6SC30051
☐ 1	WC	Whistle Chip		6SC30011	☐ 1	M1	Motor Fan		6SC30024 6SC30056
☐ 1	S1	Slide Switch		6SC30014	☐ 1	R1	100Ω Resistor		6SC30053
☐ 1	S2	Press Switch		6SC30015	☐ 1 ☐ 1		Jumper Wire (Black) Jumper Wire (Red)		870006 870008
☐ 1	RP	Photo Resistor		6SC30016	**You may order additional / replacement parts at our website: www.elenco.com/snapcircuits**				

HOW TO USE IT

The Electronic Snap Circuit Kit has 101 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), or (6) 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 have a power source block number (B1) that need two (2) "AA" batteries (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.

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.

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.

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.

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. If we use them in future manual revisions, we will send you a copy of the manual so you can show your family and friends.

Troubleshooting

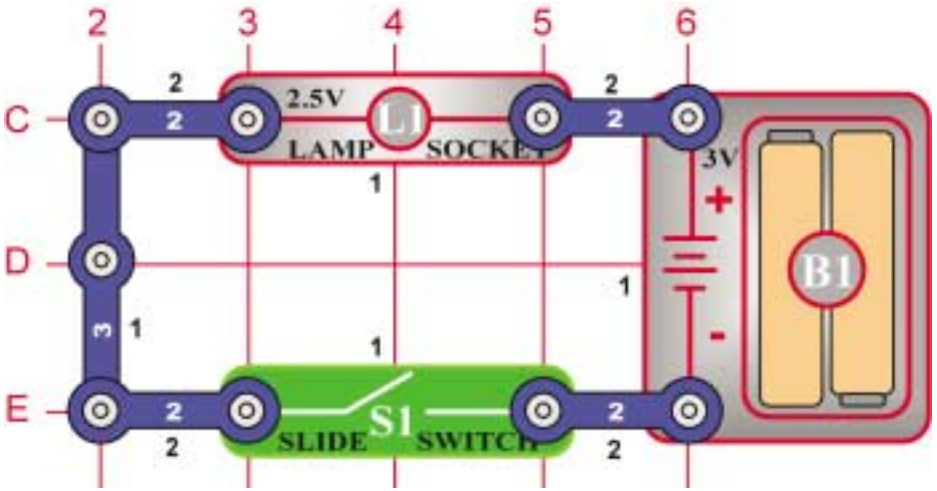
Most circuit problems are due to incorrect assembly, always double-check that your circuit exactly matches the drawing for it. Be sure that parts with positive/negative markings are positioned as per the drawing. Sometimes the light bulbs come loose, tighten them as needed. Try replacing the batteries.

PROJECT LISTINGS

Project #1

Electric Light & Switch

OBJECTIVE: To show how electricity is turned "ON"



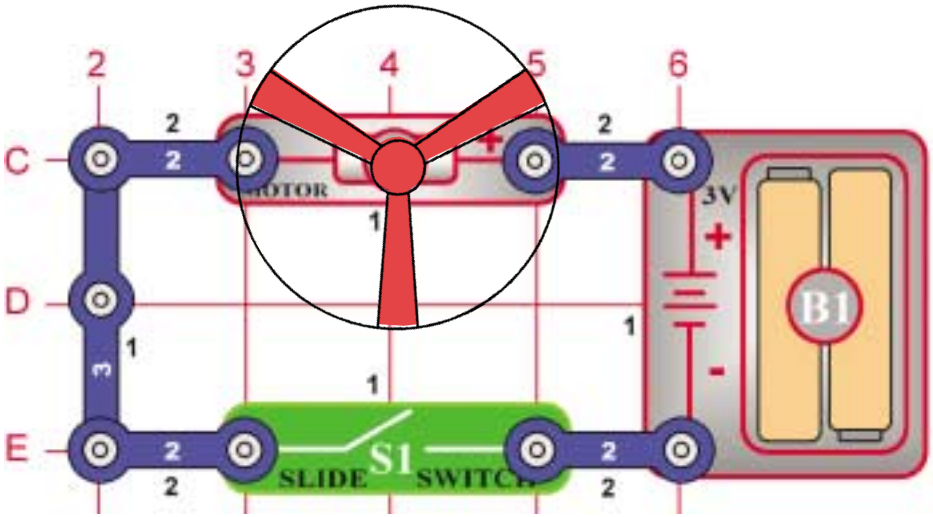
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Install two (2) "AA" batteries (not included) into the battery holder (B1) and screw the bulb into the lamp socket (L1) if you have not done so already.

When you close the slide switch (S1), current flows from the batteries through the lamp and back to the battery through the switch. The closed switch completes the circuit. In electronics this is called a closed circuit. When the switch is opened, the current can no longer flow back to the battery, so the lamp goes out. In electronics this is called an open circuit.

Project #2

DC Motor & Switch

OBJECTIVE: To show how electricity is used to run a

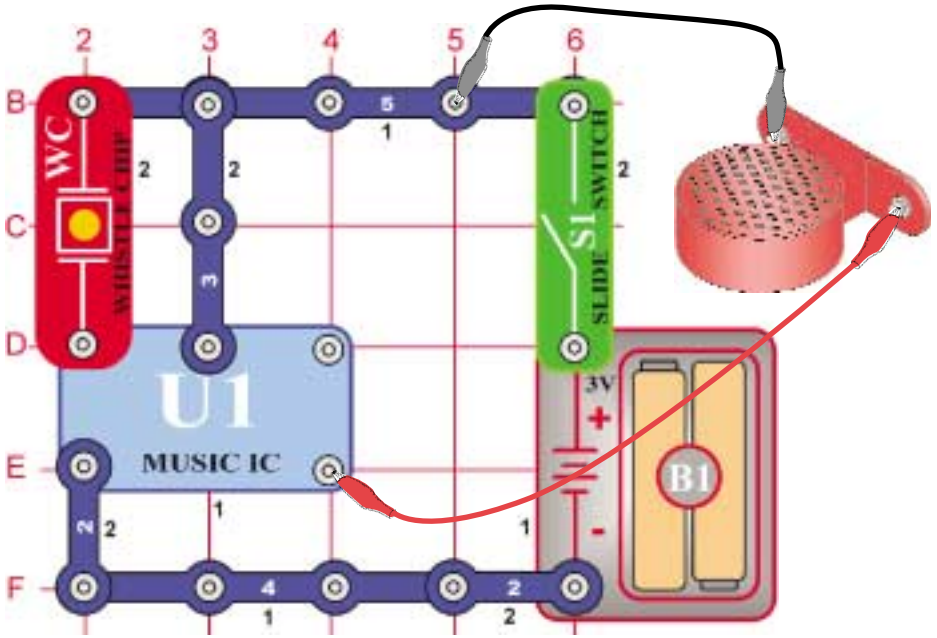


Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

When you close the switch (S1), current flows from the batteries through the motor making it rotate. Place the fan blade on the motor shaft and close the slide switch (S1). The motor will rotate forcing the fan blade to move air past the motor.

In this project, you changed electrical power into mechanical power. DC motors are used in all the battery powered equipment requiring rotary motion, such as a cordless drill, electric tooth brush, and toy trains that run on batteries just to name a few. An electric motor is much easier to control than gas or diesel engines.

Project #3



Sound Activated Switch

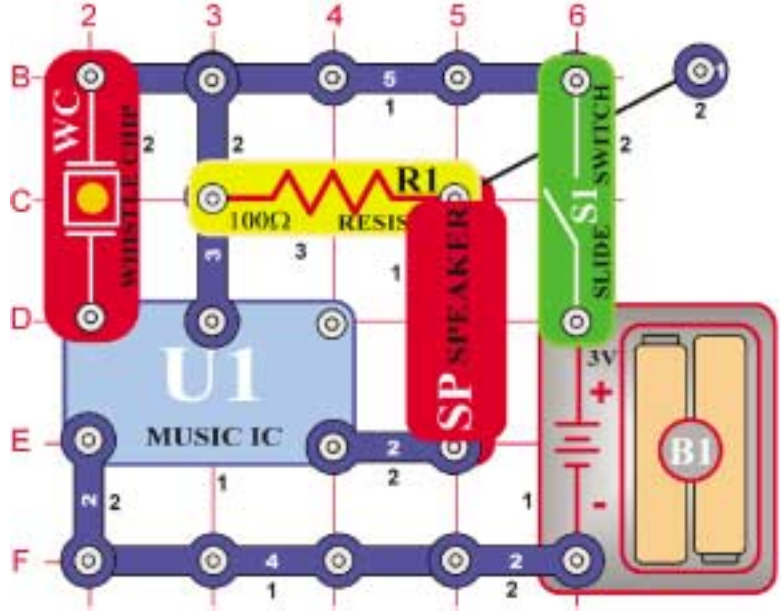
OBJECTIVE: To show how sound can turn "ON" an

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, lay the speaker on the table and connect it to the circuit using the jumper wires as shown.

When you close the slide switch (S1), the music may play for a short time, and then stop. After the music has stopped, clap your hands close to the whistle chip or tap the base with your finger. The music should play again for a short time, then stop. Blow on the whistle chip and the music should play.

You could connect the speaker using snap wires instead of the jumper wires, but then the speaker may create enough sound vibrations to re-activate the whistle chip.

Project #4



Adjusting Sound Level

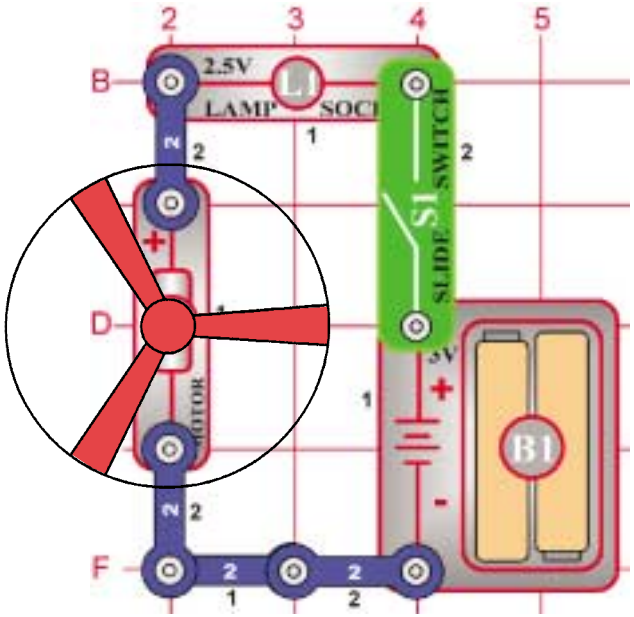
OBJECTIVE: To show how resistance can lower the

Build the circuit shown on the left by placing the speaker onto the base grid. A 2-snap wire connects it to the music IC. A 1-snap wire goes on level 2 at base grid location C5 and is under the resistor as shown in the drawing. Add the 100Ω resistor (R1) on level 3.

When you close the slide switch (S1), the music may play for a short time and then stop. After the music has stopped, clap your hands close to the whistle chip or tap the base with your finger. The music should play again for a short time, then stop.

In this project, you changed the amount of current that goes through the speaker and reduced the sound output of the speaker. Resistors are used throughout electronics to limit the amount of current that flows.

Project #5



Lamp & Fan in Series

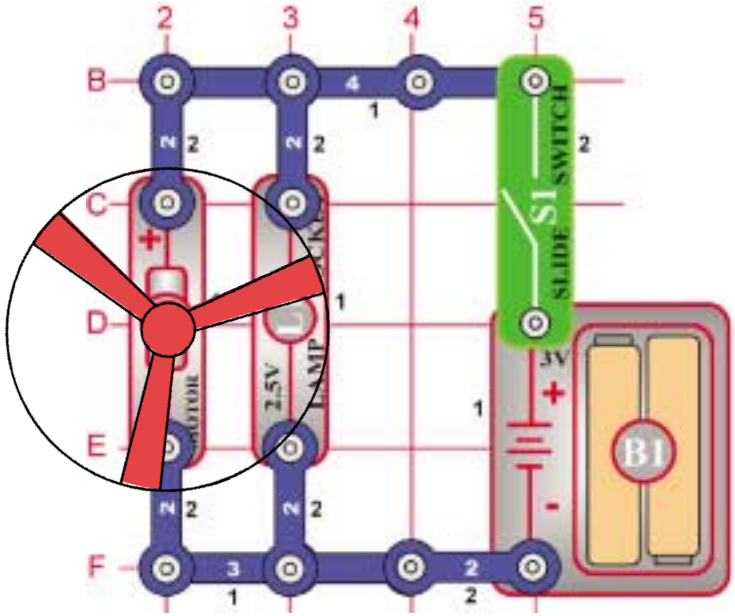
OBJECTIVE: To show how a lamp can indicate when

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, place the fan blade on the motor.

When you close the slide switch (S1), the fan will spin and the light should turn on. The fan will take a while to start turning due to inertia. Inertia is the property that tries to keep a body at rest from moving and tries to keep a moving object from stopping.

The light helps protect the motor from getting the full voltage when the switch is closed. Part of the voltage goes across the light and the rest goes across the motor. Remove the fan and notice how the light gets dimmer when the motor does not have to spin the fan blade.

Project #6



Lamp & Fan in Parallel

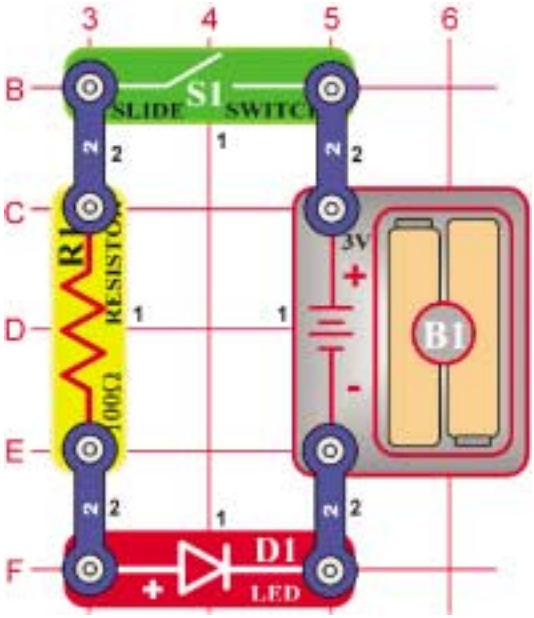
OBJECTIVE: To show how an indicator light can be

Build the circuit shown on the left.

When you close the slide switch (S1), both the fan and the light should turn on. The fan will take a while to start turning due to inertia. In this connection, the lamp does not change the current to the motor. The motor should start a little faster than in Project #5.

Remove the fan and notice how the light does not change in brightness as the motor picks up speed. It has its own path to the battery.

Project #7



Light Emitting Diode

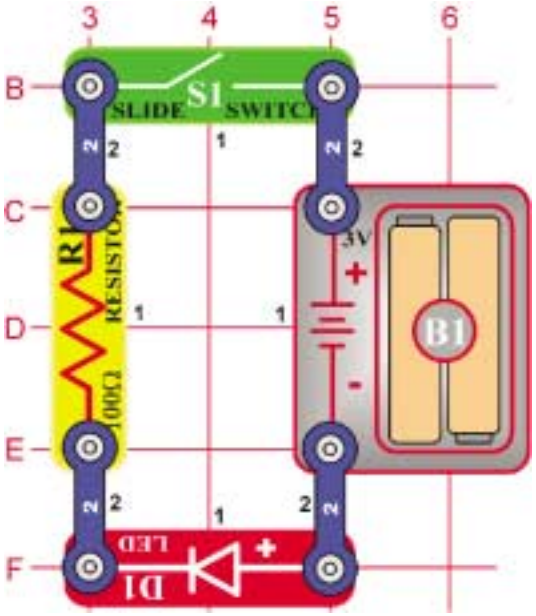
OBJECTIVE: To show how a resistor and LED are

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

When you close the slide switch (S1), current flows from the batteries through the switch, through the resistor, through the LED (light emitting diode) and back to the battery. The closed switch completes the circuit. The resistor limits the current and prevents damage to the LED. NEVER PLACE AN LED DIRECTLY ACROSS THE BATTERY! If no resistor is in the circuit, the battery may push enough current through the LED to damage the semiconductor that is used to produce the light. LEDs are used in all types of electronic equipment to indicate conditions and pass information to the user of that equipment.

Can you think of something you use everyday that has an LED in it?

Project #8



One Direction for LED

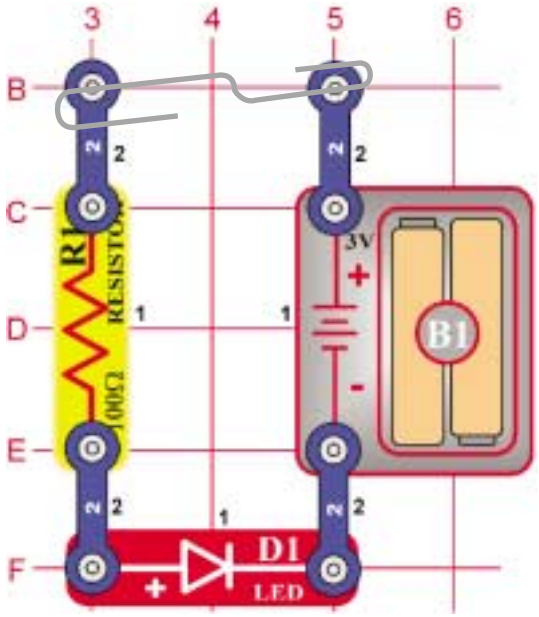
OBJECTIVE: To show how electricity can only pass in

Rebuild the circuit used in Project #7 but put the LED in as shown on the left.

