

SNAP CIRCUITS®

SKILL BUILDER

CONNECTING YOU WITH HOURS
OF BUILDING FUN!

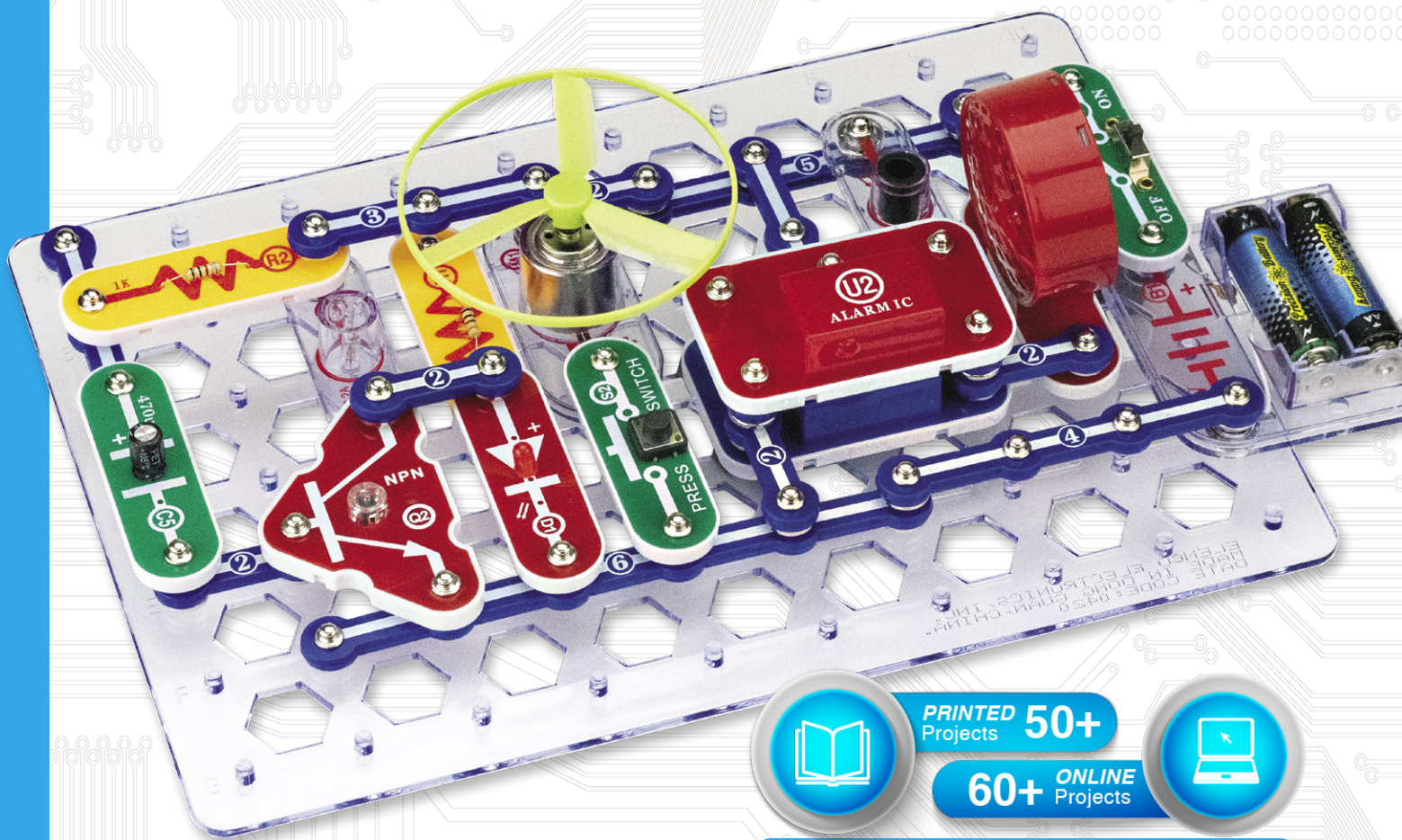
INSTRUCTION MANUAL

PROJECTS

1-57
MANUAL

58-126
ONLINE

AGES
8+



PRINTED
Projects 50+

60+ ONLINE
Projects



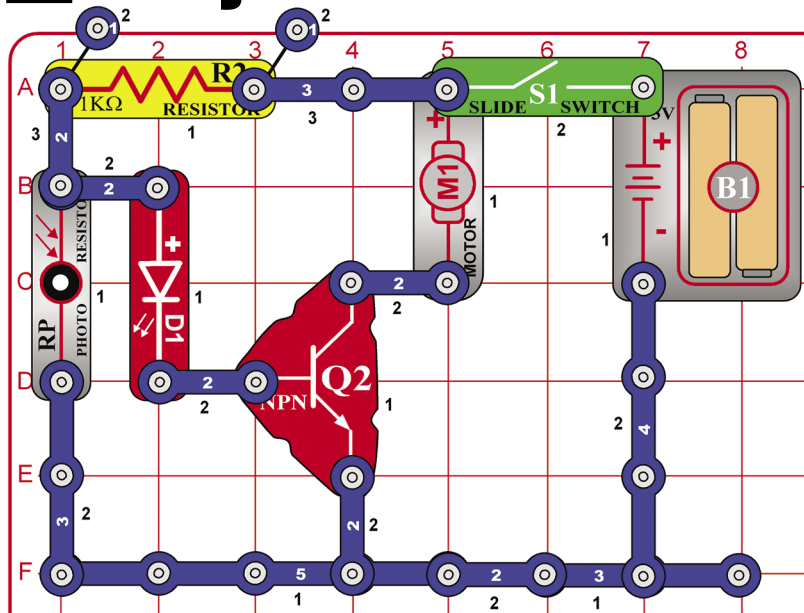
Projects 58-126 See your printed manual for projects 1-57

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Project 58

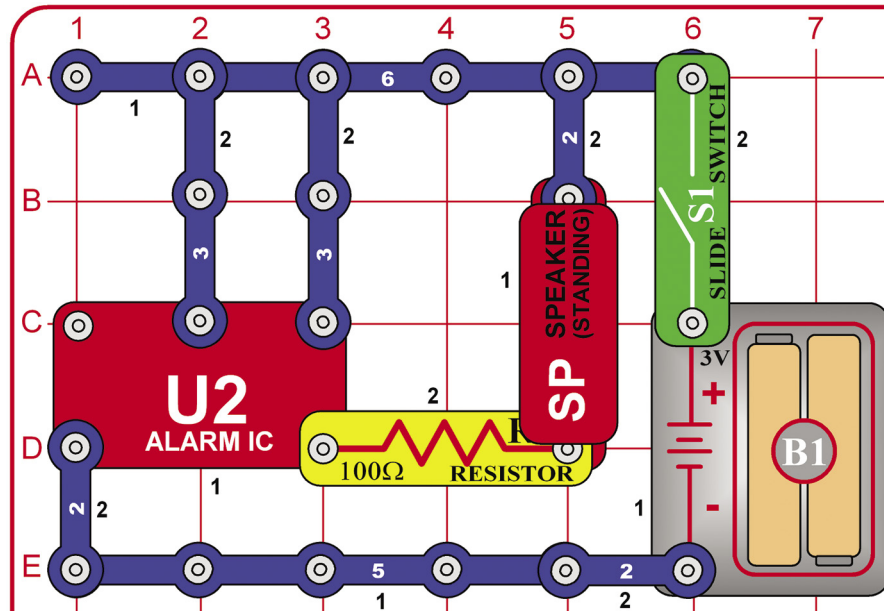


Build the circuit to the left.

Cover the photoresistor (RP) and turn on the slide switch (S1). The motor (M1) should spin. If not, give it a push to get it started. Now uncover the photoresistor or get a flashlight and shine it on the photoresistor. The motor will slow down as more light reaches the photoresistor, and will stop spinning if enough light reaches the photoresistor. This circuit demonstrates how darkness can be used to control a fan. Try this circuit with and without the fan on the motor.

WARNING: Moving parts. Do not touch the fan or motor during operation.

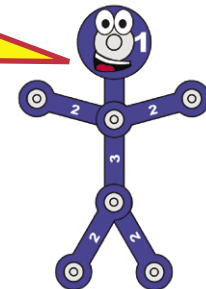
Project 59



Build the circuit shown on the left.

When you turn on the slide switch (S1), the integrated circuit (U2) should start sounding a 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.

This circuit demonstrates how sounds can be made for electronic games.



Project 60

Mind Reader Game

Build the circuit below. It uses a paper clip and a 3-Snap Wire as "shorting bars".

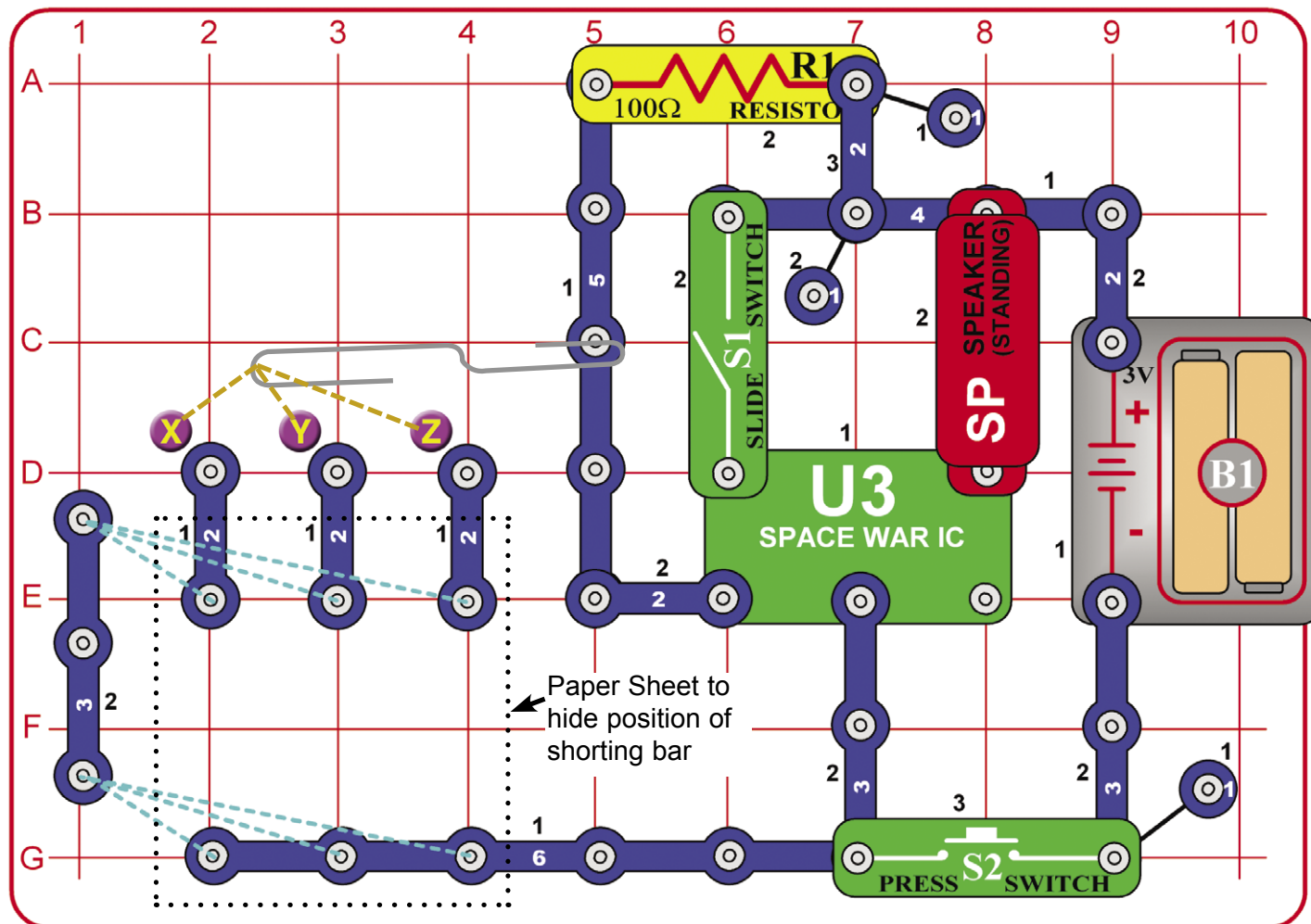
Setup: Player 1 sets the target by placing the 3-snap shorting bar under the paper on column 2, 3 or 4. Player 2 must NOT know where the shorting bar is located under the paper.

The object is for Player 2 to guess the location by placing one end of the paper clip on the 5-snap wire as shown, and the other end of the paper clip at positions X, Y, or Z and then pressing the press switch (S2). If Player 2 places the paper clip at the correct position, the sounds played indicates a "hit". He keeps guessing until he hits. After each hit, remove the 3-snap shorting bar and slide the

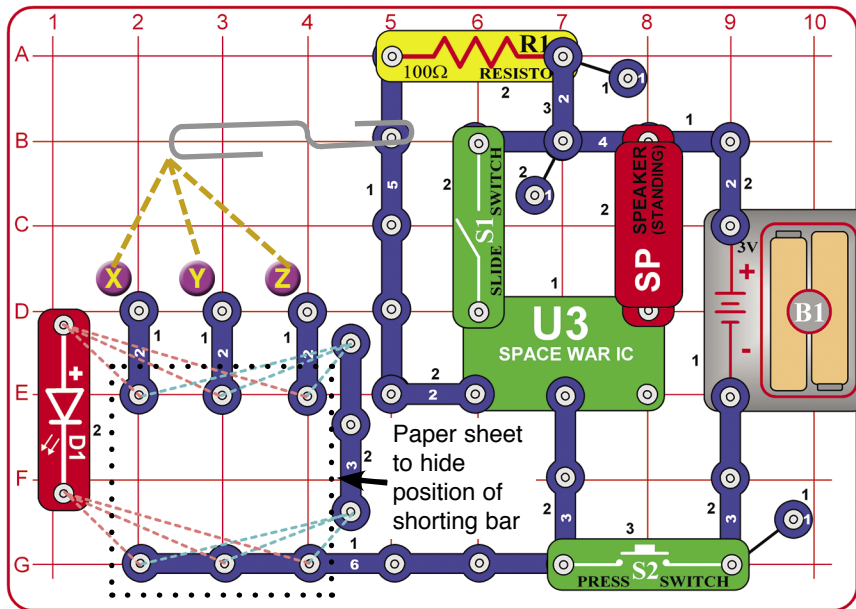
switch off and on to reset the sound.

Player 2 then sets the 2, 3, 4 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 61



Don't Make a Sound

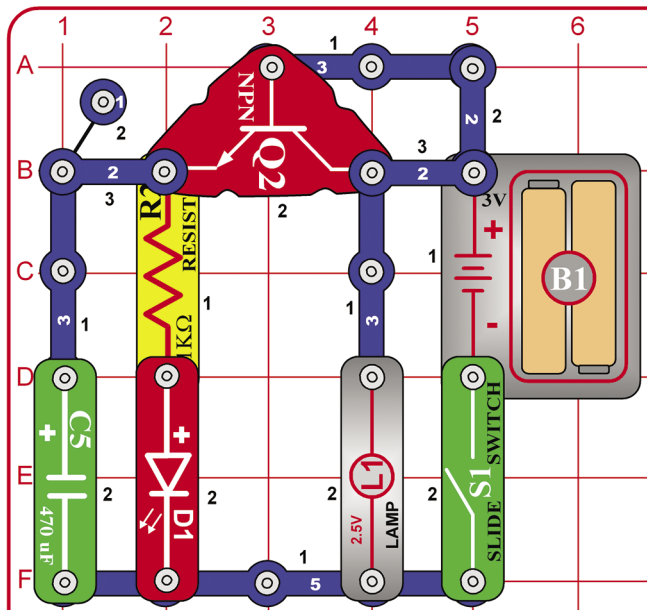
Use the circuit from Project 60, but now place a 3-snap wire and the LED (D1) as “shorting bars” under the paper sheet as shown on left.

Setup: Player 1 sets the “Quiet Zone” by placing the 3-snap wire and the LED (D1) under the paper on columns 2, 3 or 4, leaving only one open. Player 2 must NOT know where these “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 the paper clip at positions X, Y, or Z and pressing the press switch. If Player 2 places the paper clip on the correct column, and a sound plays when he presses the press switch, this means 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 2, 3 or 4 side and player 1 starts searching. Play continues until one player is at zero points and makes sound during that players turn.

Project 62



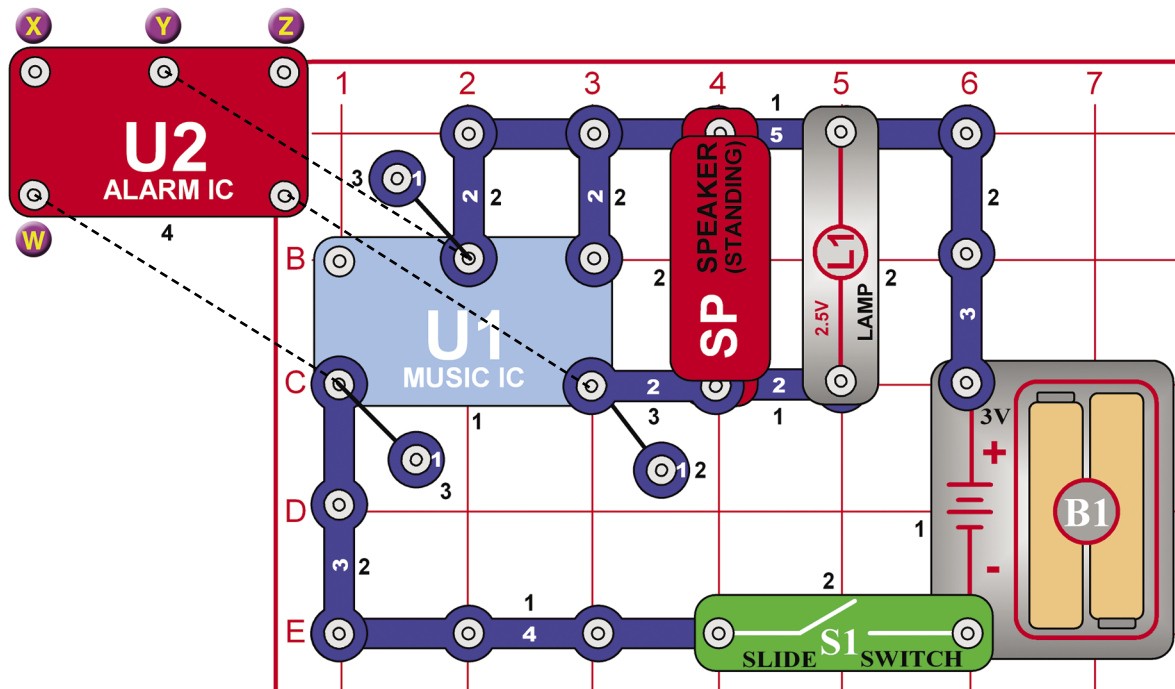
Discover the Diode

Diodes are electronic components that allow current to flow in only one direction, blocking it in the other. The red LED (D1) is a special diode that can emit light, and the transistor (Q1) can also be used as a pair of diodes.

Turn on the slide switch (S1), the lamp (L1) will be bright and the LED (D1) will be lit. The NPN transistor (Q2) is used here as a diode, allowing the batteries to charge up the 470 μ F capacitor (C5) and light the LED.

Turn off the slide switch, the lamp will go dark immediately but the LED will stay lit for a few moments as capacitor C5 discharges through it. The transistor/diode isolates the capacitor from the lamp.

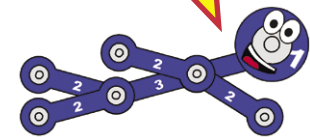
Project 63



Mixed Up Music

In the circuit, the outputs from the alarm and music ICs are connected together. Build the circuit shown and then place the alarm IC (U2) directly over the music IC (U1), resting on two 1-snaps and a 2-snap. Turn on the switch (S1) and you will hear a siren and music together while the lamp (L1) varies in brightness.

Snappy says there sure are a lot of different sounds that can be made with the music and alarm ICs.



Project 64 Blaster Disaster

Modify the last circuit by connecting points Y & Z with a 2-snap (on level 5). The circuit works the same way but now it sounds like a machine gun with music.

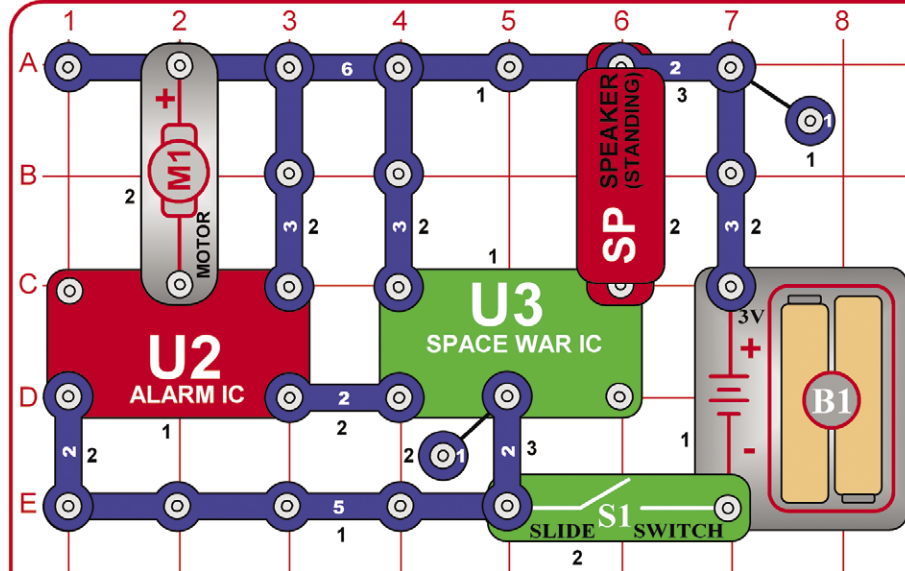
Project 65 Siren & Song

Now remove the 2-snap connection between Y & Z and then make a 2-snap connection between X & Y (on level 5). The circuit works the same way but now it sounds like a fire engine with music.

Project 66 Ambulance Song

Now remove the 2-snap connection between X & Y and then make a 2-snap connection between W & X (on level 5). The circuit works the same way but now it sounds like an ambulance with music.

Project 67



Space Battle

Build the circuit shown on the left. Turn on the switch (S1) and you will hear exciting sounds, as if a space battle is raging!

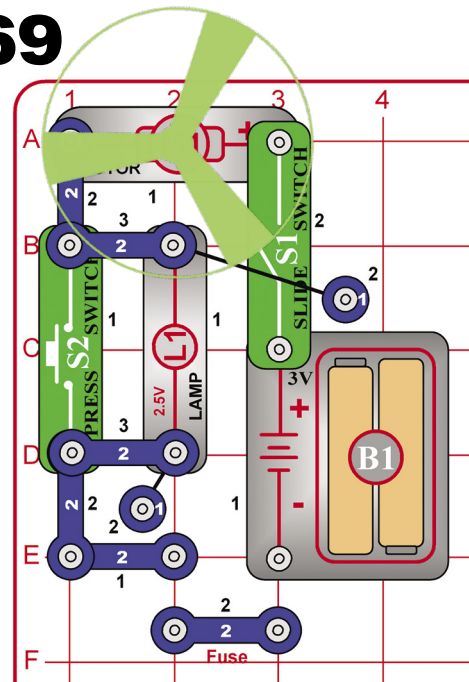
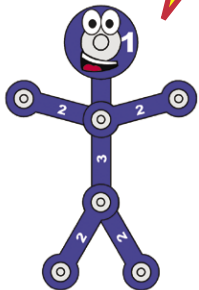
The motor (M1) is used here as a 3-snap wire, and will not spin.