When you close the slide switch (S1), current should flow from the batteries through the resistor and then through the LED. When current flows through an LED, it lights up. Since the LED is in backwards, current cannot flow. The LED is like a check valve that lets current flow in only one direction.

In this project, you changed the direction for current through the LED. An electronic component that needs to be connected in one direction is said to have polarity. Other parts like this will be discussed in future projects. Placing the LED in backwards does not harm it because the voltage is not large enough to break down this electronic component.

Project #9



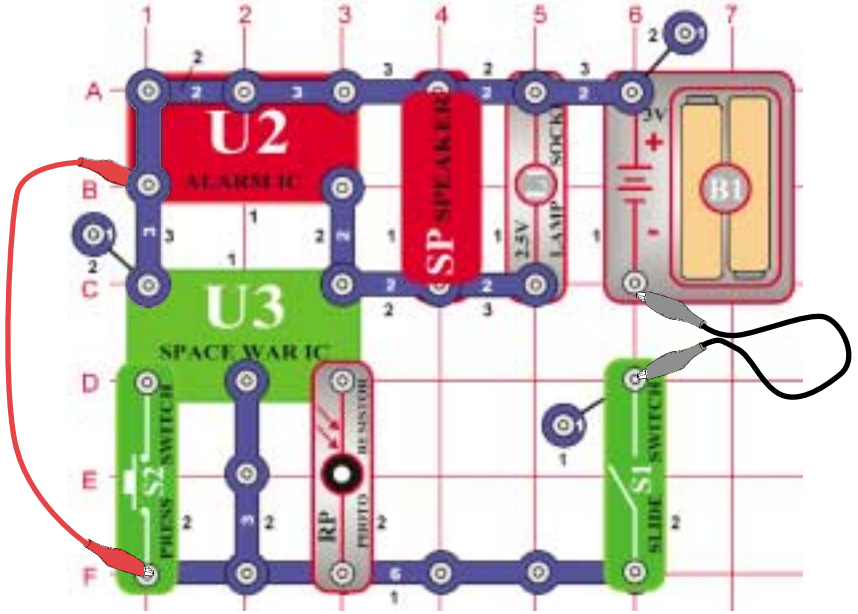
Conduction Detector

OBJECTIVE: ***To make a circuit that detects the***

Rebuild the circuit from Project #7 but leave the on-off switch out as shown on the left.

When you place a paper clip across the terminals as shown in the picture on the left, current flows from the batteries through the resistor, through the LED, and back to the battery. The paper clip completes the circuit and current flows through the LED. Place your fingers across the terminals and the LED does not light. Your body is too high of a resistance to allow enough current to flow to light the LED. If the voltage, which is electrical pressure, was higher, current could be pushed through your fingers and the LED would light. This detector can be used to see if a material like plastic is a good conductor or a poor conductor.

Project #10



Space War Alarm Combo

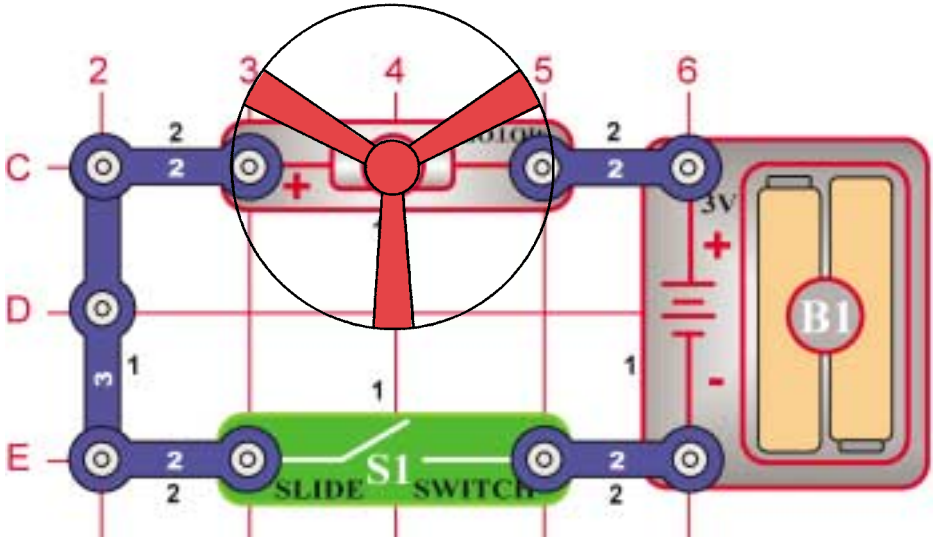
OBJECTIVE: ***To combine the sounds from the space***

Build the circuit shown and add the jumpers to complete it. Note that the red jumper wire connects to the alarm IC (U2) at base grid location C1 and not to the 3-snap wire that runs over it, and that some contact points on the alarm IC (U2) are passed over without being connected to. Turn it on, press the press switch (S2) several times, and wave your hand over the photosensitive resistor (RP) to hear all the sound combinations. If the sound is too loud you may replace the speaker (SP) with the whistle chip (WC).

Project #11

Flying Saucer

OBJECTIVE: To make a circuit that launches the fan



Rebuild the circuit from Project #2, but reverse the polarity on the motor so the negative (–) on the motor goes to the positive (+) on the battery.

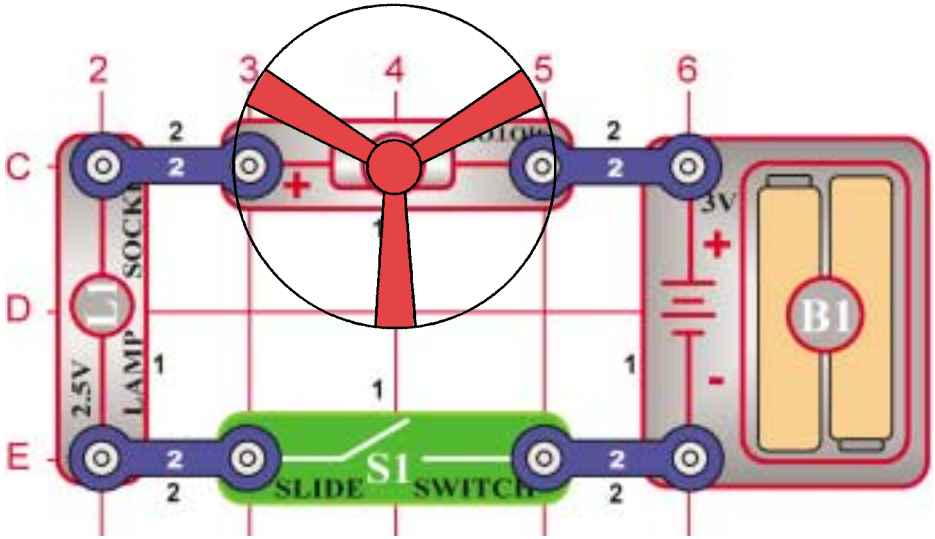
When you close the slide switch (S1), the motor will slowly increase in speed. When the motor has reached maximum rotation, turn the slide switch (S1) off. The fan blade should rise and float through the air like a flying saucer. Be careful not to look directly down on fan blade when it is spinning.

The air is being blown down through the blade and the motor rotation locks the fan on the shaft. When the motor is turned off, the blade unlocks from the shaft and is free to act as a propeller and fly through the air. If speed of rotation is too slow, the fan will remain on motor shaft because it does not have enough lift to propel it. The motor will spin faster when both batteries are new.

Project #12

Decreasing Saucer Lift

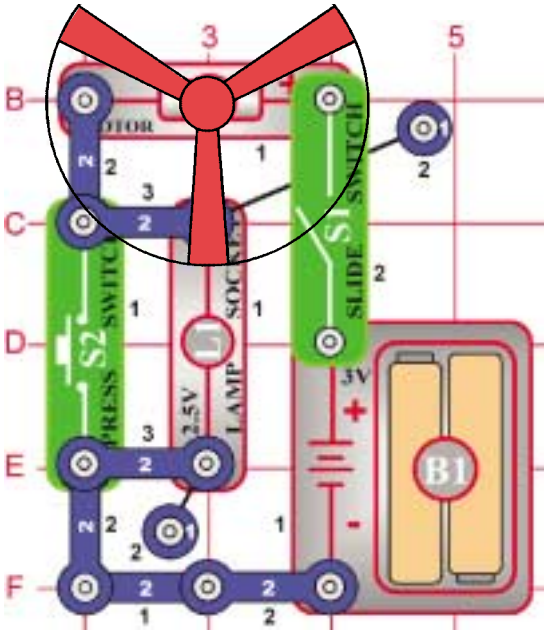
OBJECTIVE: To show how voltage effects speed of a



Change the circuit in Project #11 by adding the lamp (L1) in series with the motor as shown in the diagram on the left.

When you place the lamp in series with any electronic device, it will draw less current because it adds resistance. In this case, the lamp in series reduces the current through the motor, and that reduces the top speed of the motor. Close the slide switch (S1), and wait until the fan reaches maximum speed. Open the switch and observe the difference in the height due to the lamp. In most cases, it may not even launch.

Project #13



Two-Speed Fan

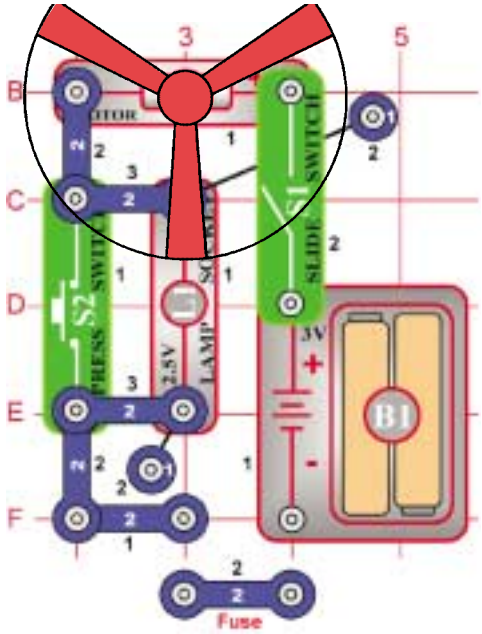
OBJECTIVE: To show how switches can increase or

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, add the 2-snap wires that are marked with a 3.

When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), motor (M1), the lamp (L1), and back to the battery (B1). When the press switch (S2) is closed, the lamp is shorted and motor speed increases.

The principle of removing resistance to increase motor speeds is only one way of changing the speed of the motor. Commercial fans do not use this method because it would produce heat in the resistor and fans are used to cool circuits by moving air over them. Commercial fans change the amount of voltage that is applied to the motor using a transformer or other electronic device.

Project #14



The Fuse

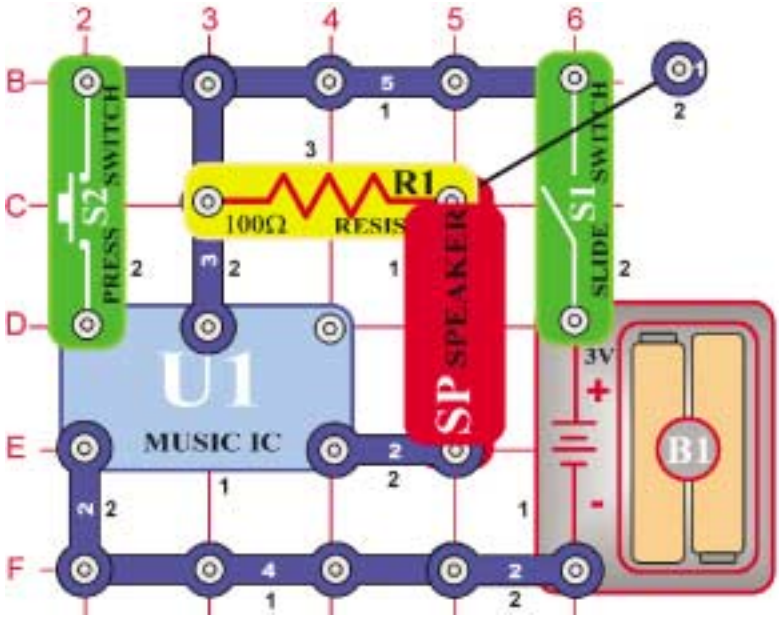
OBJECTIVE: To show how a fuse is used to break all

Use the circuit built in Project 13.

When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), the lamp (L1), motor (M1), and back to the battery (B1). Pretend the 2-snap wire marked fuse in the drawing on the left is a device that will open the circuit if too much current is taken from the battery. When press switch (S2) is closed, the light is shorted and motor speed increases due to an increase in current to the motor. While still holding press switch (S2) down, remove the 2-snap wire marked fuse and notice how everything stops. Until the fuse is replaced, the open circuit path protects the electronic parts. If fuses did not exist, many parts could get hot and even start fires. Replace the 2-snap wire and the circuit should return to normal.

Many electronic products in your home have a fuse that will open when too much current is drawn. Can you name some?

Project #15



Musical Doorbell

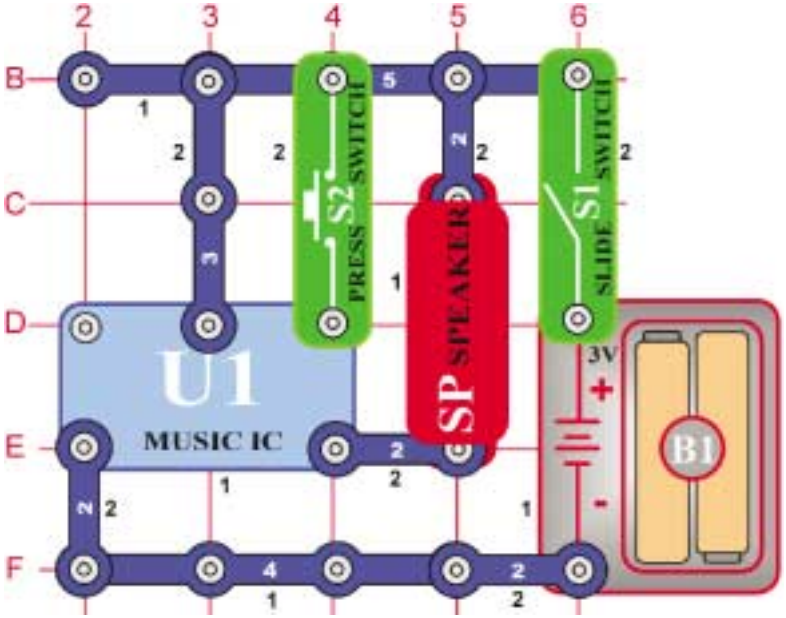
OBJECTIVE: To show how an integrated circuit can be

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, insert the 100Ω resistor last on level 3.

When you close the slide switch (S1), the music integrated circuit (U1) may start playing one song then stop. Each time you press the press switch "doorbell button" (S2) the song will play again and stop. Even if you let go of the press switch (S2), the integrated circuit keeps the song playing until it has reached the end of the song.

Musical integrated circuits are used to entertain young children in many of the toys and chairs made to hold infants. If the music is replaced with words, the child can also learn while they are entertained. Because of great advances in miniaturization, many songs are stored in a circuit no bigger than a pinhead.

Project #16



Momentary Alarm

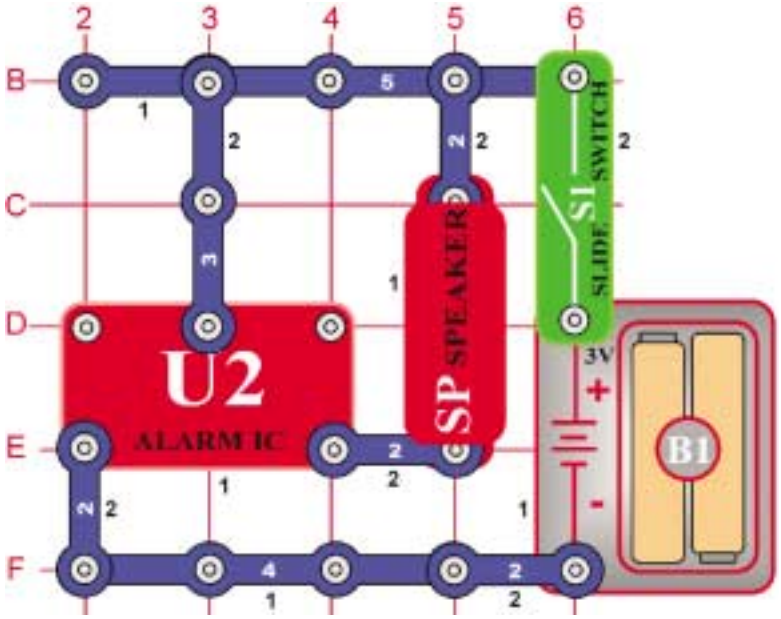
OBJECTIVE: To show how integrated circuits can also

Modify the circuit used in Project 15 to look like the one shown on the left.

When you close the slide switch (S1), the music integrated circuit (U1) may start playing one song then stop. The song will be much louder than in the previous project because it is now being used as an alarm. Each time you press the press switch "alarm button" (S2) after the song stops playing, the song will play again, but only while you hold the button down.