Project 68 Bizzare Blinker

The preceding circuit is loud and may bother people around you, so replace the speaker (SP) with the LED (D1). Make sure you connect the LED with the positive (+) side on A6, not U3. Now you have a silent space battle.

Project 69

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

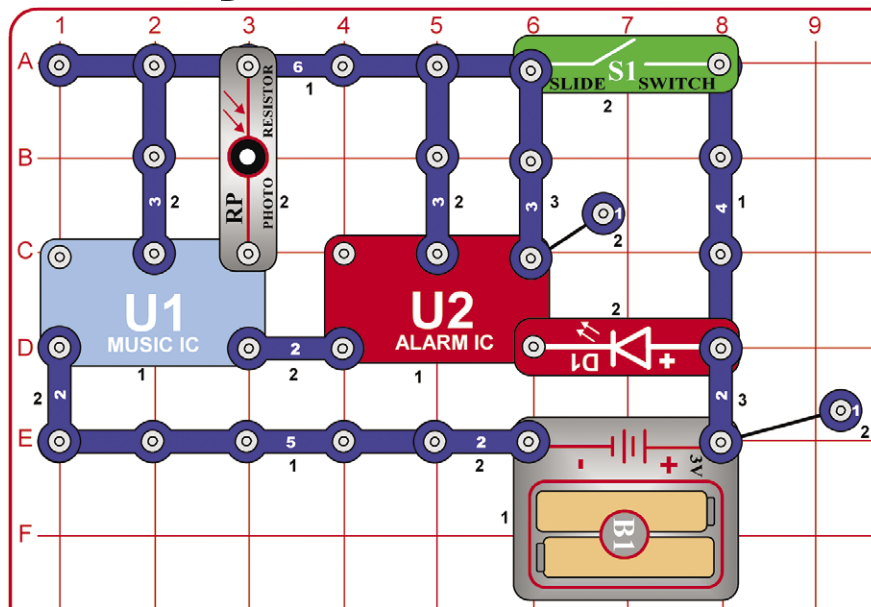


Fuse or Lose

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.

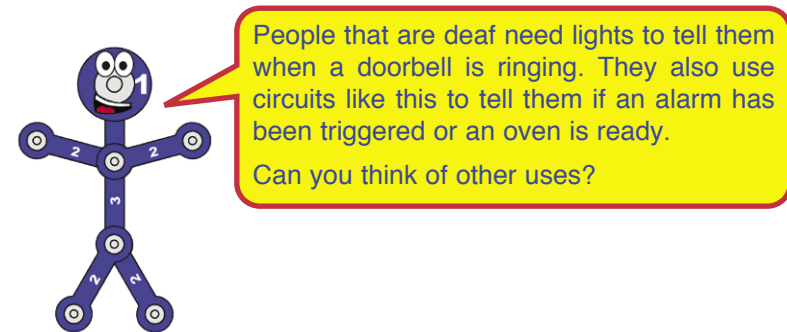
WARNING: Moving parts. Do not touch the fan or motor during operation.

Project 70

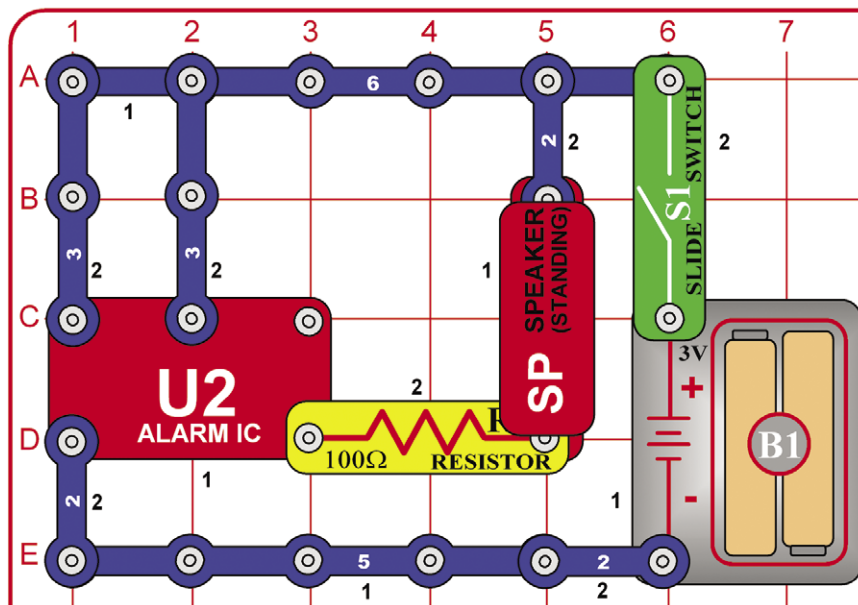


Wave & Watch

This circuit does not use the noisy speaker (SP) but instead uses a nice quiet LED (D1). Turn on the slide switch (S1), the LED flickers. Wait a few seconds, and then cover the photoresistor (RP), and the flicker stops. The flicker is controlled by the photoresistor; uncover it and the flicker resumes.



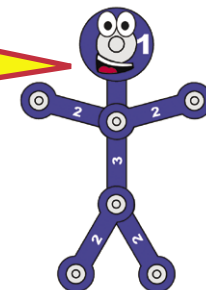
Project 71



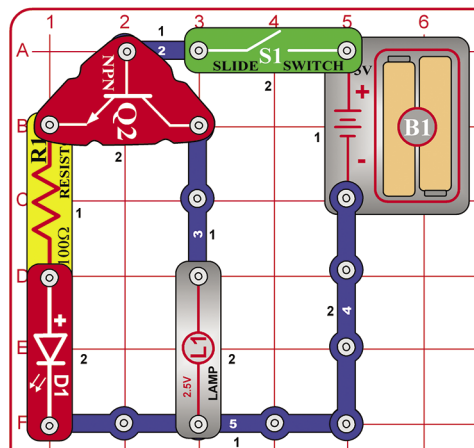
Switching Sounds

Build the circuit shown on the left. When you close the slide switch (S1), the integrated circuit (U2) should start sounding an up-down siren. This is just one more sound effect that this integrated circuit is designed to produce. 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.

Different sounds that can easily be changed are very important when designing games and toys.

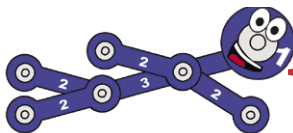


Project 72 Current Splitter

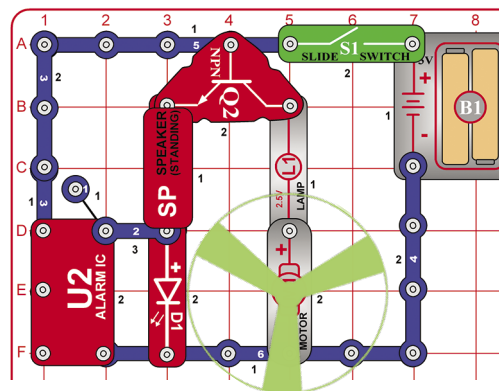


Turn on the switch (S1), the LED (D1) and lamp (L1) are bright. This is an unusual circuit which uses the NPN transistor (Q2) as two connected diodes to split the current from the batteries into the paths with the LED and lamp. If the LED (D1) does not light, you may have weak batteries in need of replacement.

Transistors use a small current to control a large current, and have three connection points (the small current, the larger current, and the combined current). But they are actually constructed using two diodes that are connected together. These diodes are similar to your LED (light emitting diode) except that they don't emit light.



Project 73 Light Up & Listen



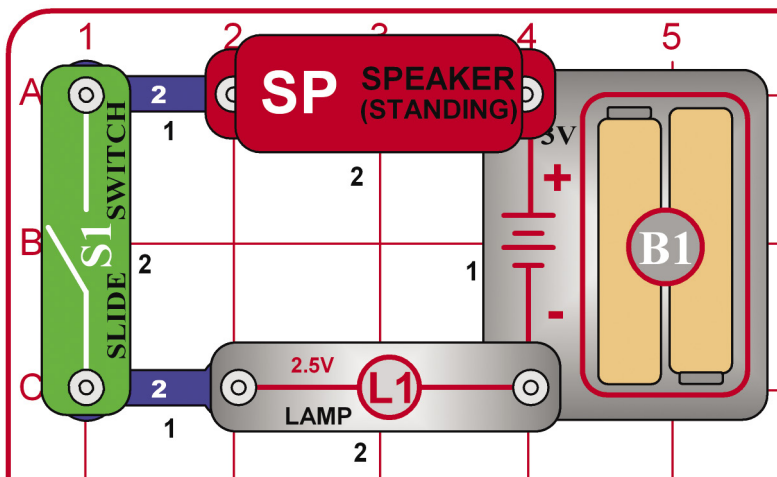
This circuit has four different types of output. Flip the switch (S1) several times. The LED (D1) and lamp (L1) light up, the motor (M1) spins, and the speaker (SP) makes a siren sound. If the LED does not light, you may have weak batteries that need replacement.

This is an unusual circuit which uses the NPN transistor (Q2) as two connected diodes, to split the current from the batteries (B1) into the paths with the LED and lamp.



WARNING: Moving parts. Do not touch the fan or motor during operation.

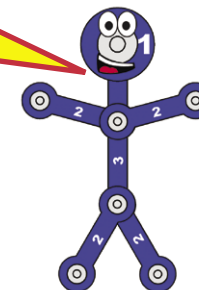
Project 74



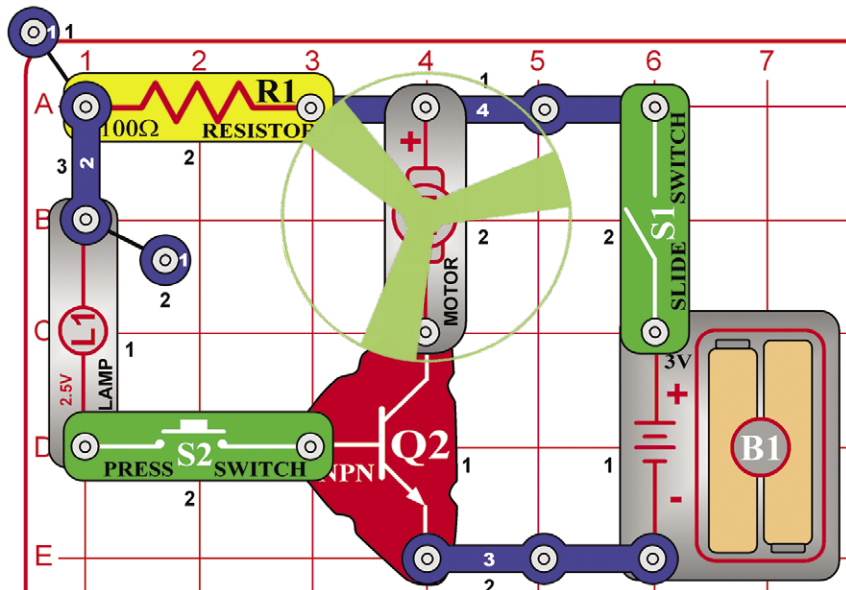
Pop On, Pop Off

Turn the slide switch (S1) on and off several times. You hear static from the speaker (SP) when you turn off the switch.

The speaker uses electromagnetism to create changes in air pressure, which your ears feel and interpret as sound. Think of the speaker as creating pressure waves in the air just like waves in a pool. You only see waves in the pool when you disturb the water, so the speaker only makes sound when the voltage changes.



Project 75

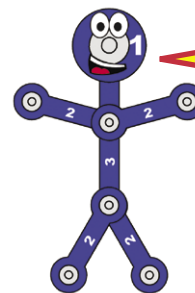


Little to Big

Place the fan on the motor (M1) and turn on the slide switch (S1), then compare this circuit to Project #31. Push the press switch (S2), the lamp doesn't light now but the motor still spins.

The lamp is dark because the 100Ω resistor (R1) limits the current through it. The NPN transistor (Q2) uses the small lamp current to create a large current that spins the motor.

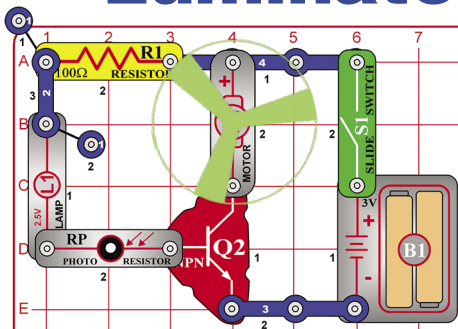
Now replace the 100Ω resistor (R1) with the larger 1KΩ resistor (R2). The motor spins more slowly now, because the transistor cannot create as large of a motor current from such a small controlling current.



Transistors, such as the NPN transistor (Q2), can amplify electric currents. In this circuit, the small current through the resistor is used to control a larger current through the motor. A large resistor value limits the current through the lamp, making it very dim, but the transistor amplified current is large enough to still spin the motor.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over motor. Fan may not rise until switch is released.

Project 76 Luminate & Rotate



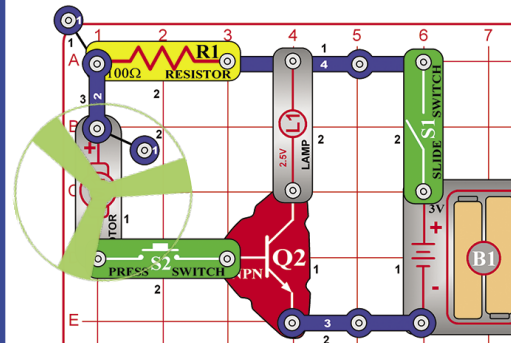
Compare this circuit to Project 75. It uses the photoresistor (RP) to control the current to the NPN transistor (Q2), instead of the press switch (S2). You can adjust the speed of the motor (M1) by changing how much light shines on the photoresistor.

The lamp is dark because the photoresistor limits the current through it. The NPN transistor uses the small lamp current to create a large current that spins the motor.

If you tried to control the motor speed by placing the photoresistor in series with the motor, the motor would not spin because the photoresistor would limit the current. But the photoresistor can control the motor speed with help from the transistor. You may need to shine a light on the photoresistor (RP) if the motor does not spin.

WARNING: Moving parts. Do not touch the fan or motor during operation.

Project 77 Light to Light



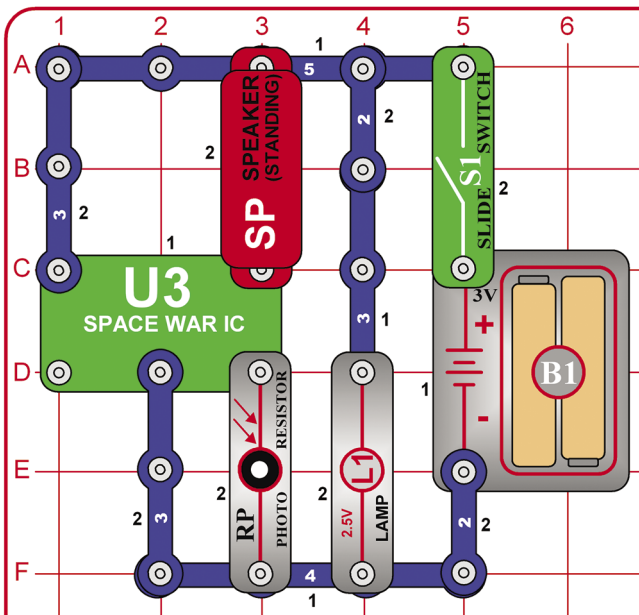
Compare this circuit to Project 23. Push the press switch (S2), the motor (M1) doesn't spin now but the lamp (L1) still lights.

The motor doesn't spin because the 100Ω resistor (R1) limits the current through it. The NPN transistor (Q2) uses the small motor current to create a large current that lights the lamp.

Now replace the 100Ω resistor (R1) with the larger 1KΩ resistor (R2). The lamp is only slightly less bright even though the motor current is much lower.

Now place the 100Ω resistor back in the circuit and replace the press switch with the photoresistor (RP). A bright light on the photoresistor will turn the lamp on. But if the light is dim, then the photoresistor has high resistance, so little current flows through the transistor and the lamp is off.

Project 78

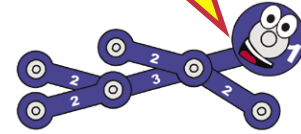


Reflection Detector

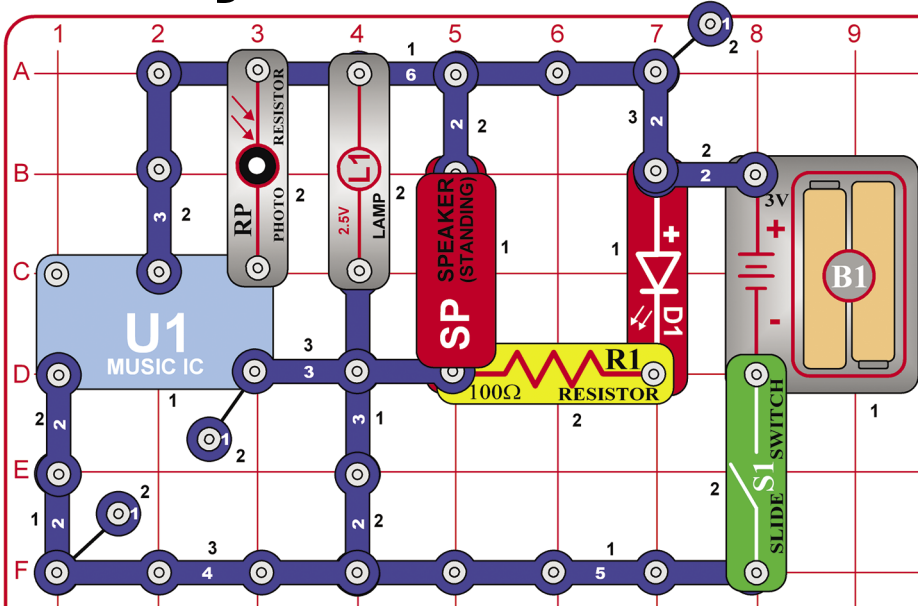
Build the circuit to the left. Place it where there won't be any room light hitting the photoresistor (RP) (such as in a dark room or under a table), and then turn it on. The 2.5V lamp (L1) will be bright, but there should be no sound.

Take a small mirror and hold it over the lamp and photoresistor. You should hear sound now. You have a reflection detector! You can also use a white piece of paper instead of a mirror, since white surfaces reflect light.

How good of a reflector is a black piece of paper? Tin foil? How about your hand?



Project 79

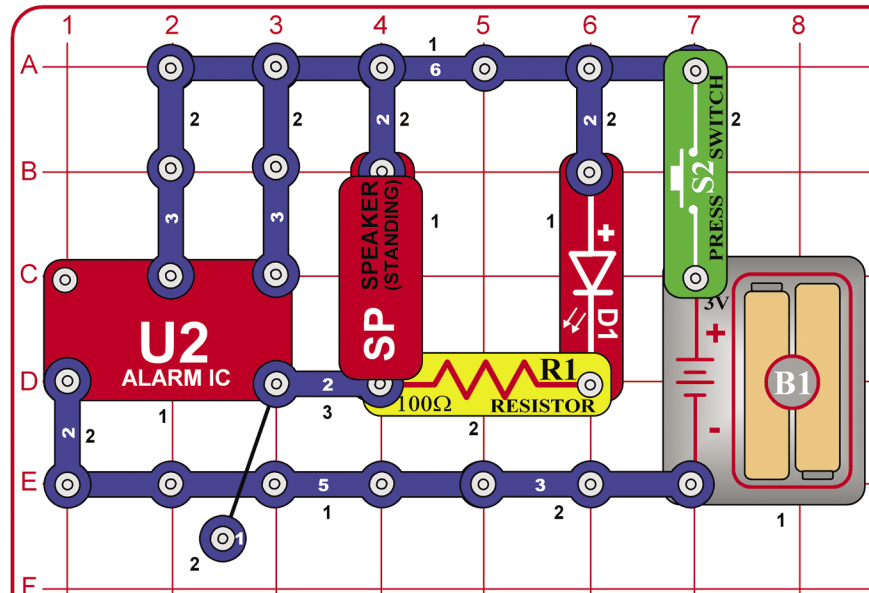


Music Reflection Detector

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

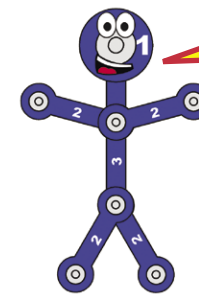
Take a small mirror and hold it over the lamp and photoresistor. You should hear sound now. You have a music reflection detector! You can also use a white piece of paper instead of a mirror, since white surfaces reflect light.

Project 80



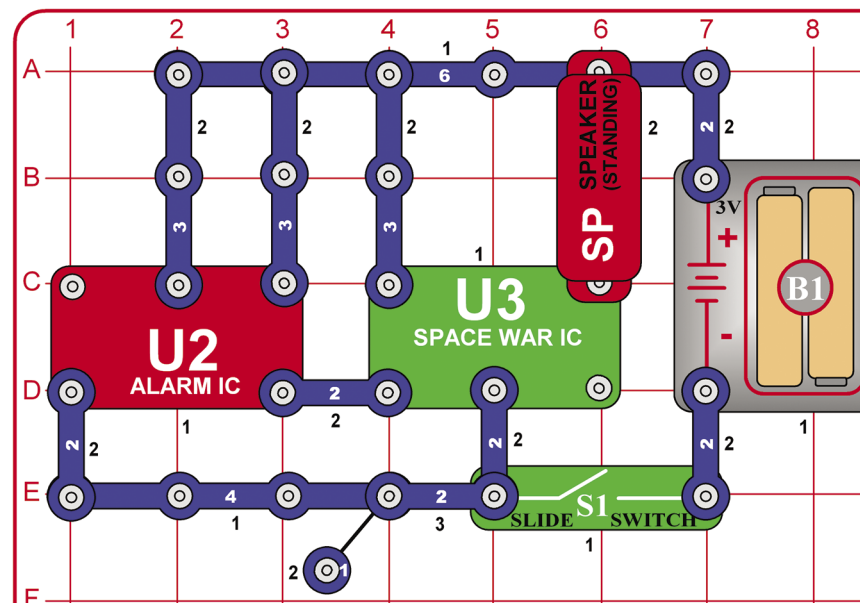
Laser Flasher

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 press switch.



This circuit demonstrates how toy laser guns can be designed.