Project #17

Alarm Circuit



OBJECTIVE: To show how an integrated circuit can be

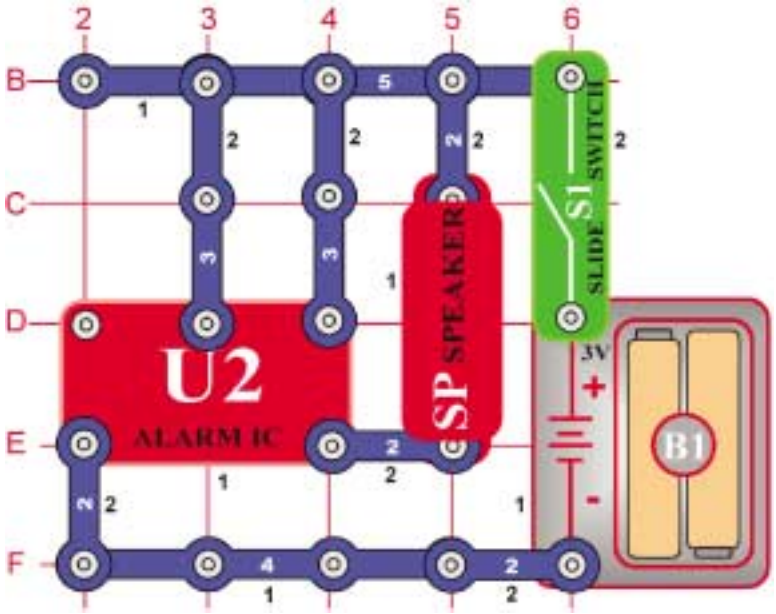
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

When you close the slide switch (S1), the integrated circuit should start sounding a very loud alarm sound. This integrated circuit is designed to sweep through all the frequencies so even hard of hearing people can be warned by the alarm.

If the alarm sound was passed through an amplifier and installed into a police car, it would also serve as a good police siren.

Project #18

Laser Gun

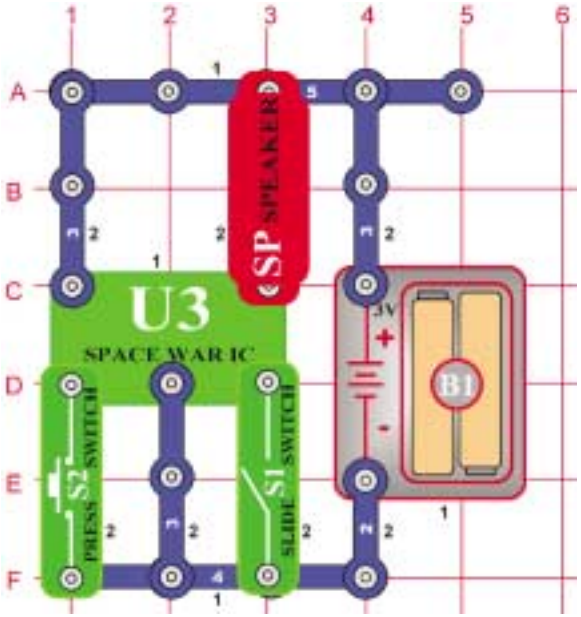


OBJECTIVE: To show how integrated circuits sound

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

When you close the slide switch (S1), the integrated circuit should start sounding a very loud laser gun sound. This integrated circuit is designed to produce different sounds that can easily be changed. You can even switch the sound on and off quickly to add sound effects to your games or recordings.

Project #19 Space War



OBJECTIVE: To introduce you to the space war

Build the circuit shown on the left, which uses the space war integrated circuit. Activate it by flipping the switch or pressing the key, do both several times and in combination. You will hear an exciting range of sounds, as if a space war is raging!

Like the other integrated circuits, the space war IC is a super-miniaturized electronic circuit that can play a variety of cool sounds stored in it by using just a few extra components.

In movie studios, technicians are paid to insert these sounds at the precise instant a gun is fired. Try making your sound occur at the same time an object hits the floor. It is not as easy as it sounds.

Project #20 Light Switch

OBJECTIVE: To show how light can control a circuit using

Use the circuit from Project 19 above, but replace the slide switch (S1) with the photosensitive resistor (RP). The circuit immediately makes noise. Try turning it off. If you experiment, then you can see that the only ways to turn it off are to cover the photosensitive resistor, or to turn off the lights in the room (if the room is dark). Since light is used to turn on the circuit, you might say it is a "light switch".

The photosensitive resistor contains material that changes its resistance when it is exposed to light, as more light shines on it decreases its resistance. Parts like this are used in a number of ways that affect our lives. For example, you may have streetlights in your neighborhood that turn on when it starts getting dark and turn off in the morning.

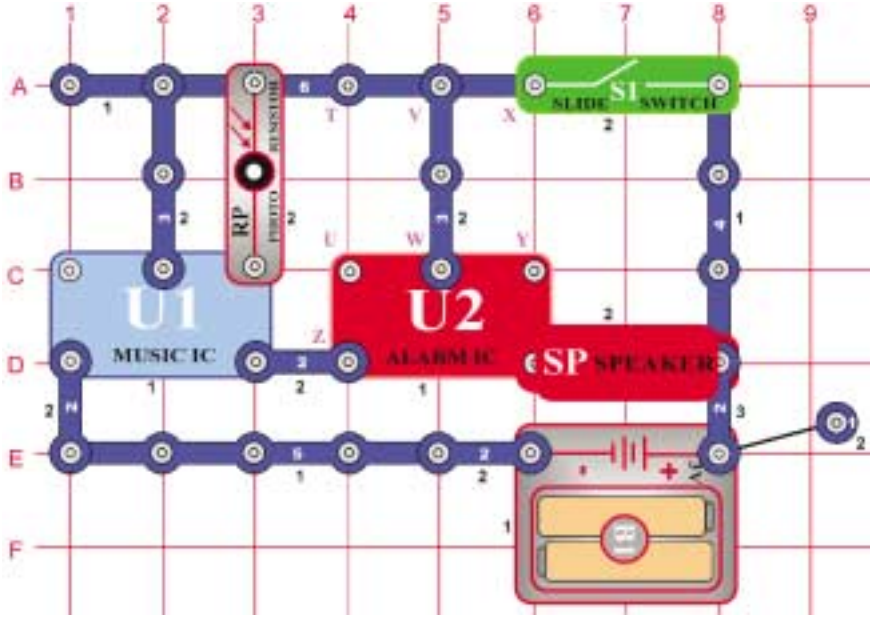
Project #21 Paper Space War

OBJECTIVE: To give a more dramatic demonstration of

Use the same circuit as for Project 20. Find a piece of white paper that has a lot of large black or dark areas on it, and slowly slide it over the photosensitive resistor. You should hear the sound pattern constantly changing, as the white and dark areas of the paper control the light to the photosensitive resistance. You can also try the pattern below or something similar to it:

Project #22

Light Police Siren



OBJECTIVE: To build a police siren that is controlled

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, insert the parts with a 3 last on level 3.

Cover the photosensitive resistor (RP) and turn on the switch (S1). A police siren is heard for a while and stops, then you can control it by covering or uncovering the photosensitive resistor.

Project #23

More Loud Sounds

OBJECTIVE: To show variations of the circuit in

Modify the circuit in Project 22 by connecting points X and Y. The circuit now sounds like a machine gun.

Project #24

More Loud Sounds (II)

OBJECTIVE: To show variations of the circuit in

Now remove the connection between X and Y and then make a connection between T and U. The circuit works the same way but now it sounds like a fire engine.

Project #25

More Loud Sounds (III)

OBJECTIVE: To show variations of the circuit in

Now remove the connection between T and U and then make a connection between U and Z. The circuit works the same way but now it sounds like an ambulance.

Project #26

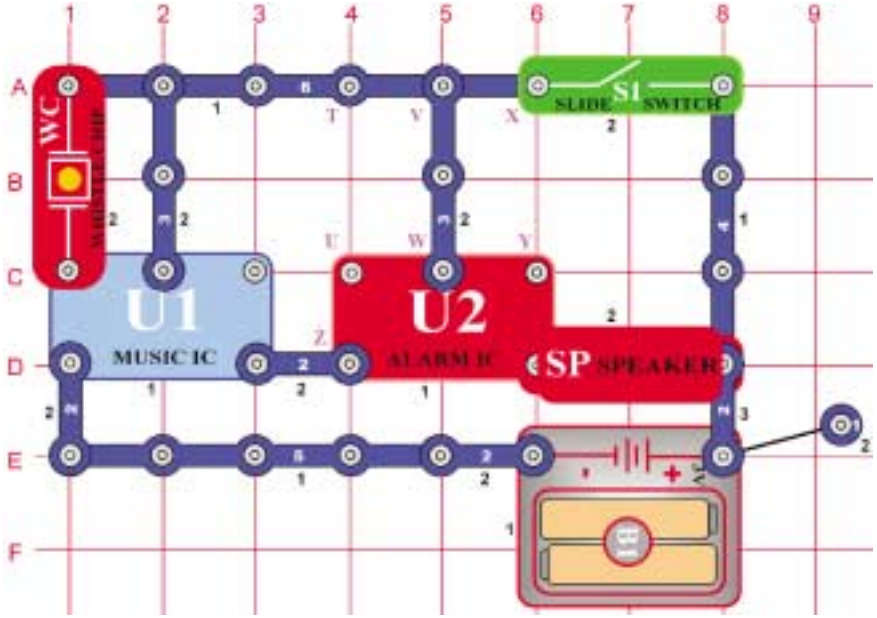
More Loud Sounds (IV)

OBJECTIVE: To show variations 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. The circuit works the same way but now it sounds like a familiar song but with static.

Project #27

Clap Sounds



OBJECTIVE: To build a police siren and other sounds

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, insert the parts with a 3 last on level 3.

Turn on the slide switch (S1) and a police siren is heard and then stops, clap your hands and it will play again. Note however that music can be heard faintly in the background of the siren. If clapping does not trigger the sound, tap the whistle chip with your finger.

Project #28

More Clap Sounds

OBJECTIVE: To show

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 #29

More Clap Sounds (II)

OBJECTIVE: To show

Now remove the connection between X and Y and then make a connection between T and U. The circuit works the same way but now it sounds like a fire engine.

Project #30

More Clap Sounds (III)

OBJECTIVE: To show

Now remove the connection between T and U and then make a connection between U and Z. The circuit works the same way but now it sounds like an ambulance.

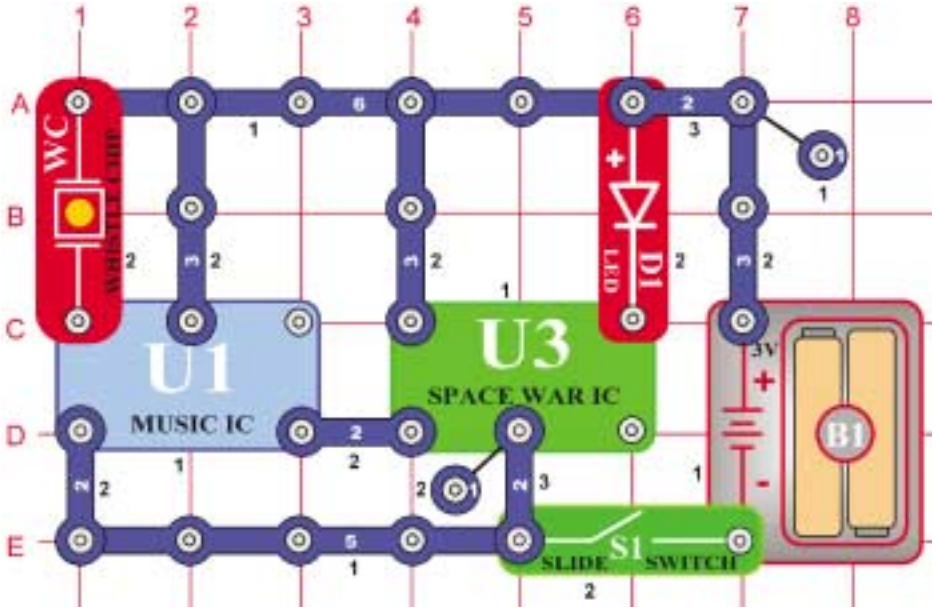
Project #31

More Clap Sounds (IV)

OBJECTIVE: To show

Now remove the connections between U and Z and between V and W, then make a connection between T and U. The circuit works the same way but now it sounds like a familiar song but with static.

Project #32 Voice Light Diode



OBJECTIVE: To build a circuit that uses your voice to control a light

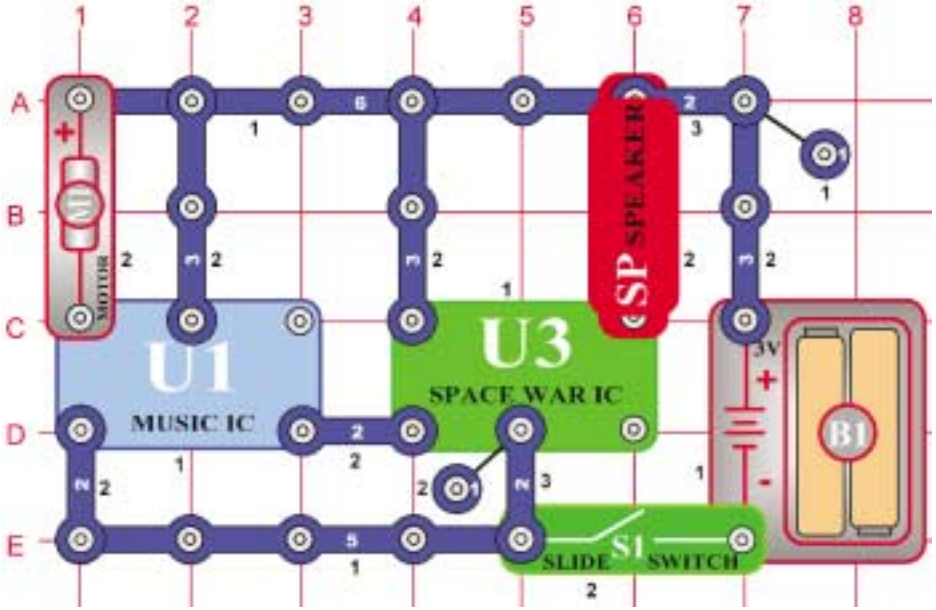
Build the circuit shown on the left and turn on the switch. The LED (D1) may be on for a while and then turn off. Clap or talk loud and the diode will light again and keep flickering for a little while.

Project #33 Voice Control

OBJECTIVE: To use your

The preceding circuit probably did not seem too exciting; so replace the LED (D1) with the speaker (SP). You hear a range of exciting sounds. Clap or talk loud and the sounds will resume.
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 #34 Motor Space Sounds



OBJECTIVE: To build a circuit that uses a motor to activate space

Turn it on and wait for any sounds to stop then spin the motor and the sounds play again.

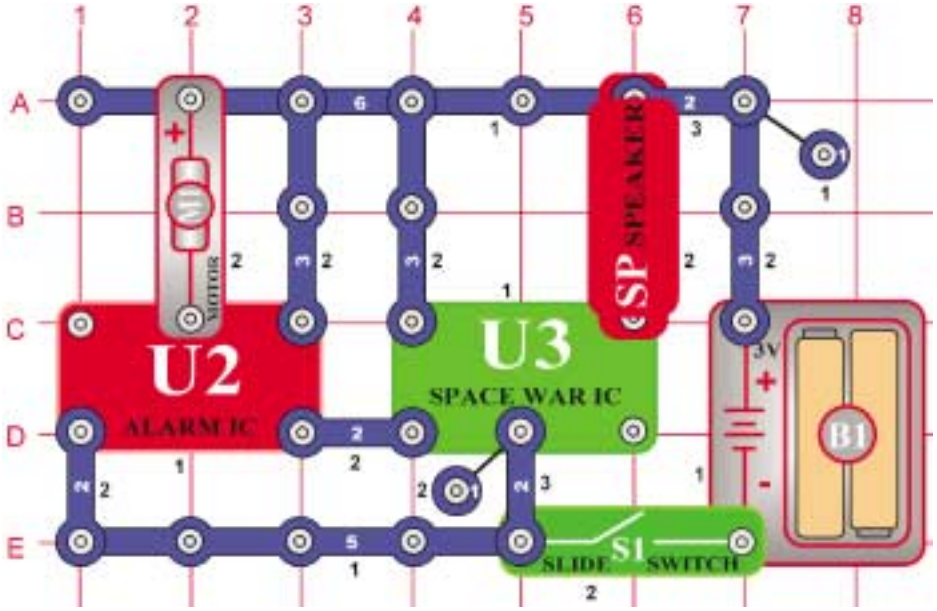
Do you know why turning the motor makes the sound play? Actually, the DC motor is also a DC generator and when you turn it, the motor generates a voltage that triggers the sound circuits.

Project #35 Motor Space Light

OBJECTIVE: To build a circuit that uses a motor to

This circuit is loud and may bother other people around you so replace the speaker with the LED (D1), (position it like in Project 32); the circuit operates in the same manner.

Project #36 Space Battle (II)



OBJECTIVE: To show another way of using the space war integrated

Build the circuit shown on the left, which is based on the circuit in the Space War Project 19. Turn on the switch and you will hear exciting sounds, as if a space battle is raging!

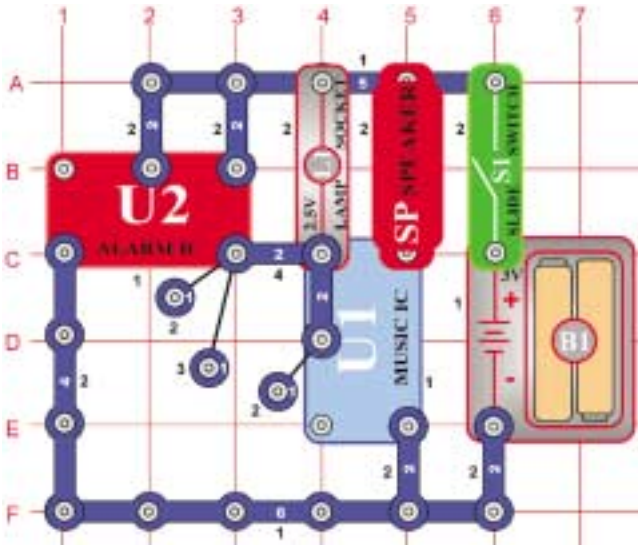
The motor is used here as a 3-snap wire, and will not spin.