Project 81



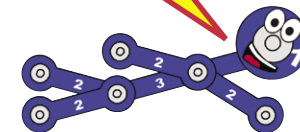
Flash & Flicker

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

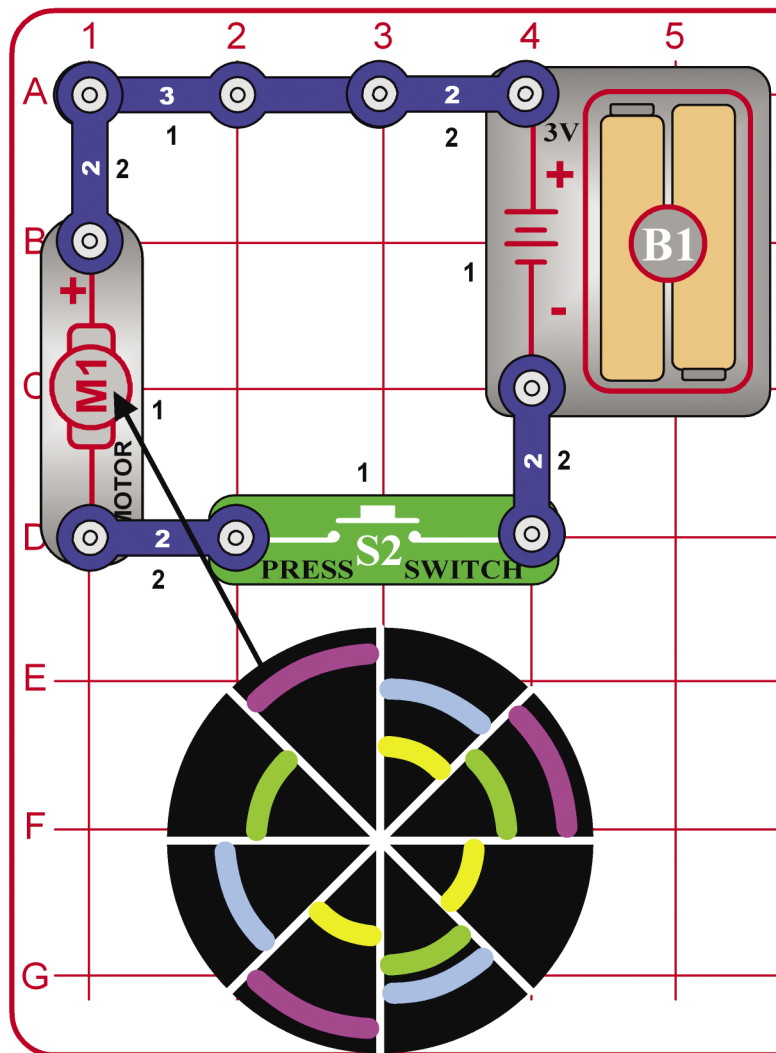
Set the switch on and the speaker makes exciting sounds. The output of the IC can control lights, speakers, and other low power devices.

You may replace the speaker (SP) with the 2.5V lamp (L1), and the bulb will flicker. You can also use the LED (D1) in place of the lamp (position it with the "+" side towards the 6-snap).

This circuit demonstrates how continuous laser gun sounds can be generated.



□ Project 82



Spinning Rings

Setup: Cut out the disc on **page 29** 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.

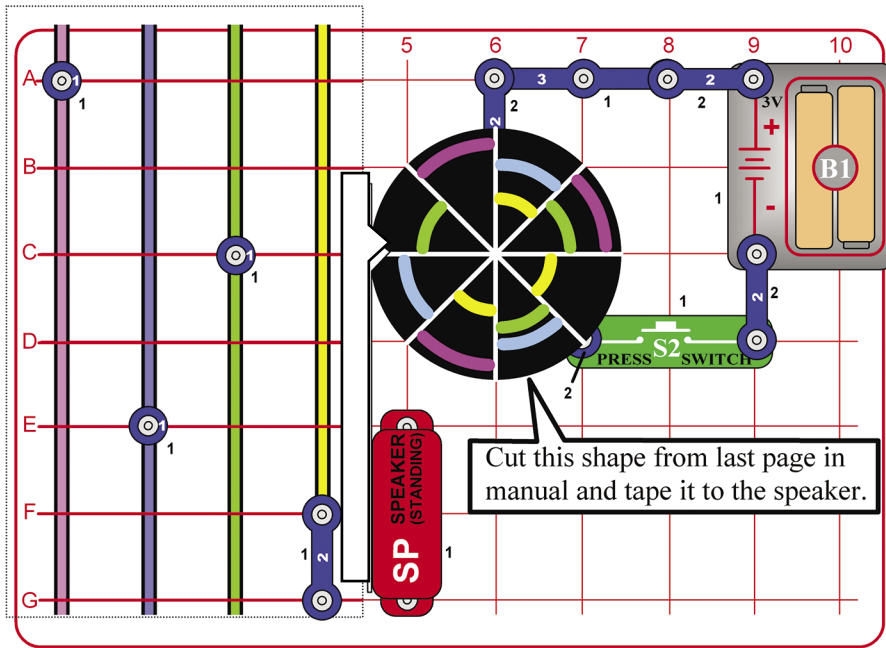
WARNING: Moving parts. Do not touch the fan or motor during operation.

□ Project 83 Strobe the House Lights

Use the circuit from Project 82.

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. Some fluorescent lights use an electronic ballast and they also produce a constant light.

Project 84



Race Game

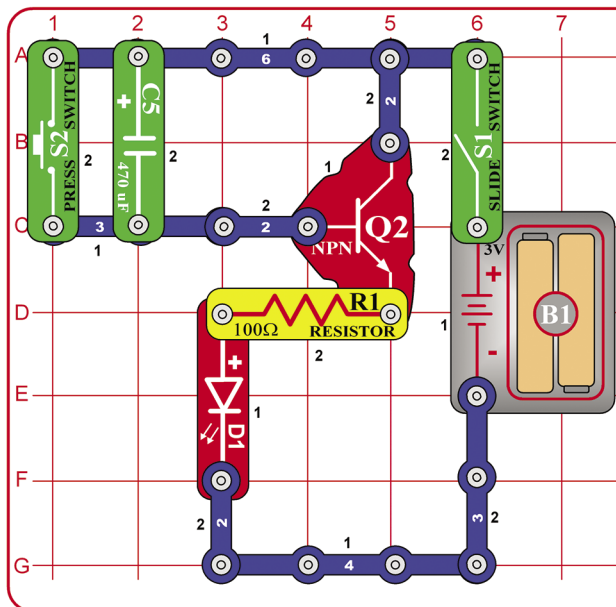
Modify Project 82 by adding the pointer as shown on the left. The paper should be cut from **page 30** and taped high enough on the speaker so the pointer will stick over the fan with paper. Bend the pointer at a right angle as shown on the left.

Setup: Cut out the grid with four (4) colors from **page 30** 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. In some models you only have three 1-snaps, so use a 2-snap if you have four players.

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.

WARNING: Moving parts. Do not touch the fan or motor during operation.

Project 85



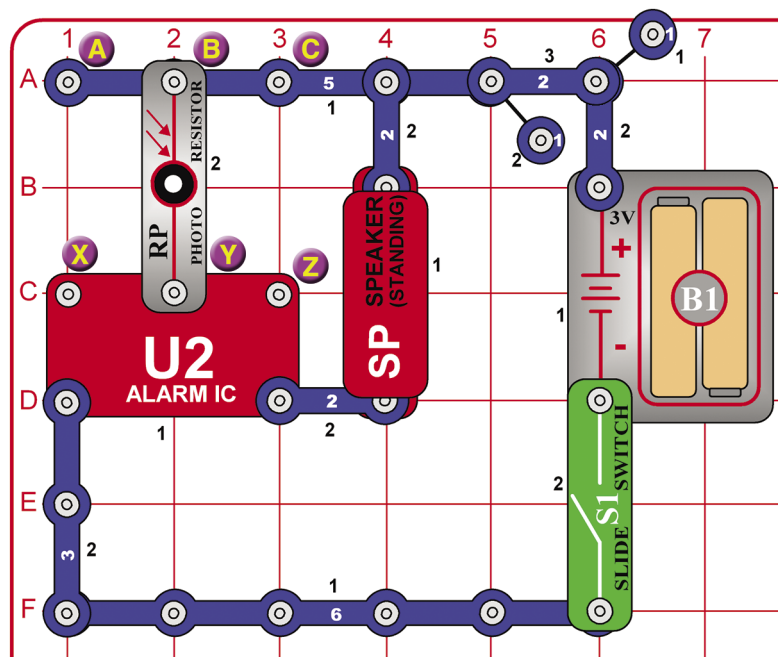
Auto-Off Night Light

Build the circuit to the left. When you turn on the slide switch (S1) the first time the LED (D1) will come on and very slowly get dimmer and dimmer. If you turn the slide switch (S1) off and back on after the LED goes out it will NOT come on again. The 470µF capacitor (C5) has charged up and the NPN transistor amplifier (Q2) can get no current at its input to turn it on. To discharge the capacitor (C5) and reset the circuit, press and release the switch (S2).



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 86

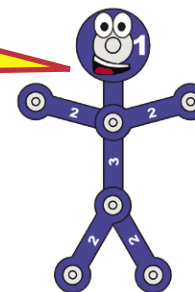


Visual Volume

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 photoresistor (RP). Try partially shielding it or placing near a very bright light, and compare the sound.

The photoresistor contains material that changes its resistance when it is exposed to light. As it gets more light, the resistance of the photoresistor decreases. 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 87 Daylight Alarm

Modify the last circuit by connecting the photoresistor to points A & X. The circuit works the same way but now it sounds like an ambulance when enough light reaches the photoresistor.

□ Project 89 Daylight Danger

Now connect a 3-snap to make a connection between A & X. Keep the photoresistor connected between points C & Z. Now depending on how much light reaches the photoresistor, you will hear either an ambulance or machine gun sound.

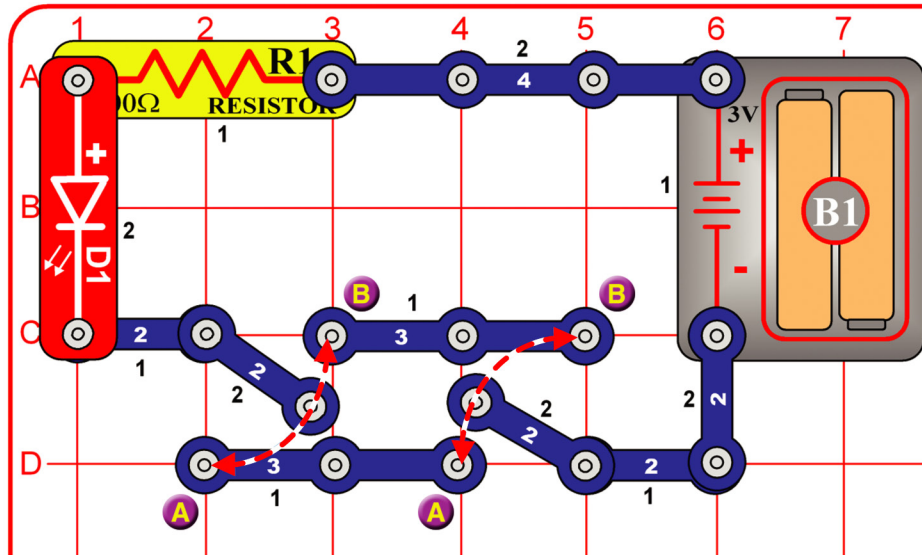
□ Project 88 Bang-Bang Bright

Now remove the photoresistor from points A & X and connect it to points C & Z. The circuit works the same way but now it sounds like a machine gun when enough light reaches the photoresistor.

□ Project 90 Crooks & Cars

Now remove the connection between A & X and then make a connection between B & Y. The circuit works the same way but now depending on how much light reaches the photoresistor you will hear either a police siren or machine gun sound.

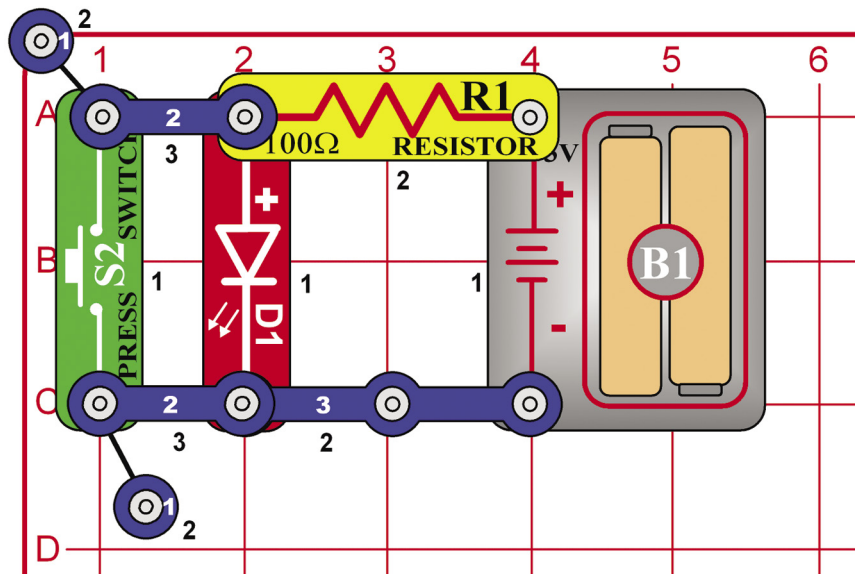
Project 91



Two-way Light Switch

Build the circuit on the left. Note that two of the 2-snaps are left unconnected on one end because they will be used as switches in this project. If you connect the free ends of each of these 2-snaps both to the “high bar” or positions B in the figure or both to the “low bar” or positions A in the figure, the LED (D1) lights up. But if you connect the free end of one of the 2-snaps to the “high bar” and the free end of the other 2-snap to the “low bar”, then the LED does not light up.