Project #37 Silent Space Battle

OBJECTIVE: To show another way of using the

The preceding circuit is loud and may bother people around you, so replace the speaker (SP) with the LED (D1), position it as in Project 32. Now you have a silent space battle.

Project #38 Periodic Sounds



OBJECTIVE: To build a circuit with light and sound that change

Build the circuit shown on the left and turn it on. The lamp alternates between being on and off while the speaker alternates between two musical tones. . . like someone is flipping a switch, but at a very consistent rate. Periodic signals like this are very important in electronics.

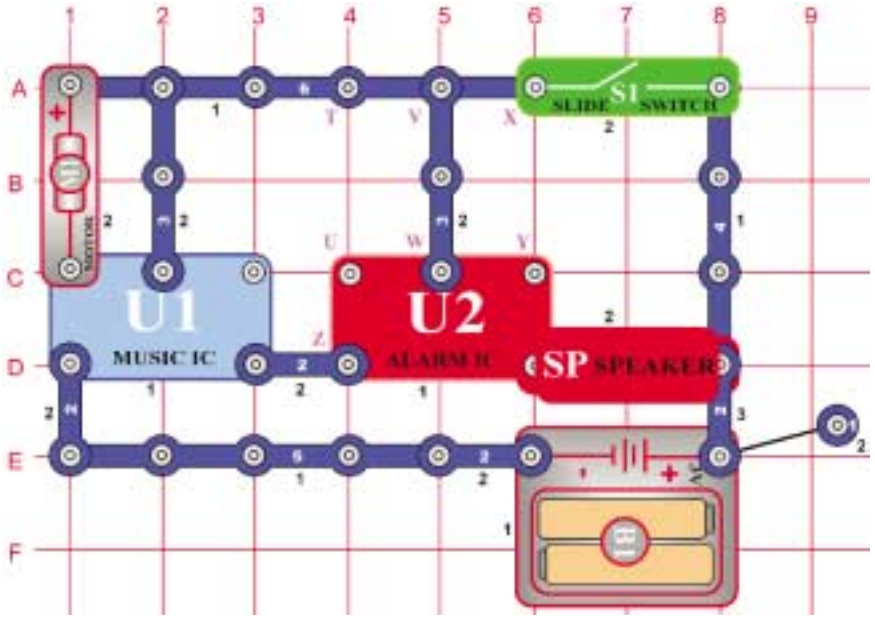
Project #39 Blinking Double Flashlight

OBJECTIVE: To build a circuit

In the circuit at left, replace the speaker (SP) with an LED (D1); position it as in Project 32. The lamp alternates between being on and off while the LED alternates between being dimmer and brighter.

Project #40

Motor-Controlled Sounds



OBJECTIVE: To show how motion can trigger

This circuit is controlled by spinning the motor with your hands. Turn on the switch and spin the motor, a police siren is heard and then stops. Spin the motor and it will play again. Note, however, that music can be heard faintly in the background of the siren.

Project #41

More Motor Sounds

OBJECTIVE: To show how motion can trigger

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 #42

More Motor Sounds (II)

OBJECTIVE: To show how motion can trigger

Now remove the connection between X and Y and then make a connection between T and U. The circuit works the same way but now it sounds like a fire engine.

Project #43

More Motor Sounds (III)

OBJECTIVE: To show how motion can trigger

Now remove the connection between T and U and then make a connection between U and Z. The circuit works the same way but now it sounds like an ambulance.

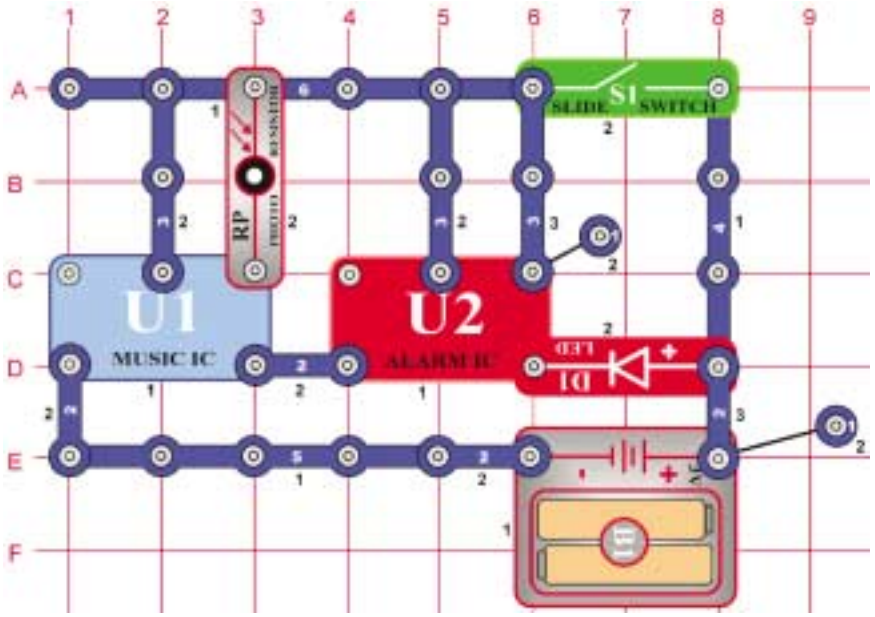
Project #44

More Motor Sounds (IV)

OBJECTIVE: To show how motion can trigger

Now remove the connections between U and Z and between V and W, then make a connection between T and U. The circuit works the same way but now it sounds like a familiar song but with static.

Project #45



Light-Controlled Flicker

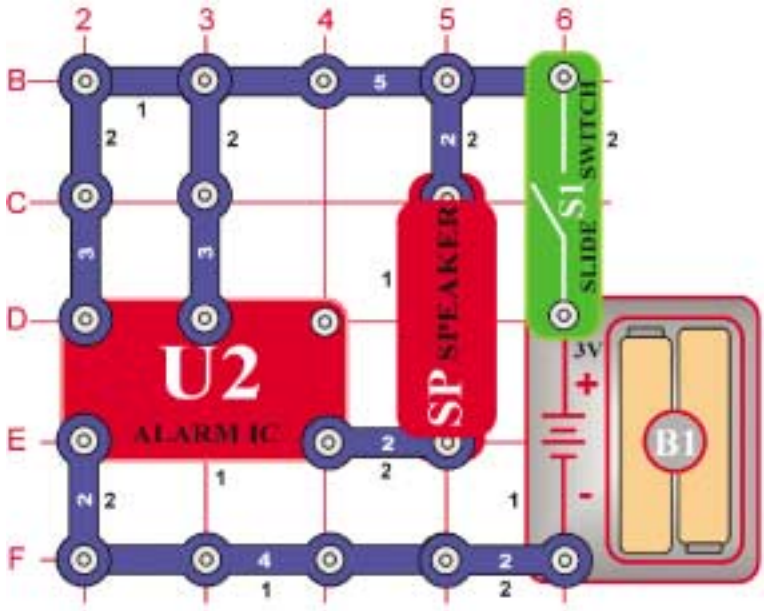
OBJECTIVE: To make a circuit that uses light to

This circuit does not use the noisy speaker it uses a nice quiet LED. Turn on the switch, the LED flickers. Cover the photosensitive resistor and the flicker stops. The flicker is controlled by the photosensitive resistor, uncover it and the flicker resumes.

People that are deaf need lights to tell them when a doorbell is ringing. They also use circuits like this to tell them if an alarm has been triggered or an oven is ready.

Can you think of other uses?

Project #46



More Sound Effects

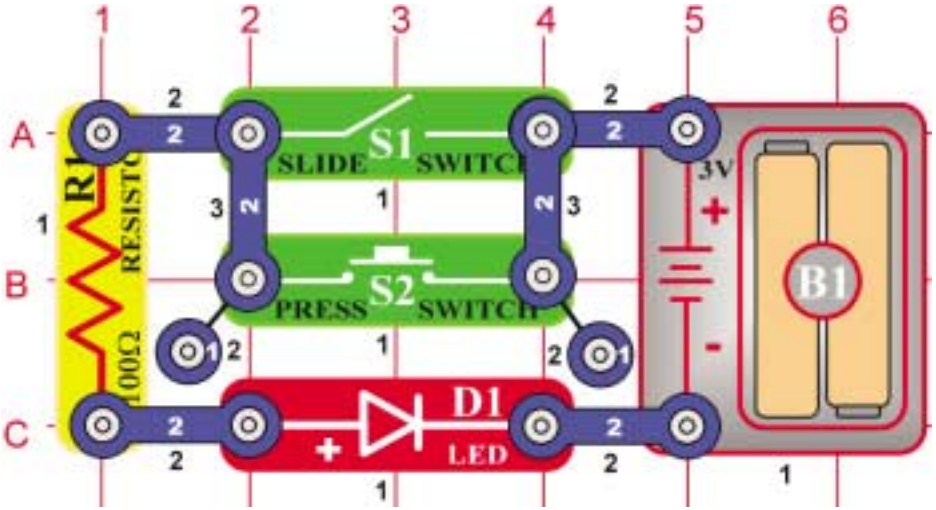
OBJECTIVE: To investigate the different sound effects

Build the circuit shown on the left. When you close the slide switch (S1), the integrated circuit should start sounding an up-down siren. This is just one more sound effect that this integrated circuit is designed to produce. Different sounds that can easily be changed are very important when designing games and toys. Switch the sound on and off quickly and see if you can create even different effects. This mode will create many robotic sounds if switched quickly.

Project #47

This OR That

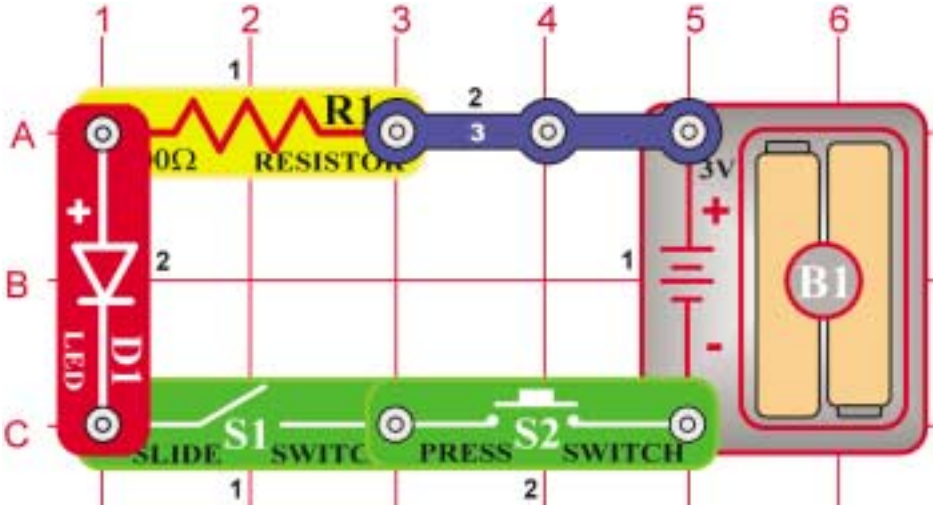
OBJECTIVE: To introduce you to the OR concept of



Build the circuit shown. Notice that if you turn on the slide switch (S1) OR press the press switch (S2) the LED lights up. There is no partially lit state here, the diode is either totally on or totally off. While this may seem very simple and boring, it represents an important concept in electronics. Two switches like this may be used to turn on a light in your house, or they might be two sensors at a railroad crossing used to start the ding-ding sound and lower the gate. You could also have more than two switches and the circuit would function the same way.

Project #48

This AND That



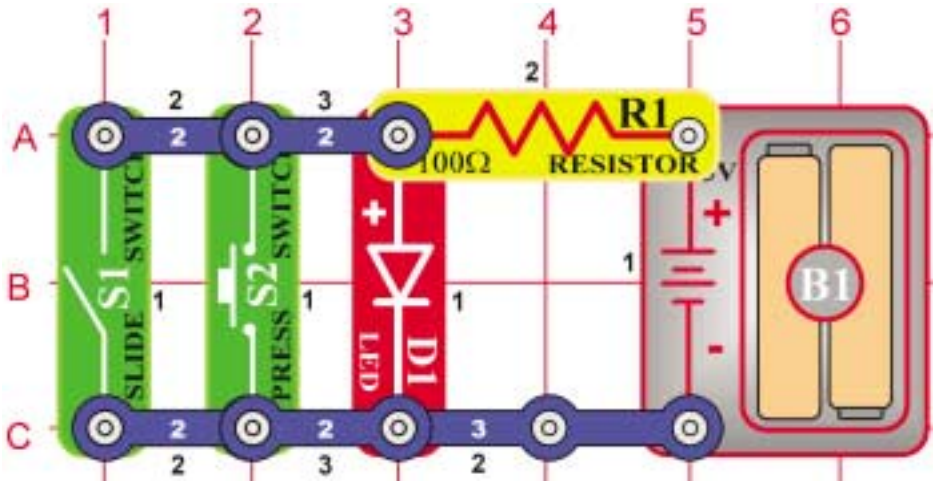
Build the circuit shown. Notice that if you turn on the slide switch (S1) AND press the press switch (S2) the LED lights up. Once again, there is no partially lit state here, the LED is either totally on or totally off. Two switches like this may be used to turn on the same light in your house, the room switch and the master switch in the electrical box. You could also have more than two switches and the circuit would function the same way.

Combinations of AND and OR circuits are used to add and multiply numbers together in modern computers. These circuits are made of tiny transistors in massive integrated circuits.

Project #49

Neither This NOR That

OBJECTIVE: To demonstrate the concept of a NOR

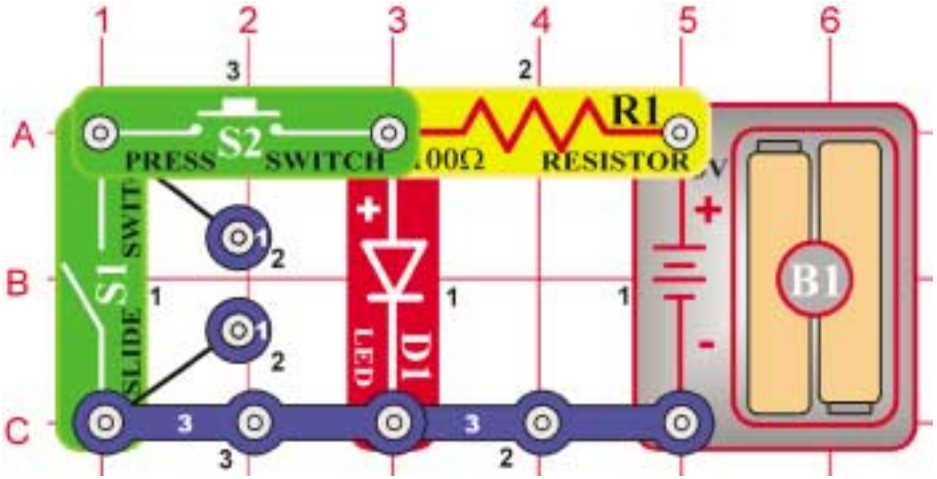


Build the circuit at left and test the combinations of the slide switch (S1) and press switch (S2). If you compare it to the OR circuit in Project 47, you can see the LED lights in the opposite combinations of that circuit. Hence, we refer to it as a NOR circuit (short for "NOT this OR that"). Like the OR and AND, it is an important building block in computers.

Project #50

NOT This AND That

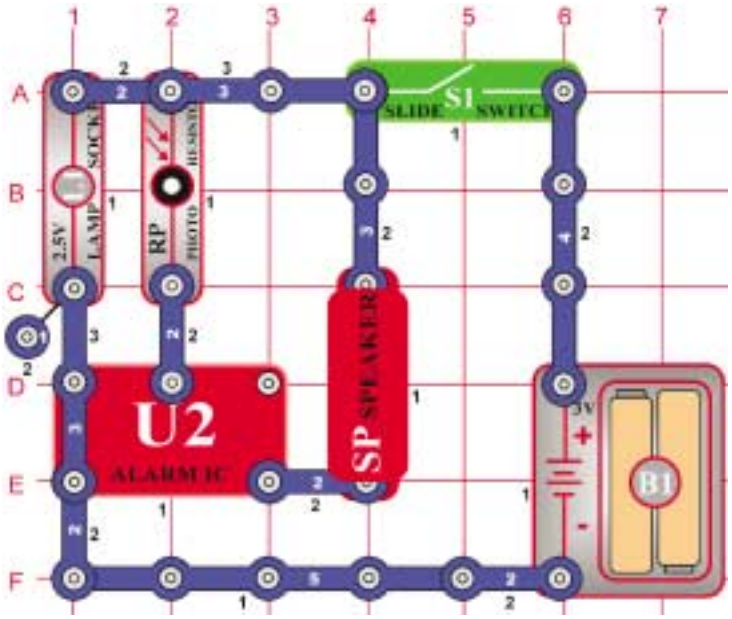
OBJECTIVE: To demonstrate the concept of a NAND



Build the circuit at left and test the combinations of the slide switch (S1) and press switch (S2). If you compare it to the AND circuit in Project 48, you can see the LED lights in the opposite combinations of that circuit. Hence, we refer to it as a NAND circuit (short for "NOT this AND that"). This circuit can also have more or less than two inputs, though when it only has one input it is referred to as a NOT circuit. Like the OR, AND, and NOR, NAND and NOT are important building blocks in computers.

Project #51

Reflection Detector

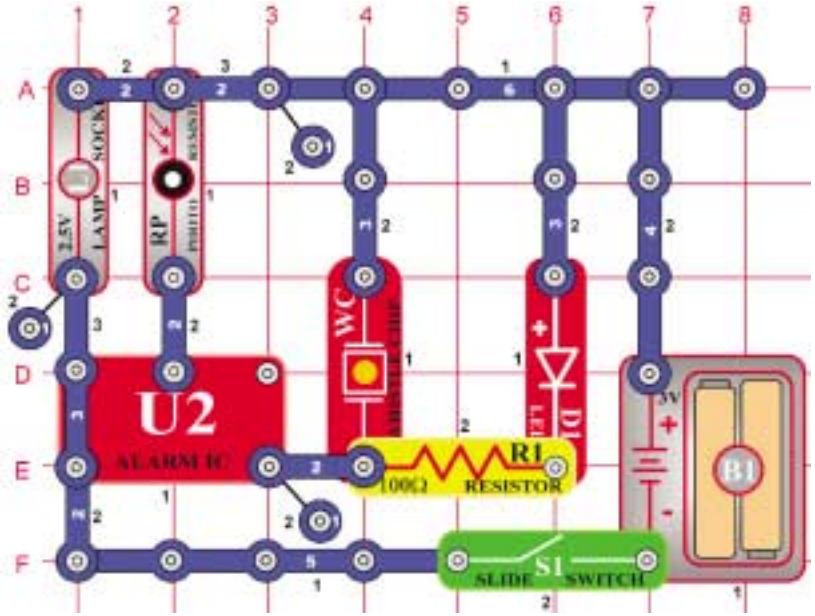


Build the circuit at left. Place it where there won't be any room light hitting the photosensitive resistor (RP) (such as in a dark room or under a table), and then turn it on. The 2.5V lamp (L1) will be bright but there should be little or no sound.

Take a small mirror and hold it over the lamp and photosensitive resistor. You should hear sound now. You have a reflection detector! The more light that gets reflected like this, the louder the sound. You can try holding the mirror at different angles and distances and see how the sound changes. You can also hold a white piece of paper over them, since white surfaces reflect light.

Project #52

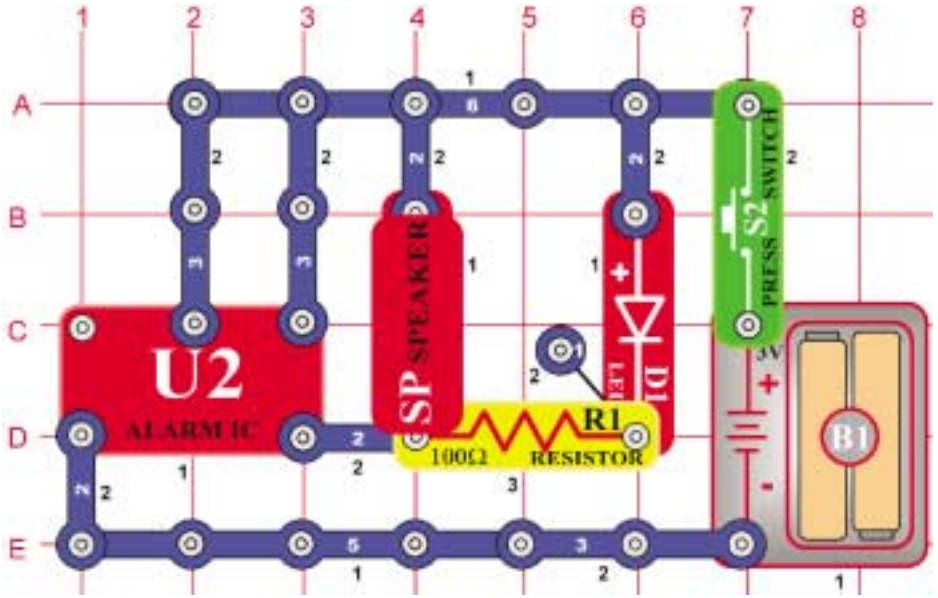
Quieter Reflection Detector



Let's modify the reflection detector circuit so that it is not so loud and annoying. We'll also put a lamp on it that can be seen in a noisy room. Build the circuit at left. Place it somewhere where there won't be any room light hitting the photosensitive resistor (such as in a dark room or under a table), and then turn it on. The 2.5V lamp will be bright but there should be little or no sound.

Take a small mirror and hold it over the lamp and photosensitive resistor. You should hear sound now as the mirror onto the photosensitive resistor reflects light from the lamp. The more light that gets reflected like this, the louder the sound. You can also hold a white piece of paper over the circuit, since white surfaces reflect light.

Project #53

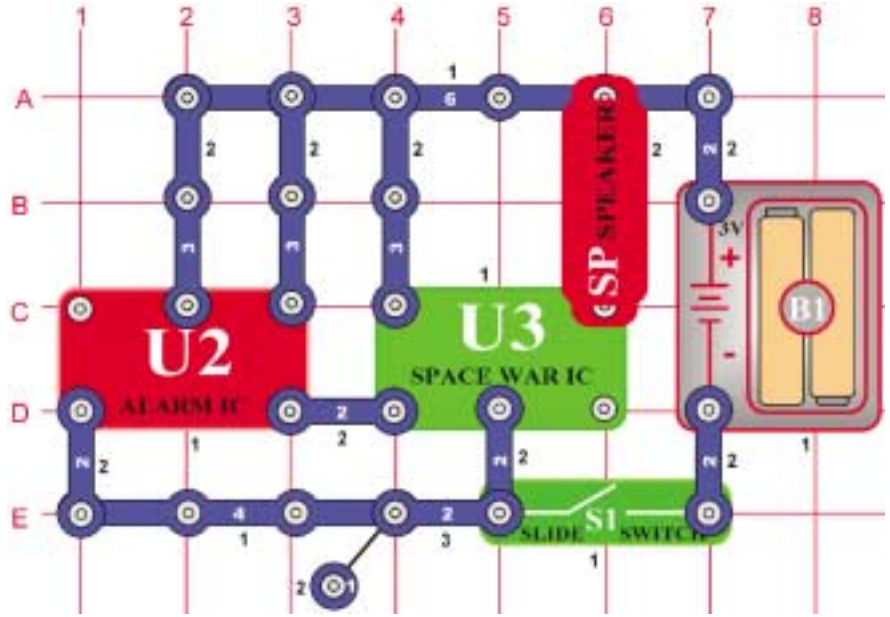


Flashing Laser Light with Sound

OBJECTIVE: To build the circuit used in a toy laser

When you press 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.

Project #54

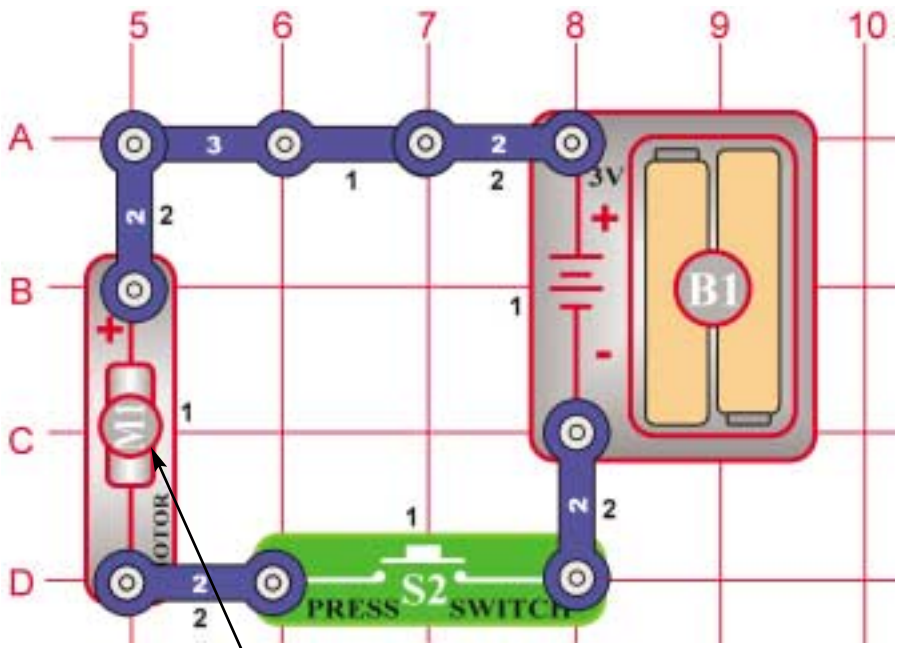


Space War Flicker

OBJECTIVE: To build a circuit using the space war

Build the circuit shown on the left, which uses the Space War integrated circuit.

Set the switch on and the speaker makes exciting sounds. The output of the IC can control lights, speakers, and other low power devices.



Project #55

Spinning Rings

Setup: Cut out the disc on page 42 that looks like the one shown here. Using Scotch tape, attach the disc with the printed side up on the top of the fan blade. Place the blade on the motor as shown to the left and below.

When the press switch (S2) is pressed, the arcs will turn into colored rings with a black background. Notice how the color drops in brightness when it is stretched to make a complete circle.

Project #56

Strobe the House Lights

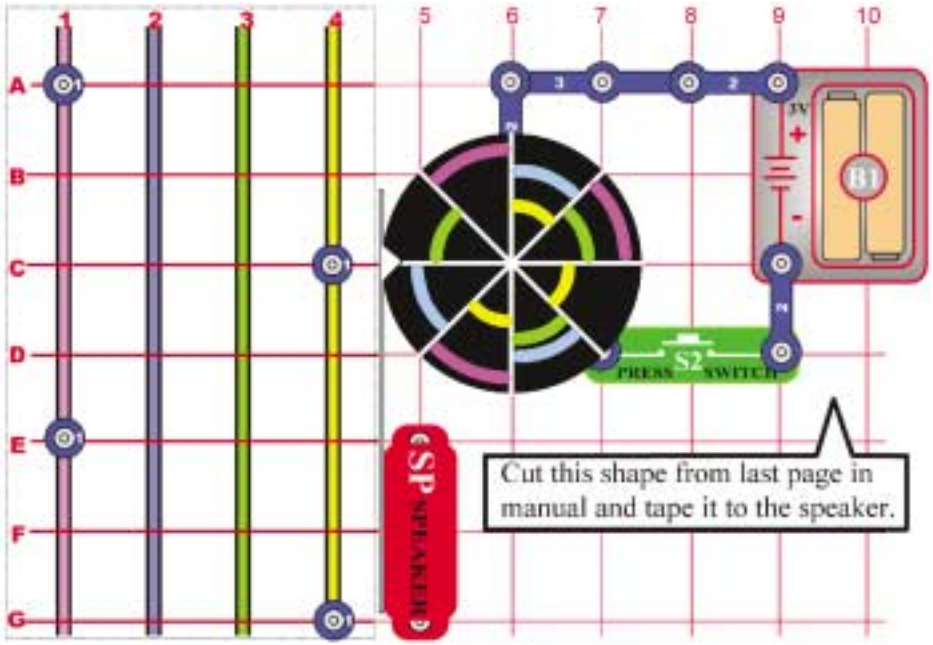
OBJECTIVE: To use the spinner to see strobe effect

Use the circuit from Project 55.

Setup: Place the spinning rings under a fluorescent light that runs on normal house current. Start the disc spinning and release the press switch (S2). As the speed changes you will notice the white lines first seem to move in one direction then they start moving in another direction. This effect is because the lights are blinking 60 times a second and the changing speed of the motor is acting like a strobe light to catch the motion at certain speeds. To prove this, try the same test with a flashlight. The light from a flashlight is constant and if all other lights are out, you will not see the effect that looks like a helicopter blade in a movie.

Project #57

Race Game



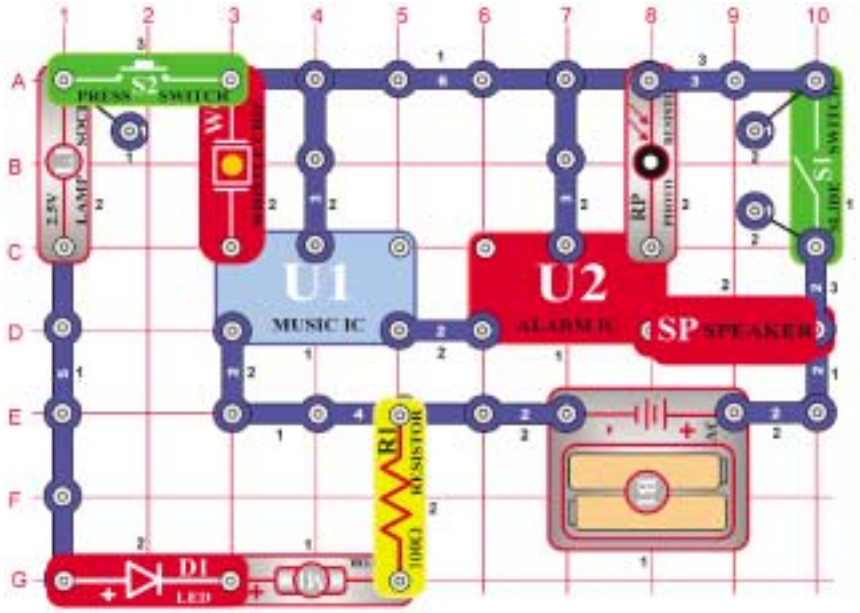
Modify Project 56 by adding the pointer as shown on the left. The paper should be cut from page 42 and taped high enough on the speaker so the pointer will stick over the fan with paper. Bend the pointer at a right angle as shown on the left.

Setup: Cut out the grid with four (4) colors from page 42 and place it under the base as shown on the left. Each player picks a color (or two colors if only 2 people are playing) and places a single snap on row G. The purple player in column 1, the blue player in column 2, the green player in column 3, and the yellow player in column 4. Spin the wheel by closing the press switch (S2). The first single color wedge that the pointer points to is the first player to start.

The Play: Each player gets a turn to press the press switch. They release the press switch and when the pointer points to a wedge the players that match the colors on the wedge get to move up one space. If a liner comes up like the one shown on the left then the players on each side of the line get to move up two (2) spaces. The first player to reach the top row (A) wins. If two players reach the top row at the same time they must both drop down to row "D" and play continues.

Project #58

Using Parts as Conductors



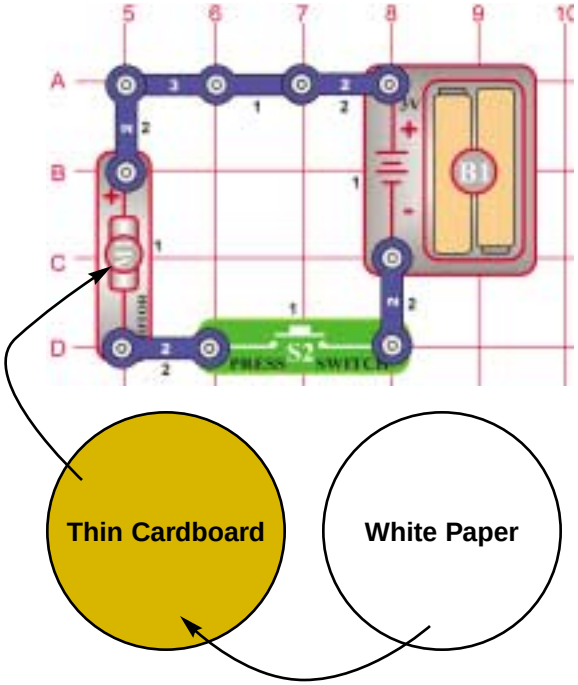
OBJECTIVE: ***To show that motors and lamps may***

Turn on the switch and tap the whistle chip (WC), it makes a machine gun sound (with music in the background). Thoroughly cover the photoresistor with your hand and the sound becomes a siren. After a while the sound will stop, tap the whistle chip and it resumes.

Press the press switch (S2) and the LED (D1) lights, but the lamp (L1) does not light and the motor (M1) does not spin. Electricity is flowing through the lamp and motor, but not enough to turn them on. So in this circuit they are acting like 3-snap wires.

Project #59

Spin Draw



Rebuild the simple motor connection as shown on the left. This is the same setup as Project 57.

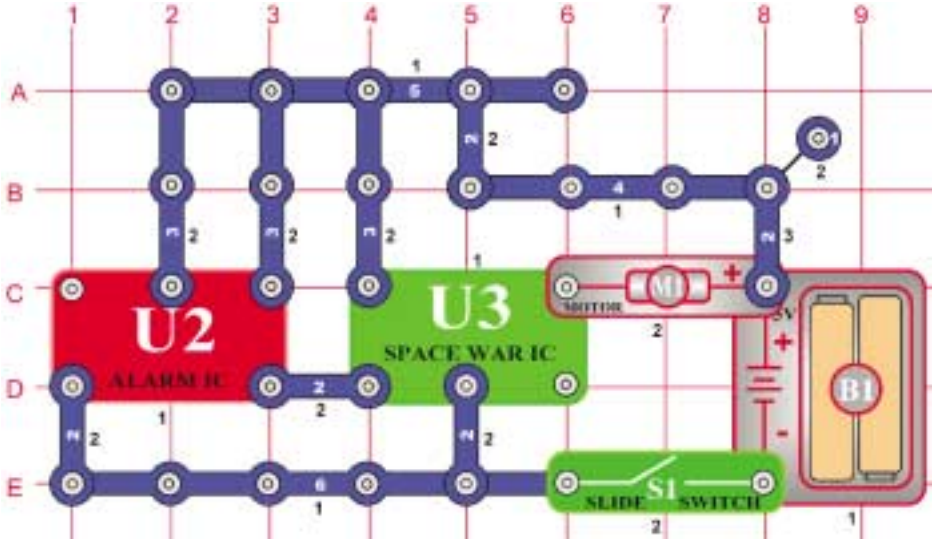
Setup: Cut out a circular piece of thin cardboard from the back of an old spiral notebook or note pad. Use the fan blade as a guide. Place the fan on the cardboard and trace around it with a pencil or pen. Cut the cardboard out with scissors and tape it to the fan blade. Do the same thing with a piece of white paper, but tape the paper on top of the cardboard so it can be removed easily later.