Project 92



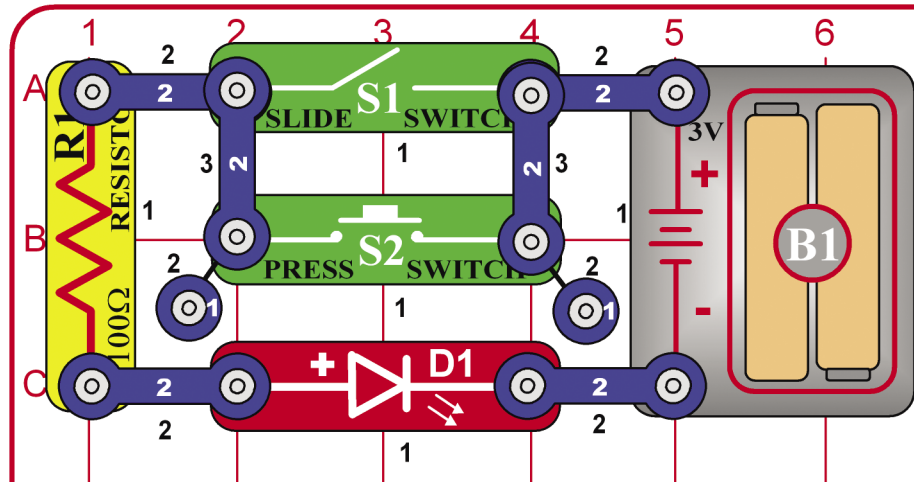
Same or “NOT”

Build the circuit shown. Notice that when the press switch (S2) is pressed, the LED (D1) goes off. This is an example of an inverter circuit, or NOT gate. Whenever the input is high (switch is on), the output is low (LED is off) and whenever the input is low (switch is off) the output is high (LED is on). Disassemble the circuit when finished to avoid draining your batteries.



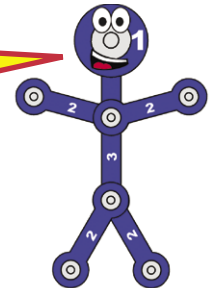
Although this circuit seems simple, inverters or NOT gates are very important in digital logic circuits.

Project 93

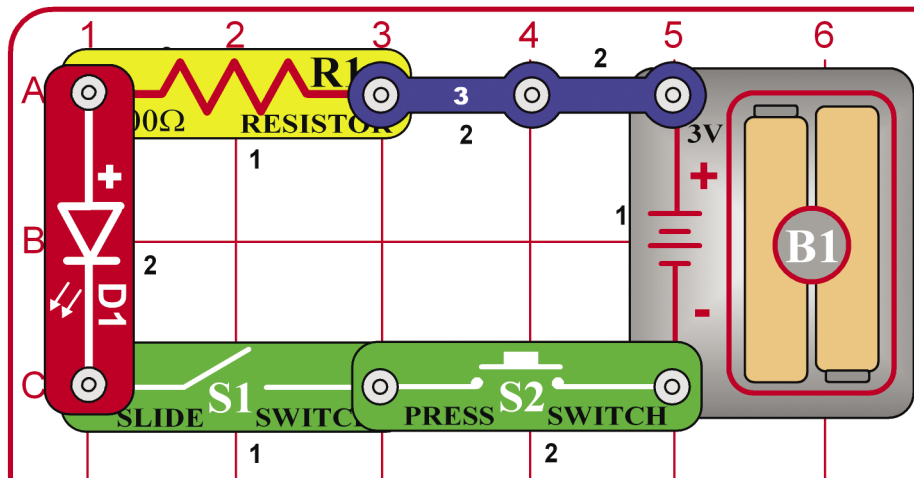


Build the circuit shown. Notice that if you turn on the slide switch (S1) **OR** press the press switch (S2) the LED (D1) lights up. There is no partially lit state here, the diode is either totally on or totally off. While this may seem very simple and boring, it represents an important concept in electronics. 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.

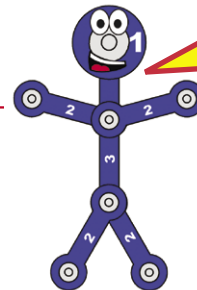
This circuit is commonly called an OR gate. OR gates are used in digital logic circuits to perform logical additions. When one of the inputs is high (one of the switches is on) the output is high (LED on). The output will only be low (LED off) if both inputs are low (both switches are off).



Project 94

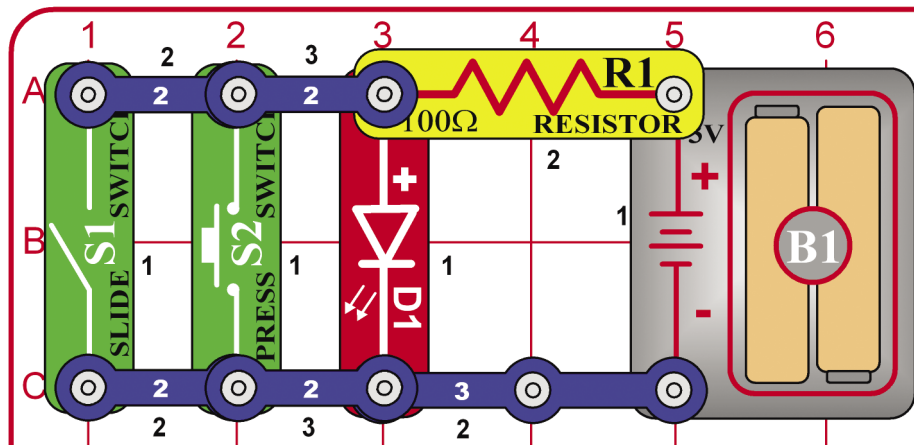


Build the circuit shown. Notice that if you turn on the slide switch (S1) **AND** press the press switch (S2) the LED (D1) lights up. Once again, there is no partially lit state here, the LED is either totally on or totally off. Two switches like this may be used to turn on the same light in your house, 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.



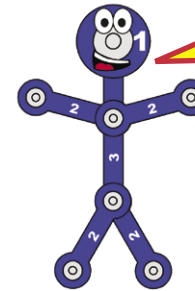
This circuit is commonly called an AND gate. AND gates are used in digital logic circuits to perform logical multiplies. When one of the inputs is low (one of the switches is off) the output is low (LED off). The output will only be high (LED on) if both inputs are high (both switches are on). Combinations 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 95



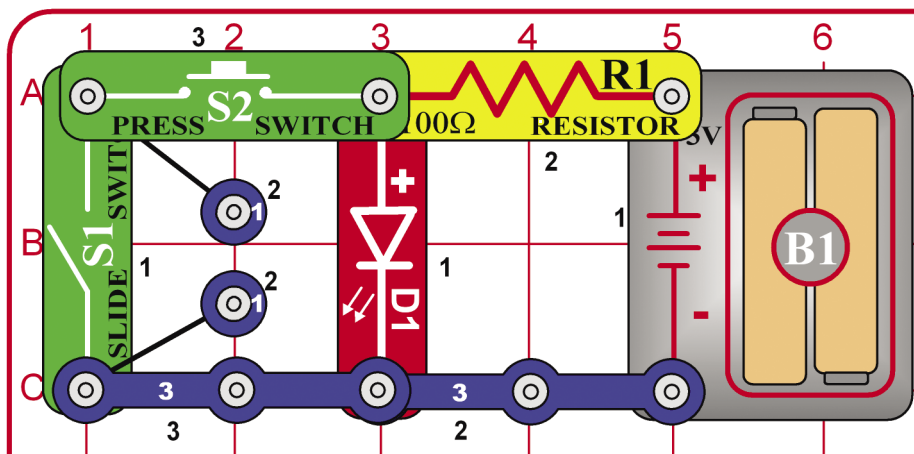
Neither This NOR That

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 93, you can see the LED (D1) 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.



This circuit is commonly called a NOR gate. NOR gates are used in digital logic circuits to perform an inverted logical add. When one of the inputs is high (one of the switches is on) the output is low (LED off). The output will only be high (LED on) if both inputs are low (both switches are off).

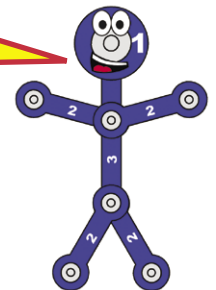
Project 96



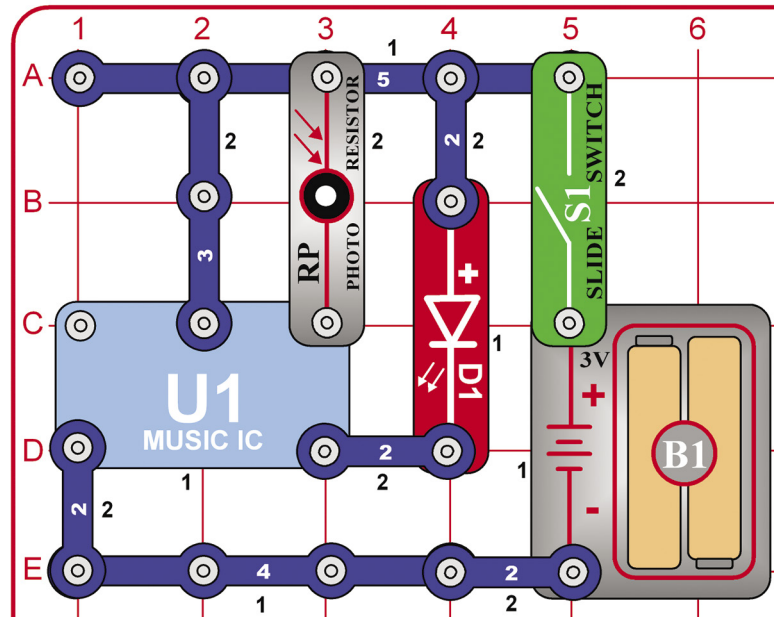
NOT This AND That

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 94, you can see the LED (D1) 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.

This circuit is commonly called a NAND gate. NAND gates are used in digital logic circuits to perform an inverted logical multiply. When one of the inputs is low (one of the switches is off) the output is high (LED on). The output will only be low (LED off) if both inputs are high (both switches are on).



Project 97



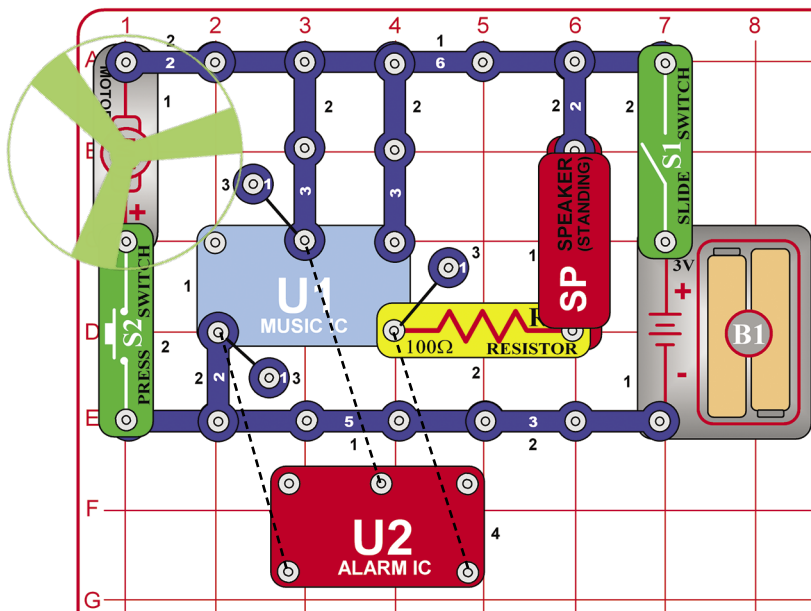
Light Makes Light

Build the circuit to the left. Cover the photoresistor, turn the switch on, and notice that the LED is on for several seconds and then goes off. Uncover the photoresistor and place the unit near a light and the LED will light. Cover the photoresistor (RP) again and the LED will turn off. The resistance of the photoresistor decreases as the light increases activating the U1 IC that varies the voltage to the LED making it light.