Drawing: To make a ring drawing obtain some thin and thick marking pens as drawing tools. Spin the paper by pressing and holding press switch (S2) down. Press the marker on the paper to form rings. To make spiral drawings, release press switch (S2) and as the motor approaches a slow speed move the marker from the inside outward quickly.

Change the colors often and avoid using too much black to get hypnotic effects. Another method is to make colorful shapes on the disc then spin the disc and watch them blend into each other. When certain speeds are reached under fluorescent lights, the strobe principle shown in another project will produce strange effects and backward movement. Make a wheel with different colored spokes to see this strange effect. Adding more spokes and removing spokes will give different effects at different motor speeds.

Project #60

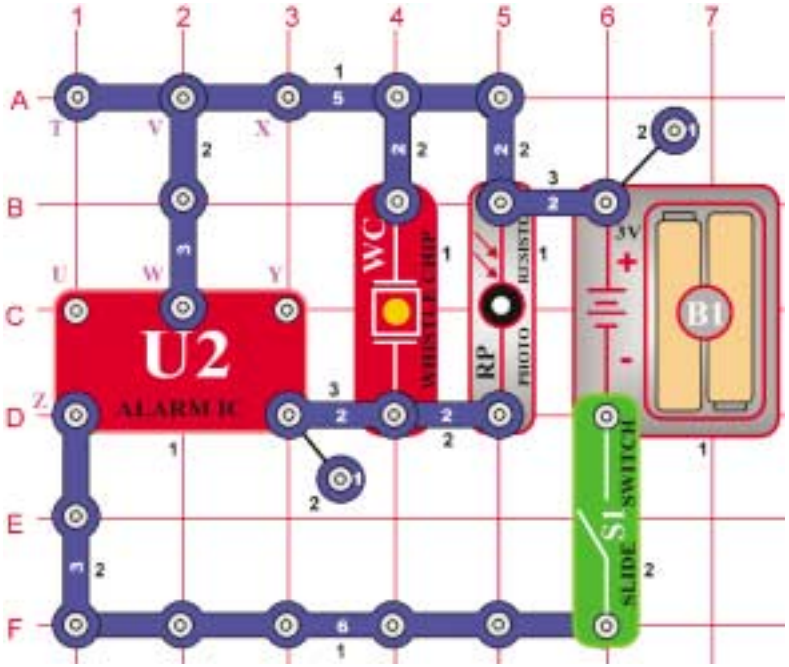
Space War Flicker Motor



Turn on the switch and the motor spins (you may need to give it a push with your finger to get it started). The sounds from the IC are used to drive the motor.

Project #61

Light-Controlled Sounds



OBJECTIVE: To give a more dramatic demonstration

Build the circuit shown on the left.

Turn on the slide switch (S1), a police siren is heard. The loudness of the sound depends on how much light reaches the photosensitive resistor, try partially shielding it or placing near a very bright light, and compare the sound.

Project #62 Light-Controlled Sounds (II)

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 #63 Light-Controlled Sounds (III)

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 #64 Light-Controlled Sounds (IV)

OBJECTIVE: To show a variation of the circuit in

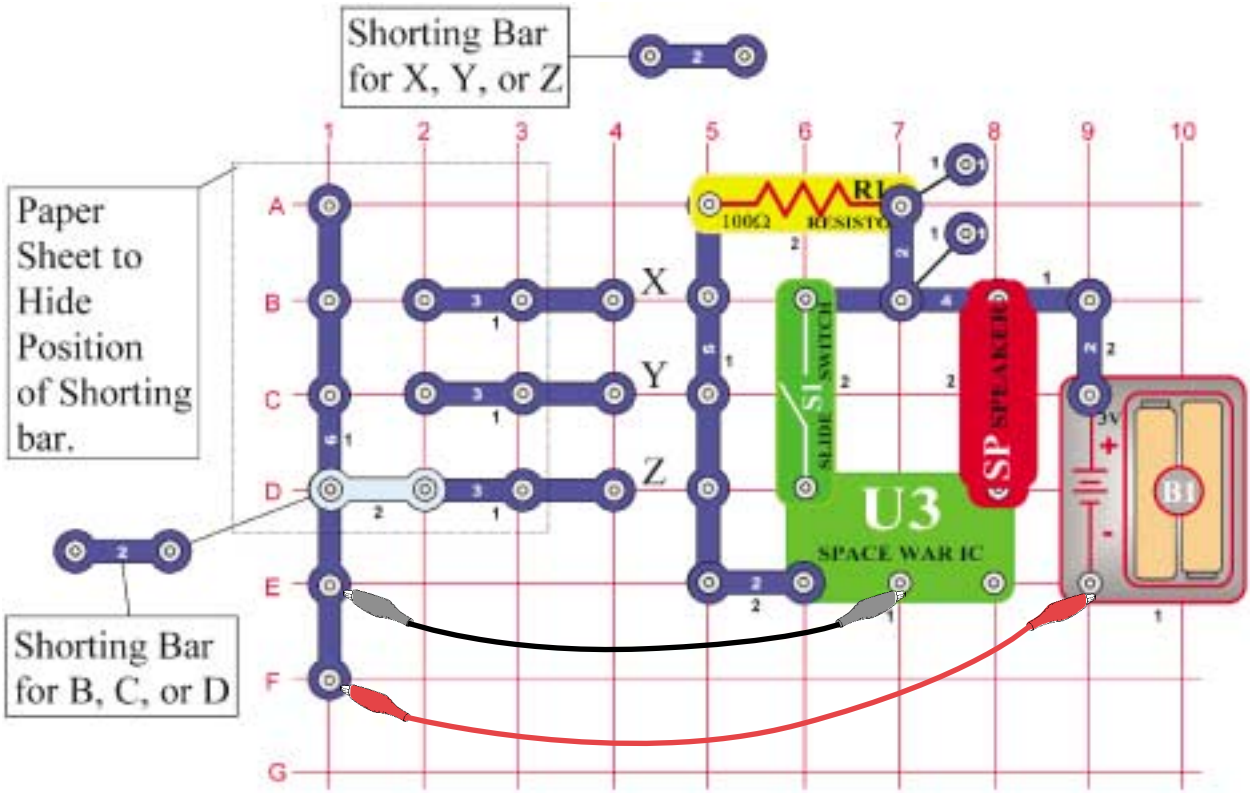
Now remove the connection between T and U and then make a connection between U and Z. Now it sounds like an ambulance.

Project #65 Light-Controlled Sounds (V)

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 computer.

Project #66 Electronic Bombing Game



Build the circuit at left. It uses both jumper wires as permanent connections. It also uses two 2-snap wires as "shorting bars".

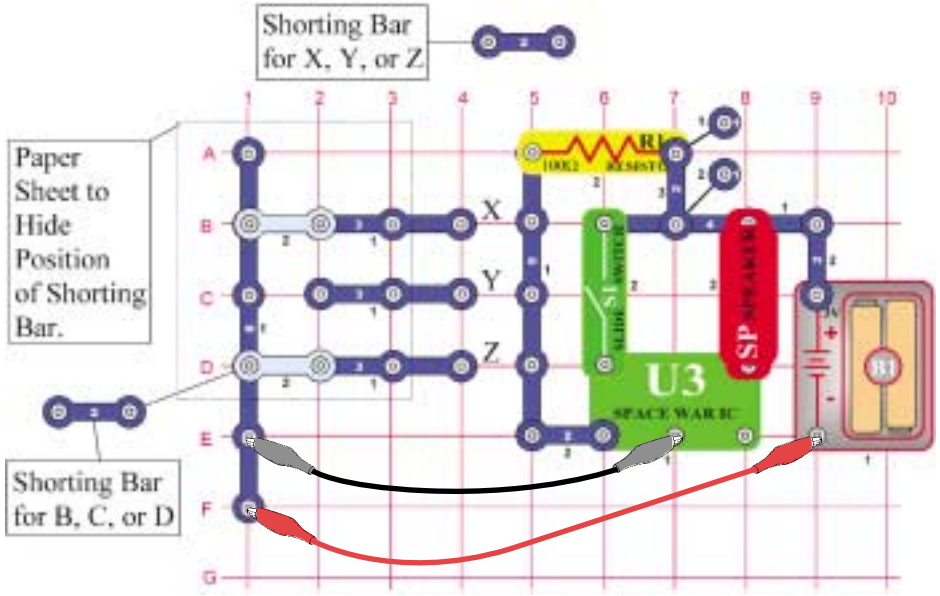
Setup: Player 1 sets the target by placing one shorting bar under the paper on row B, C, or D. Player 2 must NOT know where the shorting bar is located under the paper.

The object is for Player 2 to guess the location by placing his shorting bar at positions X, Y, or Z. In the drawing on the left Player 1 set up this hole at position "D". If Player 2 places his shorting bar across "Z" on the first try then he gets a hit. He keeps guessing until he hits. After each hit, remove the shorting bars and slide the switch off and on to reset the sound.
Player 2 then sets the B, C, D side and player 1 tries his luck.

Play multiple rounds and see who gets the best overall score. The winner will be the player who is best at reading his opponent's mind.

Project #67

Quiet Zone Game



OBJECTIVE: Make and play the electronic game of

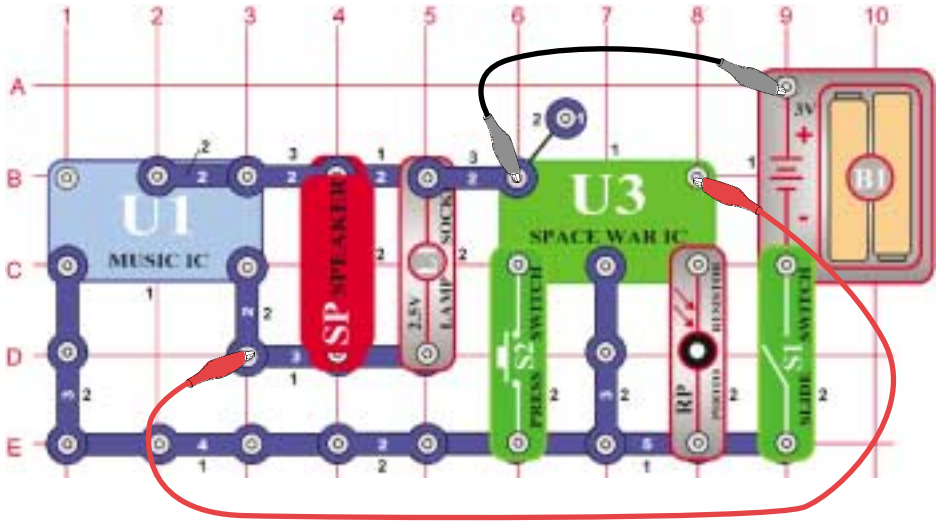
Use the circuit from Project 66, but place two 2-snap wires ("shorting bars") under the paper sheet as shown on left.

Setup: Player 1 sets the "Quiet Zone" by placing 2 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 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 three (3) tries to find the zone on each turn. Each time sounds are made he loses a point.
Player 2 then sets the 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 #68

Space War Music Combo

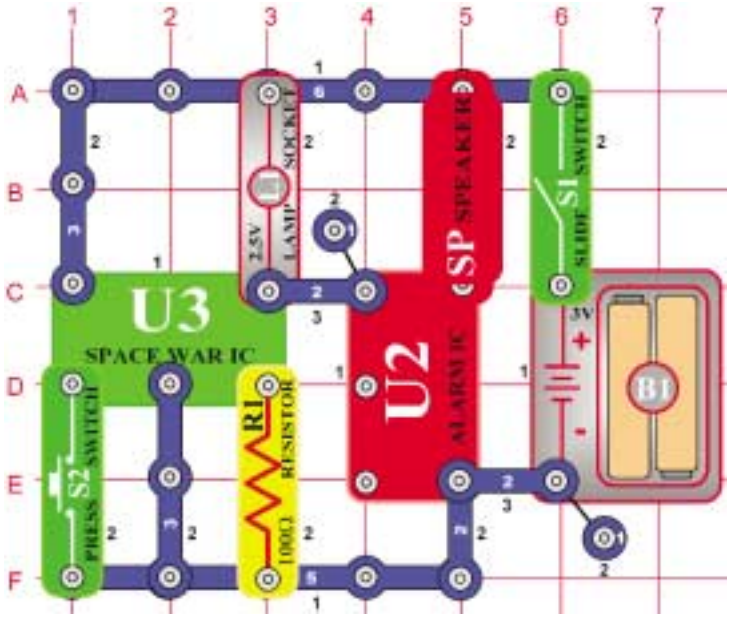


OBJECTIVE: To combine the sounds from the space

Build the circuit shown and add the jumpers to complete it. Turn it on, press the press switch (S2) several times, and wave your hand over the photosensitive resistor to hear all the sound combinations. If the sound is too loud you may replace the speaker (SP) with the whistle chip (WC).

Project #69

Space War Siren

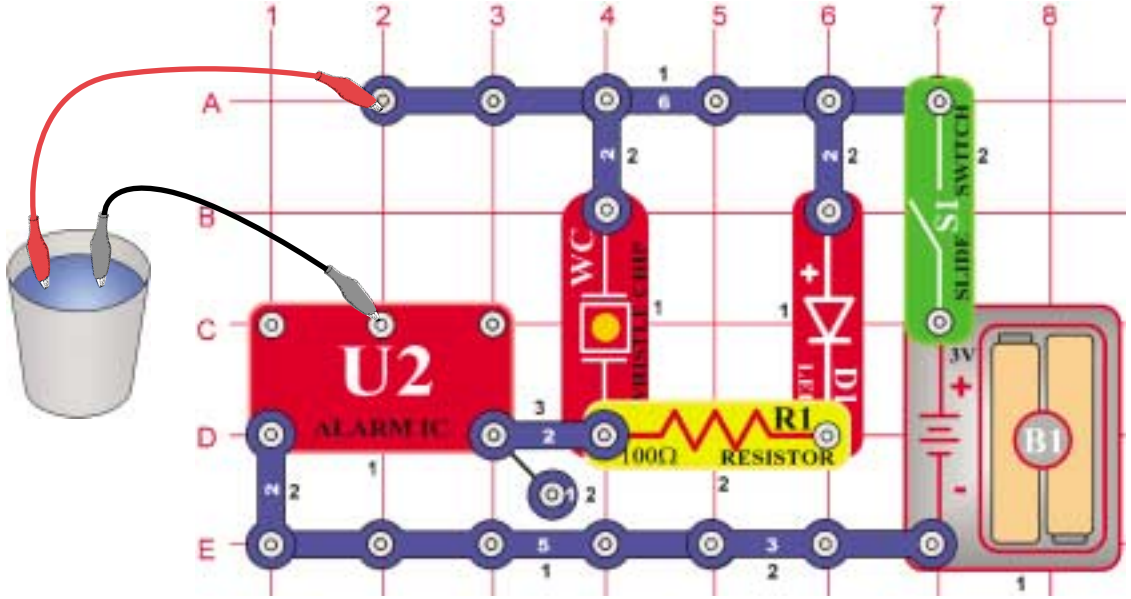


OBJECTIVE: To combine effects from the space war

Build the circuit shown on the left and turn on the slide switch (S1). Press and hold the press switch (S2) for more sound effects.

Project #70

Quiet Water Alarm



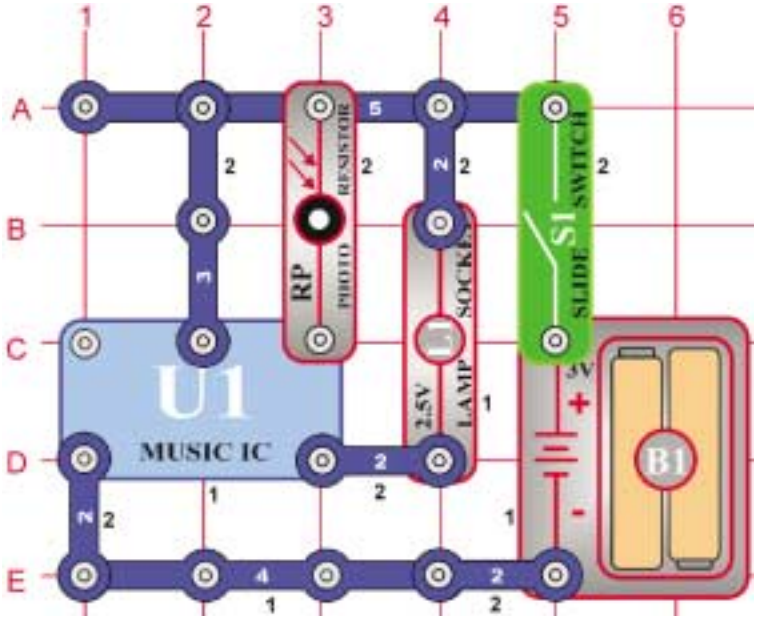
OBJECTIVE: To sound an alarm when

Sometimes you want a water alarm that can be heard but is not loud enough to be annoying or distracting, so let's make one. We'll also put a light on it that could be seen in a noisy room, in a real application you could use a powerful light that would be easily seen.

Build the circuit shown but initially leave the jumper wires outside the cup. Turn on the switch; nothing happens. Place the jumper wires into a cup of water and an alarm sounds and the light comes on.

Project #71

Light-Controlled Lamp



Cover the unit, turn the switch on, and notice that the lamp is off. Place the unit near a light and the lamp turns on. Cover the photosensitive resistor and place it in the light again. The lamp will not turn on. The resistance of the photosensitive resistor decreases as the light increases. The low resistance acts like a wire connecting point C to the positive (+) side of the battery.

Project #72

Voice-Controlled Lamp

OBJECTIVE: To turn a lamp on and off using the

Use the circuit from Project #71. Remove the photosensitive resistor (RP) and connect the whistle chip (WC) across points A and B. Turn the switch on and clap your hands or talk loud near the whistle chip, the lamp will light. 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 then activates the music IC and turns the lamp on.

Project #73

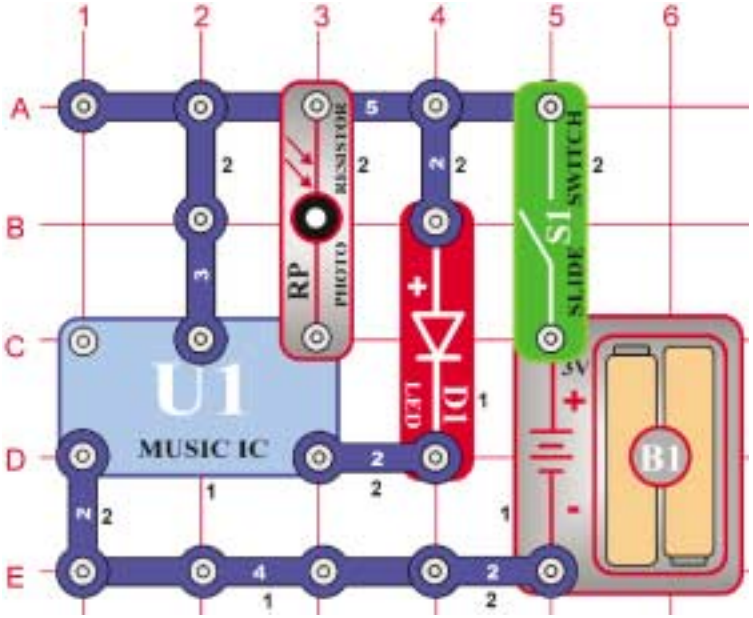
Motor-Controlled Lamp

OBJECTIVE: To turn a lamp on and off using the

Use the circuit from Project #72. Remove the whistle chip and connect the motor (M1) across points A and B. Turn the switch on and turn the shaft of the motor and the lamp will light. As the motor turns, it produces a voltage. This is because there is a magnet and a coil inside the motor. When the axis turns the magnetic field will change and generate a small current in the across it's terminals. The voltage then activates the music IC.

Project #74

Light-Controlled LED



Cover the unit, turn the switch on, and notice that the LED is off. Place the unit near a light and the LED will light. Cover the photosensitive resistor (RP) and place it near the light again. The LED will not turn on. The resistance of the photosensitive resistor decreases as the light increases.

Project #75

Sound-Controlled Time Delay LED

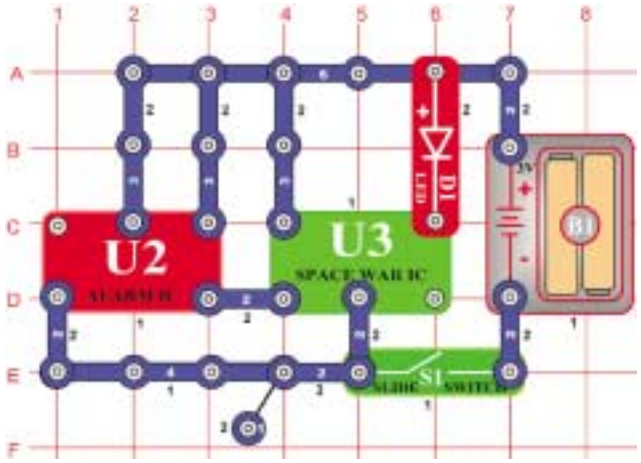
Use the circuit from Project #74. Remove the photosensitive resistor (RP) and connect the whistle chip (WC) to points A and B. Turn the switch on and clap your hands or talk loud near the whistle chip the LED will light. The whistle chip has a piezocrystal between the two metal plates. The sound causes the plates to vibrate and produce a small voltage. The voltage then activates the music IC.

Project #76

Motor-Controlled Time Delay LED

Use the circuit from Project #75. Remove the whistle chip and connect the motor (M1) to point A and B. Turn the switch on and turn the shaft of the motor and the LED will light. As the motor turns, it produce a voltage. There is a magnet and a coil inside the motor. When the axis turns the magnetic field will change and generate a small current in the across it's terminals. The voltage then activates the music IC.

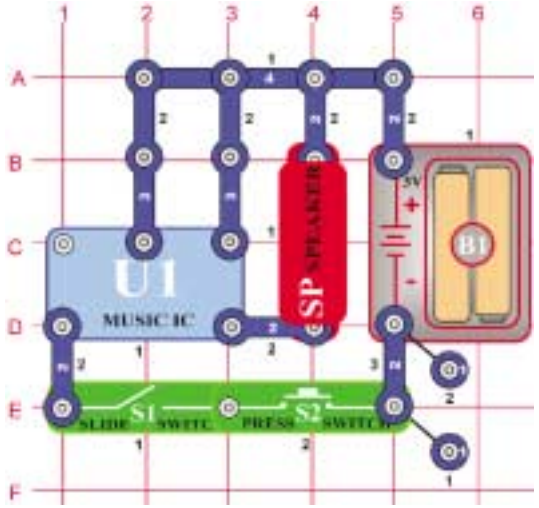
Project #77
Space War Flicker LED



OBJECTIVE: Flash an LED using the space

Build the circuit shown on the left. The circuit uses the Alarm and Space War IC's to flash the LED (D1). Turn the switch on and the LED starts flashing.

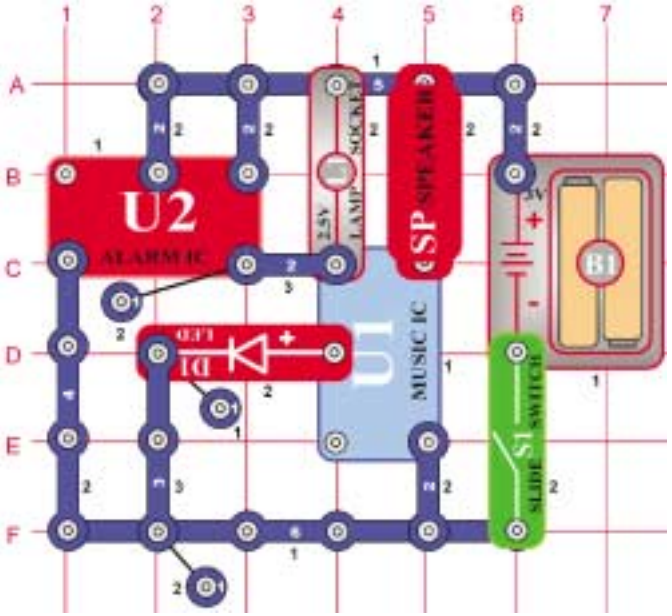
Project #78
Music AND Gate



OBJECTIVE:

You will only hear music if you turn on the slide switch (S1) AND press the press switch (S2). This is referred to as an AND gate in electronics.
This concept is important in computer logic.
Example: If condition X AND condition Y are true, then execute instruction Z.

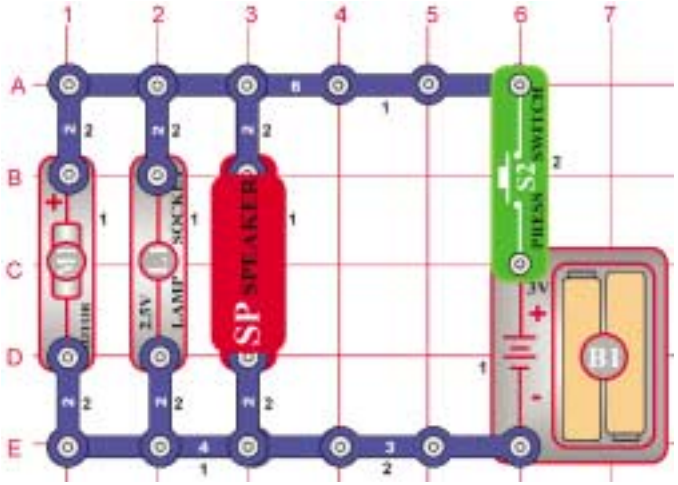
Project #79
Flash and Tone



OBJECTIVE: Build a circuit that flashes light and

Turn the switch on and the lamp and LED starts flashing. The LED will flash at a much faster rate than the lamp. You hear two different tones driving LED and lamp. IC's can be connected to control many different devices at the same time.

Project #80



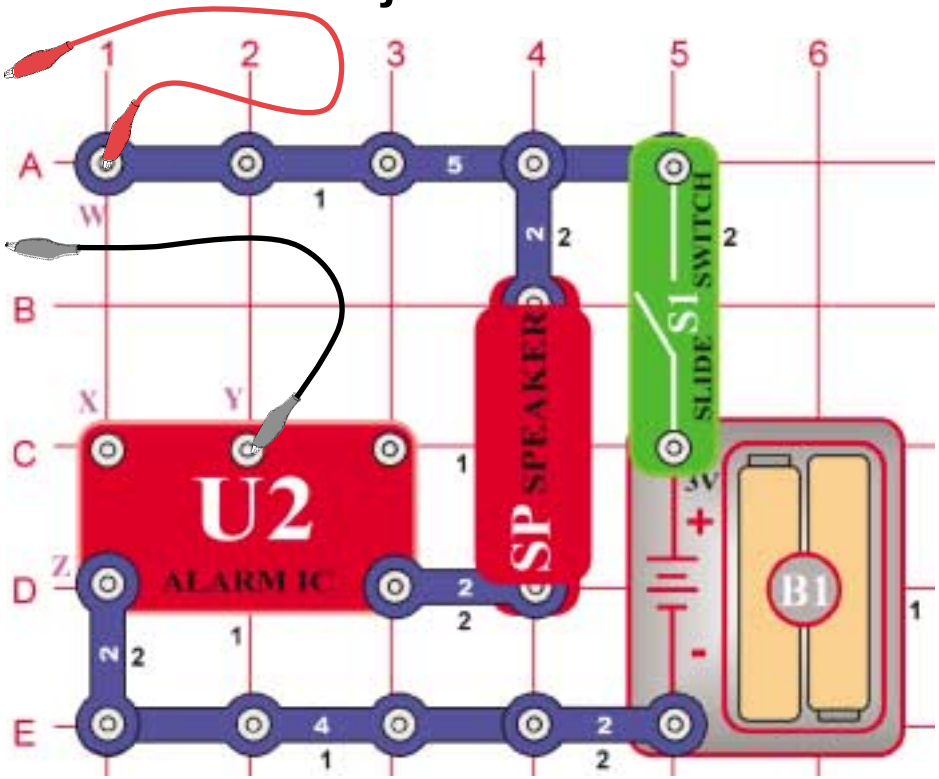
Lamp, Speaker & Fan in Parallel

OBJECTIVE: To show the power drop of components

Leave the fan off the motor. When you press the press switch (S2), the motor spins and the lamp turns on. Observe how bright the lamp is. Place the fan on the motor and press the press switch again. The lamp is not as bright now, because it takes more power from the batteries to spin the motor with the fan on it, which leaves less battery power available to light the lamp. If you have weak batteries, the difference in lamp brightness will be more obvious because weaker batteries don't have as much power to supply.

The speaker is being used as a low-value resistance here to make the above effects more apparent. If you remove it, then the lamp brightness will increase slightly.

Project #81



Pencil Alarm

Build the circuit shown and connect the two jumpers to it, leave the loose ends of the jumpers unconnected for now. There is one more part 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. 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.

Project #82

Pencil Alarm Variants

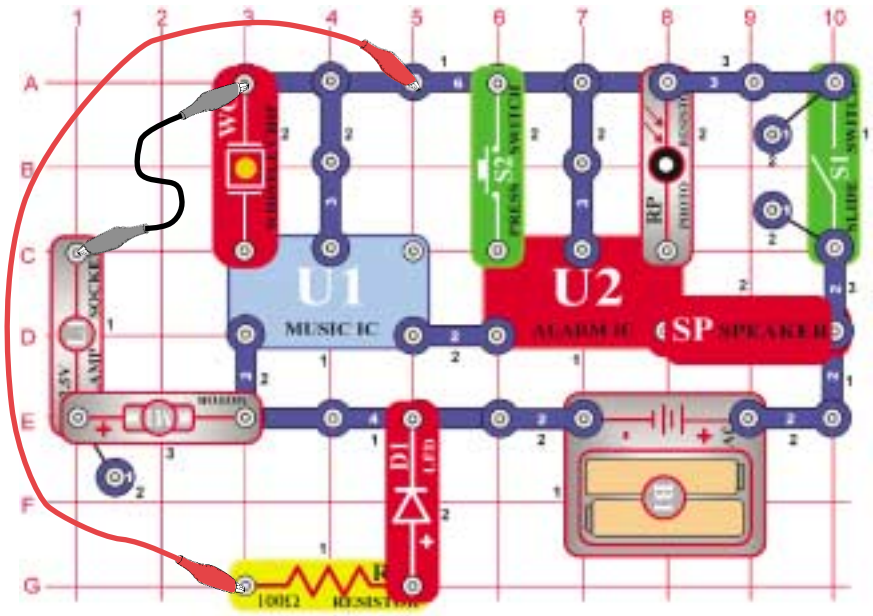
Remove the jumper connected to point Y (as shown in the drawing) and connect it to point X instead. Touch the loose ends to the pencil drawing again, the sound is different now.

Next connect a 2-snap wire between points X and Y connect the jumper to either point. Touch the loose ends to the pencil drawing again, you hear a different sound.

Now remove the 2-snap wire between X and Y and connect it between X and Z, connect the jumpers to W and Y. Touch the loose ends to the pencil drawing again, you hear yet another sound.

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

Project #83



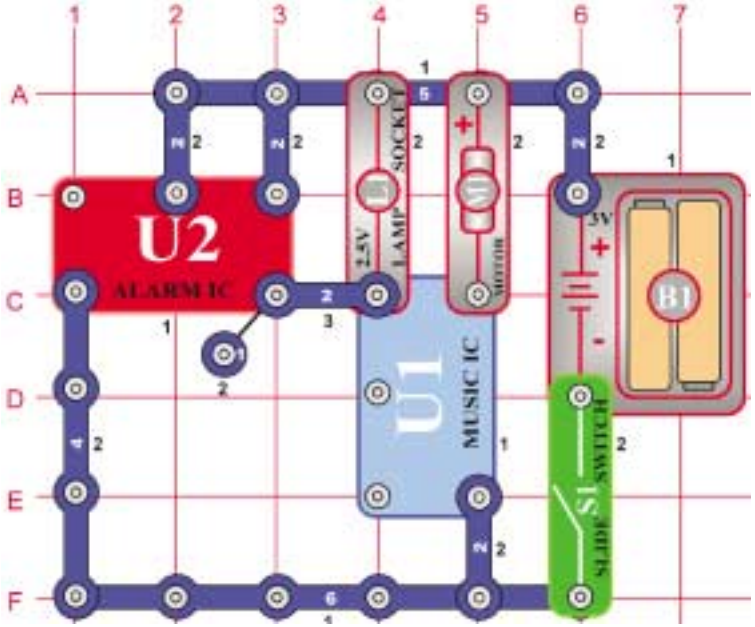
Fun with the Alarm IC

OBJECTIVE: To show some new ways of using the

Build the circuit shown and place the fan on the motor, but leave the jumpers off for the time being. Turn on the switch and tap the whistle chip (WC), it makes a machine gun sound (with music in background). Thoroughly cover the photosensitive resistor (RP) with your hand and the sound becomes a siren, now press the press switch (S2) and the sound becomes that of an ambulance. Uncover the photosensitive resistor and the sound remains that of a machine gun whether the press switch (S2) is pressed or not. After a while the sound will stop, tap the whistle chip and it resumes.

Connect the two jumpers as shown and tap the whistle chip to resume the sound. The lamp (L1) and LED (D1) are lit and the motor spins. The sound continues, but it may become distorted as the motor speeds up. The motor draws a lot of power from the batteries, and this may reduce the voltage to the music and alarm ICs, distorting the sound.

Project #84



Touch Motor

OBJECTIVE: Build a circuit that spins a motor when you

Place the fan onto the motor. Turn the switch on and the lamp starts flashing. Place your finger on point A; the motor should start spinning. Your finger activated the music IC that powers the motor. Remove your finger and the motor will stop after a while.