Project 98 Go & Glow

Use the preceding circuit. Connect the motor (M1) across points A1 and C1 on the base grid, and remove the photoresistor (RP). Turn the switch on and the LED (D1) lights for several seconds then goes out. Turn the shaft of the motor and the LED will light again. As the motor turns, it produces 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 through its terminals. This voltage then activates the music IC.

Project 99



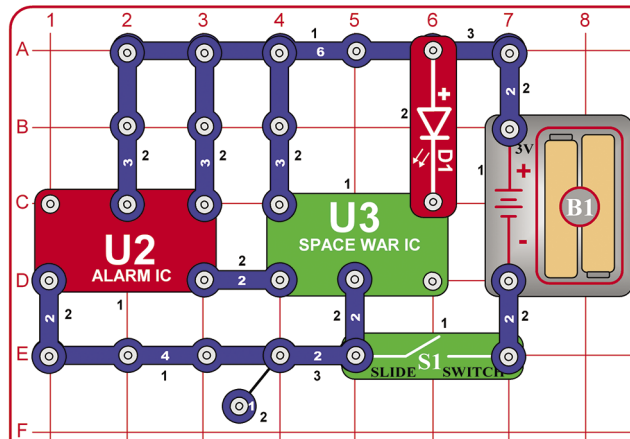
Power Pitch

In the circuit, the outputs from the alarm (U2) and music ICs are connected together. Build the circuit shown and then place the alarm IC (U2) directly over the music IC (U1), resting on three 1-snaps. Turn on the slide switch (S1) and you will hear a siren and music together. Push the press switch (S2) and the fan spins, while the sound may not be as loud. The fan may rise into the air when you release the switch.

This circuit is similar to Project #47, but the fan will fly a little higher since the sound circuit no longer drives the lamp (L1) and therefore uses less battery power.

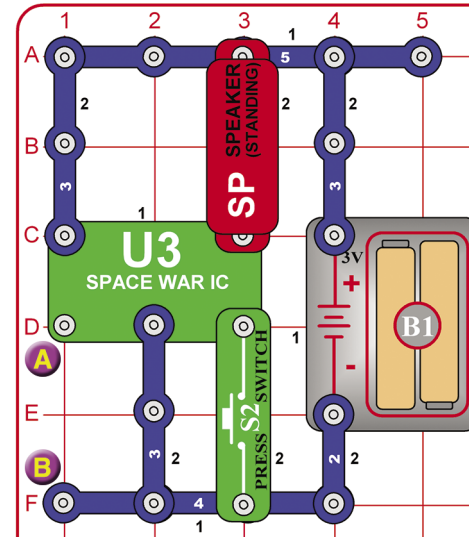
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over motor.

Project 100 Flashing Flare



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

Project 101 Touch & Go

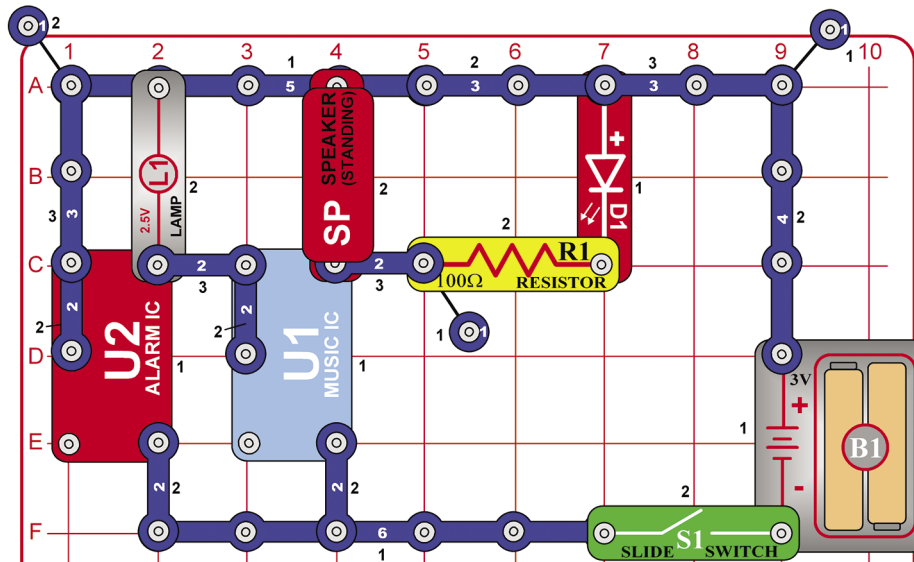


Wet your fingers with some water or saliva and touch them across points A and B several times to hear some space war sounds. Push the press switch (S2) to hear more sounds at the same time.

This circuit uses your body to conduct electricity, and turn on the circuit.

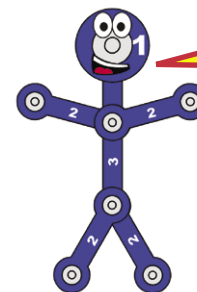
Wetting your fingers improves the connection between the metal and your finger.

Project 102



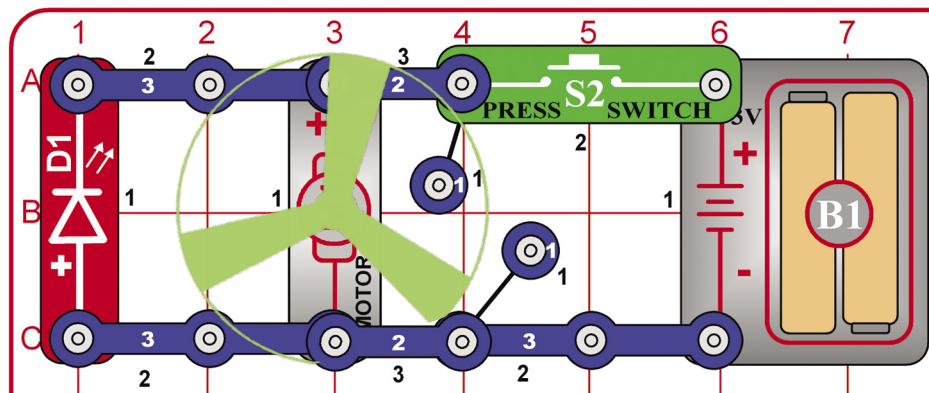
Two-Tone Twinkler

Turn the switch (S1) on and the lamp (L1) and LED (D1) start flashing. You hear two different tones driving the LED and lamp. ICs can be connected to control many different devices at the same time.



Connecting the output of the Alarm or Music ICs to multiple devices (such as the LED, speaker and lamp) enables these devices operations to be synchronized.

Project 103



Fan Flash Energy

Place the fan on the motor (M1). Hold down the press switch (S2) for a few seconds and then watch the LED (D1) as you release the switch. The LED flashes briefly but only after the batteries (B1) are disconnected from the circuit.

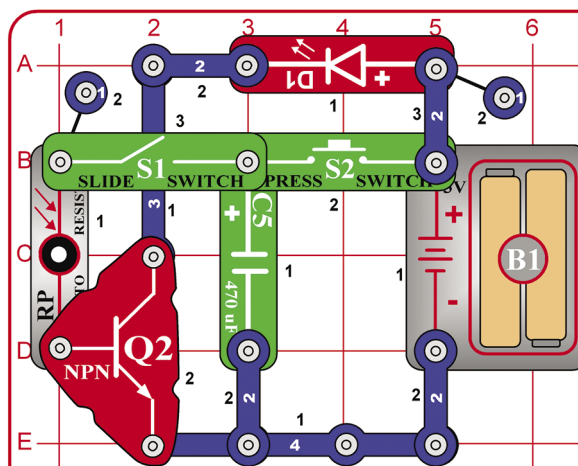
Do you know why the LED flashes? It flashes because the mechanical energy stored in the fan blade makes the motor act like a generator. When the switch is released, this energy creates a brief current through the LED.

If you reverse the motor direction, then the LED will light the same way, but the fan may fly off after the LED lights.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over motor.

Project 104

Photo Timer Light

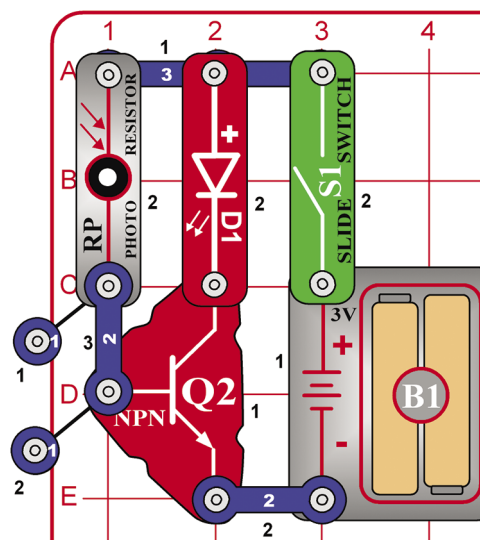


Press and release the press switch (S2), then turn on the slide switch (S1). The LED will light for a while when there is room light on the photoresistor (RP) and slowly dims.

The capacitor (C5) will store energy until a light shines on the photo resistor to release the energy, which activates the NPN transistor (Q2) and turns on the LED (D1). Press the press switch again to recharge the capacitor.

Project 105

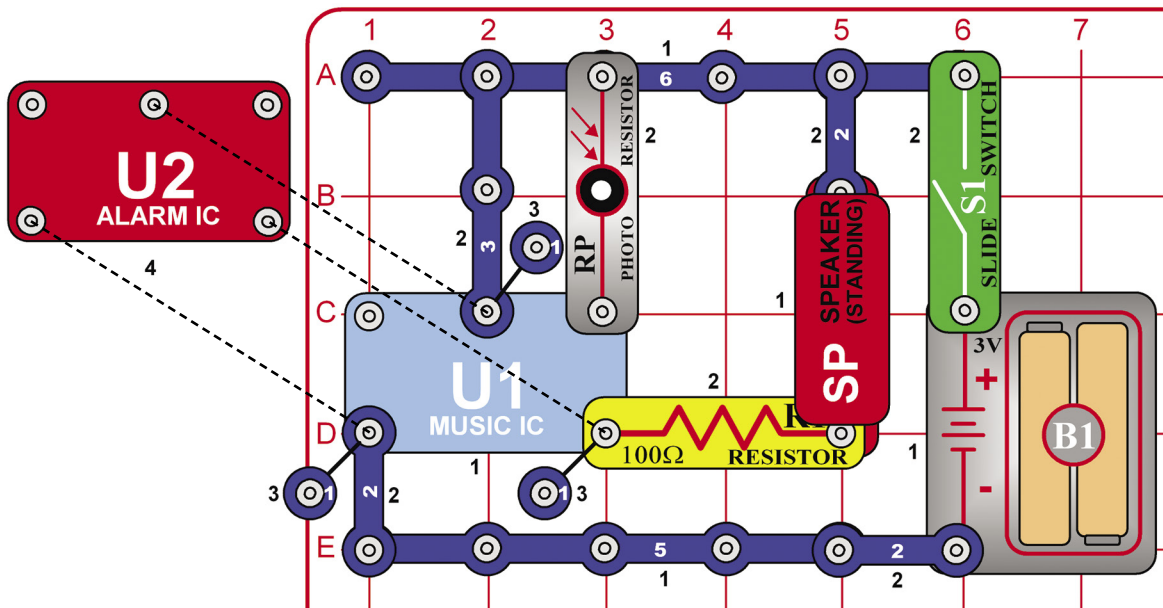
Room Light to Red Light



Turn on the switch, the brightness of the LED depends on how much room light shines on the photoresistor. The resistance drops as more light shines, allowing more current to the NPN.