Project #85

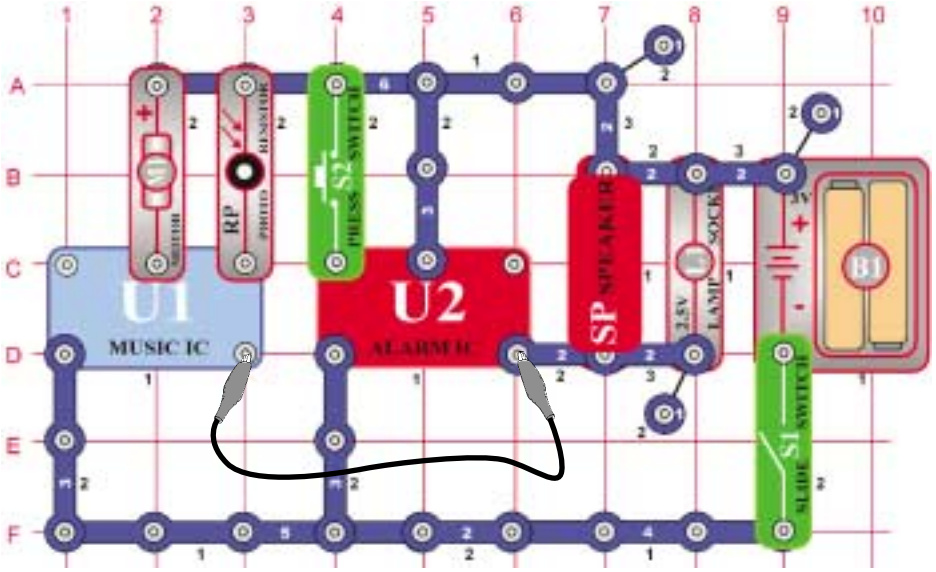
Touch Light

OBJECTIVE: Build a

Use the circuit in Project #84. Replace the motor with the LED (D1) (positive side on top). Turn the switch on. When the lamp lights, the LED flickers. When the lamp is off, the LED is on.

Project #86

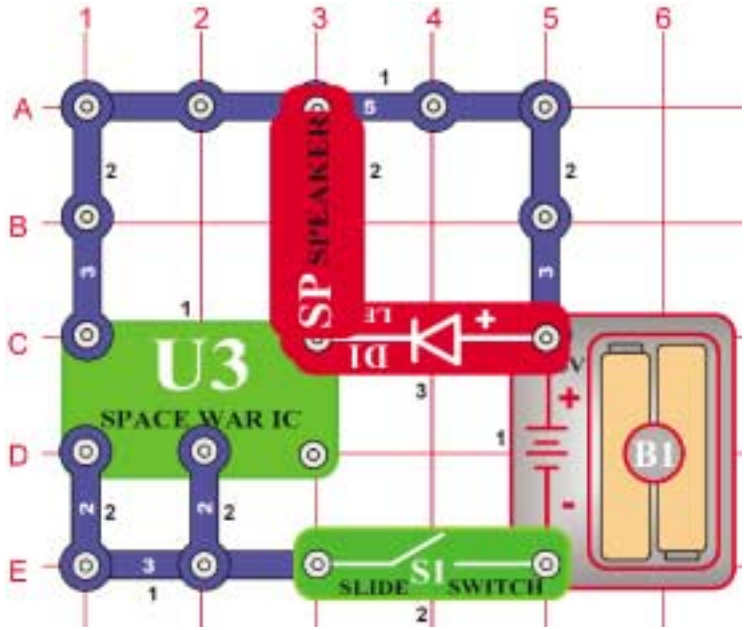
Music Alarm Combo



OBJECTIVE: To combine the sounds from the music

Build the circuit shown and add the jumper to complete it. Turn it on and you will hear a siren and music together. Press the press switch (S2) and the siren changes to a fire engine sound. The music will stop if you cover the photosensitive resistor. The motor is used here as a 3-snap wire and will not spin.

Project #87



Bomb Sound

OBJECTIVE: Build a circuit that sounds like a bomb

Turn the switch on and you hear the sound of a bomb dropping and then exploding. The LED lights and then flashes as the bomb explodes. This is one sound generated from the space war IC.

Project #88

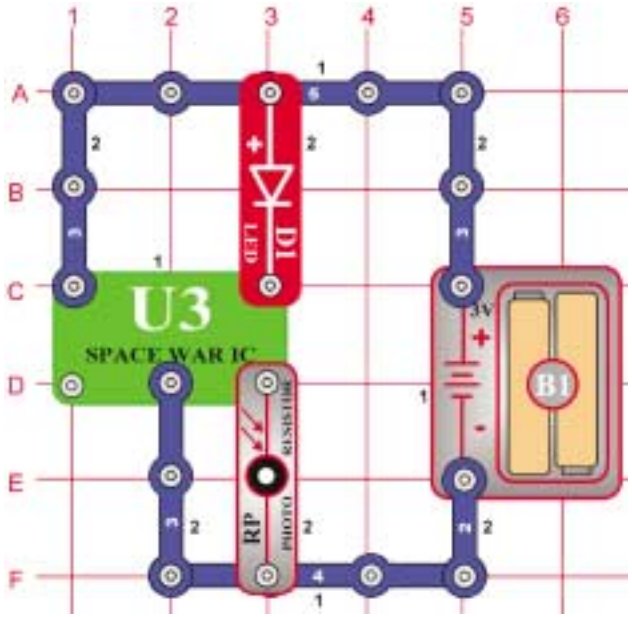
Bomb Sound (II)

OBJECTIVE: Build a circuit that sounds like a

Use the circuit from Project #87. Replace the switch with the motor (M1). Turn the shaft on the motor and now it sounds like a bunch of bombs dropping.

Project #89

Light-Controlled LED (II)



OBJECTIVE: Build a circuit that turns an LED on

When there is light on the photosensitive resistor, the LED will flicker. Shield the photosensitive resistor from the light, the LED should turn off.

Project #90

Touch Light

OBJECTIVE: Build a circuit that turns on and off an

Use the circuit from Project 89. Replace the photosensitive resistor with the whistle chip (WC). Tap on the whistle chip and the LED flickers. Tap again and the LED may flicker for a longer time. See how long the LED will stay on.

Project #91

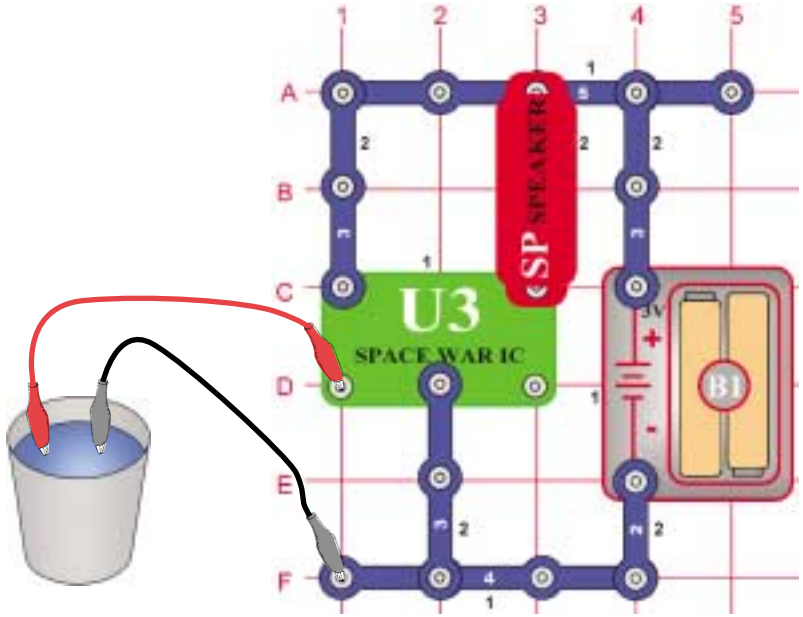
Touch Sound

OBJECTIVE: Build a circuit plays sound if you tap on

Use the circuit from Project 90. Replace the LED with the speaker (SP). Now you can hear the different sound as you tap on the whistle chip.

Project #92

Water Space War



OBJECTIVE: To use water to control the space war

Build the circuit shown on the left, including the jumper wires going between it and the cup of water shown. There will be sound as long as the wires are in the water. Placing the wires out of and then back into the water will change the sound played, there are eight (8) different sounds.

Project #93

Water Space War (II)

OBJECTIVE: To use water to control the space war

Use the circuit from Project 92. Move the jumper wires from points D1 and F1 to points D3 and F3 and try it again. Does it work the same way? See if you can get the same eight (8) sounds.

Project #94

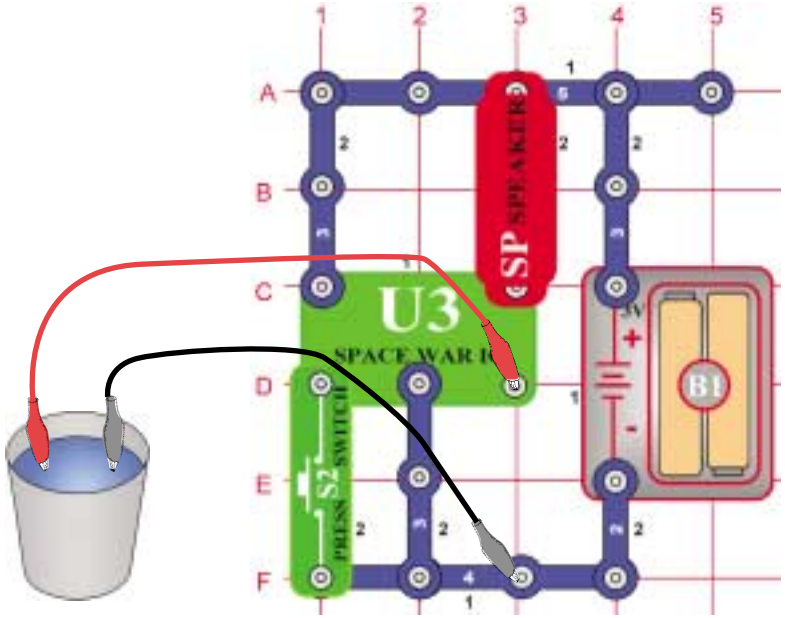
Human Space War

OBJECTIVE: To use your body to control the space war

Use the circuit from Project 93, but instead of placing the jumper wires in the water to control the circuit, touch the metal in the jumper with your fingers. Letting go and touching them again will change the sound just as pulling the wires out of the water did.

Project #95

Noisier Water Space War



OBJECTIVE: To use water to control the space war

Add the press switch (S2) to the preceding circuit to make it look like the one at left. There will be sound if the press switch is pressed or the jumper wires are in the water.
Pressing the press switch or pulling the wires out of the water changes the sound played.

If you prefer you can just touch the jumper wire metal with your fingers instead of putting the jumpers in the water.

Project #96

Light/Water Space War

OBJECTIVE: To use water to control the space war

Use the circuit from Project #95. Replace the speaker (SP) with the LED (D1). Putting the jumper wires in the water OR pressing the press switch will cause the diode to be bright.

Project #97

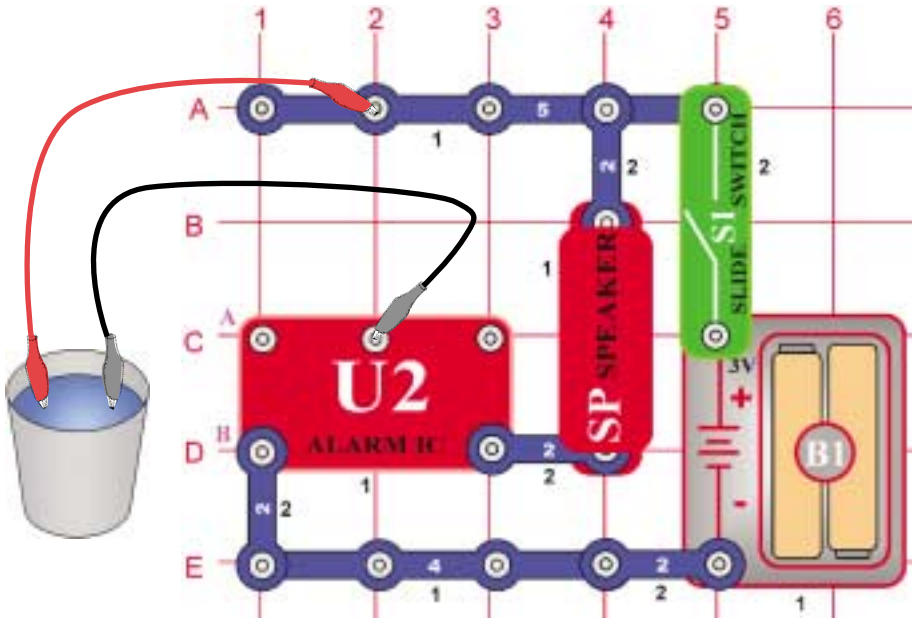
OR/AND Space War Light

OBJECTIVE: To control the space war integrated

Use the circuit from Project #96. Replace the LED (D1) with the 2.5V Lamp (L1). Putting the jumper wires in the water OR pressing the press switch (S2) will cause the lamp to be dimly lit. Putting the jumper wires in the water AND pressing the press switch at the same time will cause the lamp to be much brighter.

Project #98

Simple Water Alarm



OBJECTIVE: To sound an alarm when water is

Build the circuit shown but initially leave the jumper wires outside the cup. Turn on the switch; nothing happens. Place the jumper wires into a cup of water and an alarm sounds!

You could use longer wires and lay them on your basement floor, if your basement floods during a storm then this circuit will sound an alarm.

Project #99

Simple Salt Water Alarm

Add salt to the water and tone of the alarm is louder and faster, telling you that salt is in the water you detected. Also, try holding the jumper wires with your fingers, to see if your body can set off the alarm.

Project #100

Ambulance Water Alarm

OBJECTIVE: To show a variation

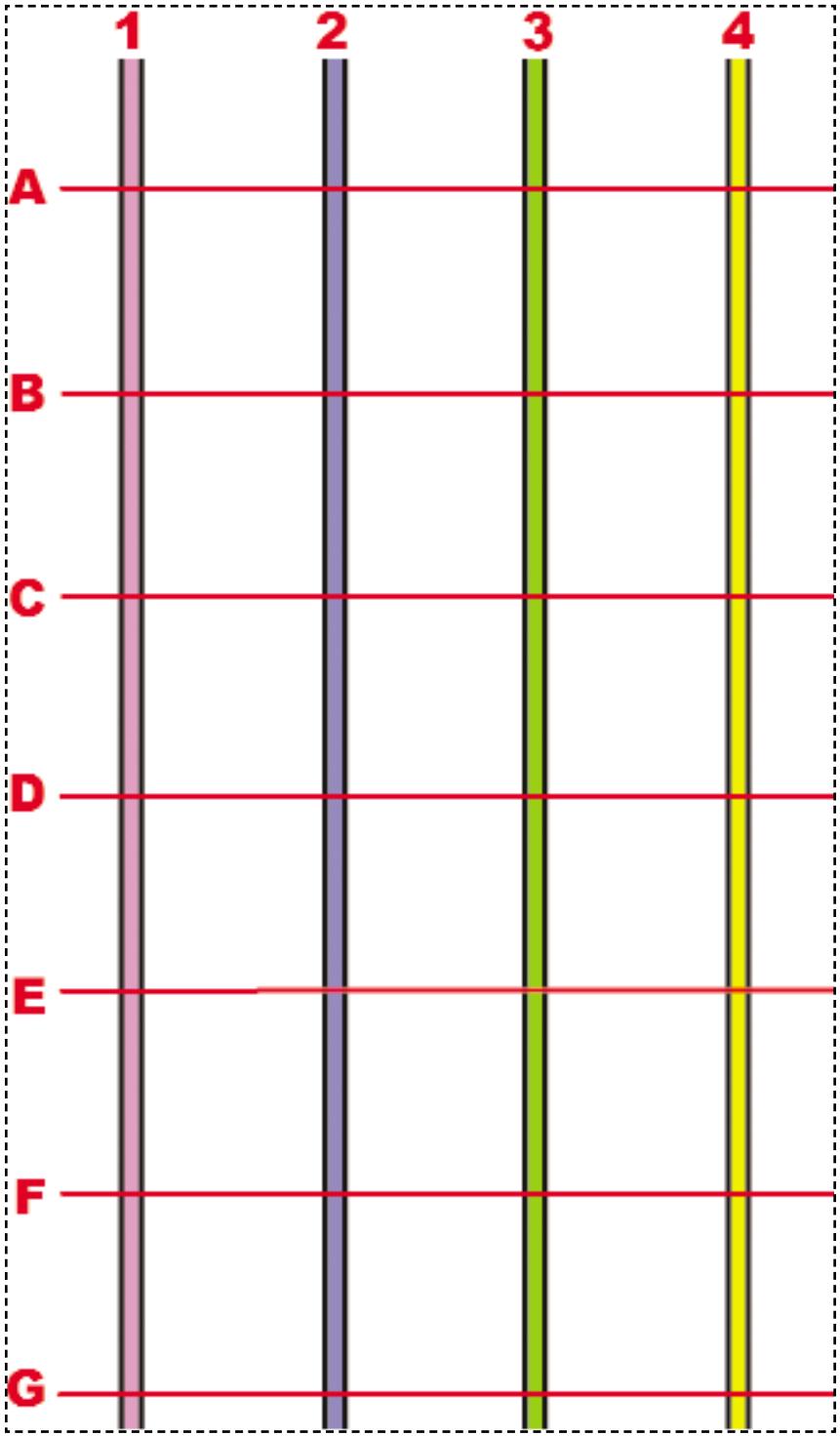
Modify the circuit in Project 98 by making a connection between A and B. The water alarm works the same way but now it sounds like an ambulance.

Project #101

Ambulance Contact Alarm

OBJECTIVE: To show a variation

The same circuit also detects if the jumper wires get touched together, so connect them to each other. The tone of the sound is now much different. Therefore, this circuit will tell you if there is water between the jumper wires or if the wires are touching each other.



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