Project 106

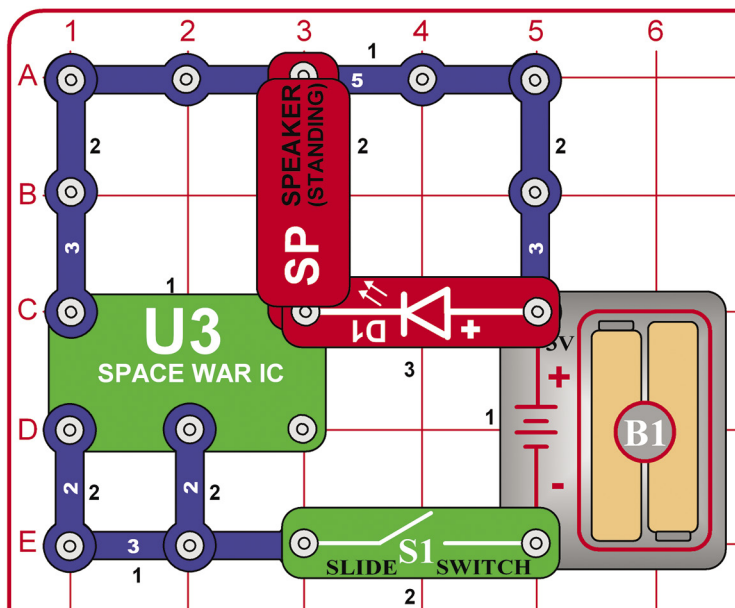
Music Alarm Combo



Build the circuit shown and then place the alarm IC (U2) directly over the music IC (U1), resting on the three 1-snaps. Turn on the slide switch (S1) and you will hear a siren and music together. After a few seconds, covering the photoresistor (RP) will stop the music (but the siren continues).

Project 107

Hit the Target

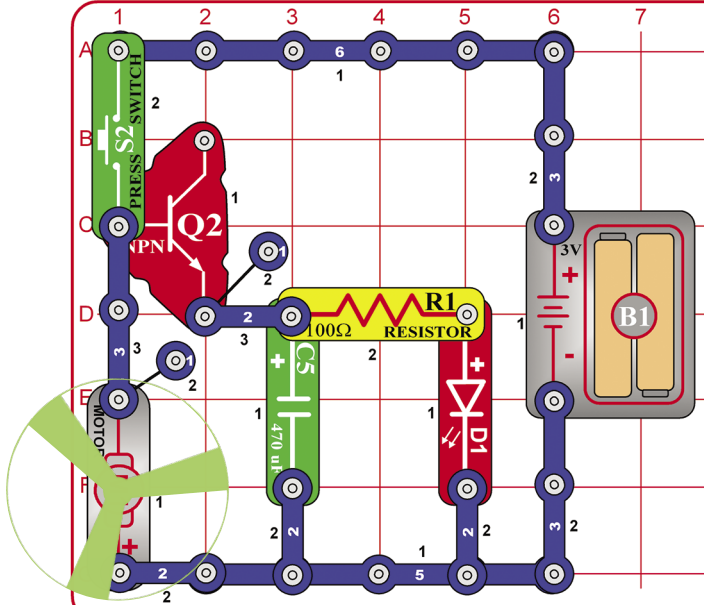


Turn the slide switch (S1) on and you hear the sound of a bomb dropping and then exploding. The LED (D1) lights and then flashes as the bomb explodes. This is one sound generated from the space war IC (U3).

Project 108 Many Missiles

Use the preceding circuit. Replace the slide switch (S1) with the motor (M1). Turn the shaft on the motor and now it sounds like a bunch of bombs dropping.

Project 109



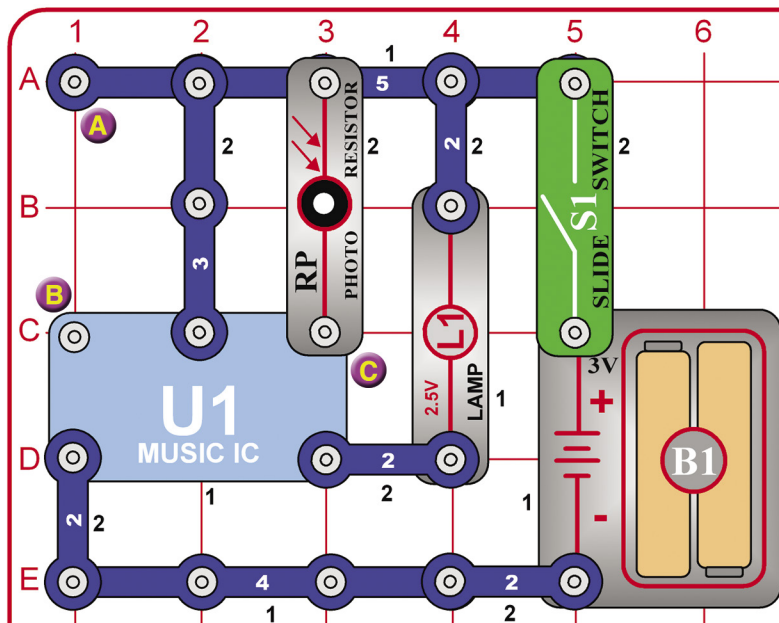
Long Gone Light

Push the press switch (S2). If the fan is off the motor (M1) (or flies off) then the LED (D1) will be bright.

It takes a lot of current to spin the motor when the fan is on it, and the voltage drops because the batteries (B1) cannot supply enough. When the fan flies off, the current drops and the voltage rises. The NPN transistor (Q2, used here as a diode) and 470μF capacitor (C5) are a detector circuit, which measures the voltage at the motor.

WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over motor.

Project 110



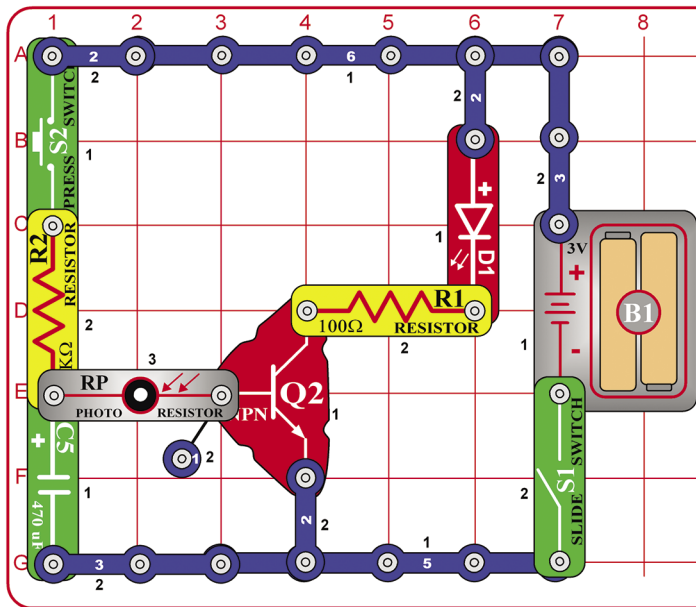
Light-controlled Lamp

Build the circuit to the left. Cover the photoresistor (RP), turn the slide switch (S1) on, and notice that the lamp (L1) is off after several seconds. Place the unit near a light and the lamp turns on. Cover the photoresistor again. The lamp turns off. The resistance of the photoresistor decreases as the light increases. The low resistance acts like a wire connecting point C to the positive (+) side of the battery activating the music IC (U1).

Project 111 Motor-controlled Lamp

Use the preceding circuit. Remove the photoresistor (RP) and connect the motor (M1) across points A & B. The lamp (L1) lights for a few seconds and then turns off. Turn the slide switch (S1) 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 coil and a voltage across its terminals. The voltage then activates the music IC (U1).

Project 112

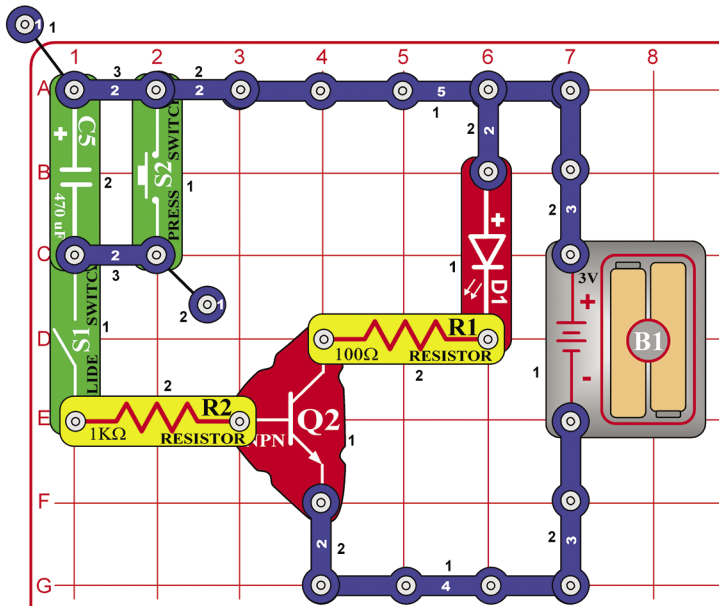


The Dark Dimmer

Turn on the slide switch (S1) and push the press switch (S2). If there is light on the photoresistor (RP), then the LED (D1) will stay on for a long time after you release the press switch.

The energy stored in the 470μF capacitor (C5) keeps the controlling current to the NPN transistor (Q2) on even though the press switch was turned off. If it is dark, the high resistance of the photoresistor shuts off the current to the transistor.

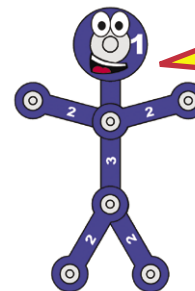
Project 113



Lagging Light

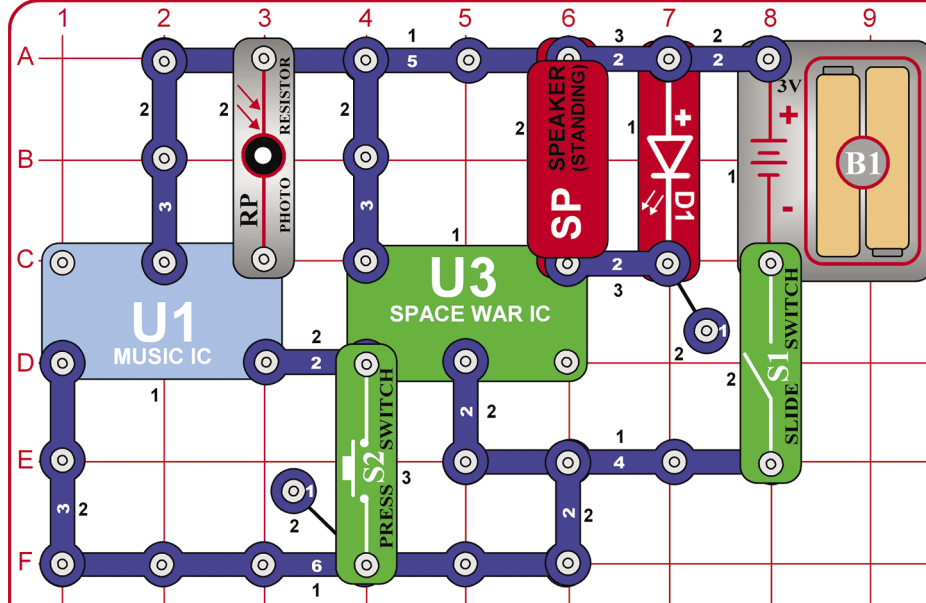
Build the circuit and turn on the slide switch (S1). The LED (D1) is bright but slowly gets dark as the 470μF capacitor (C5) charges up.

The LED will stay dark until you push the press switch (S2), which discharges the capacitor.



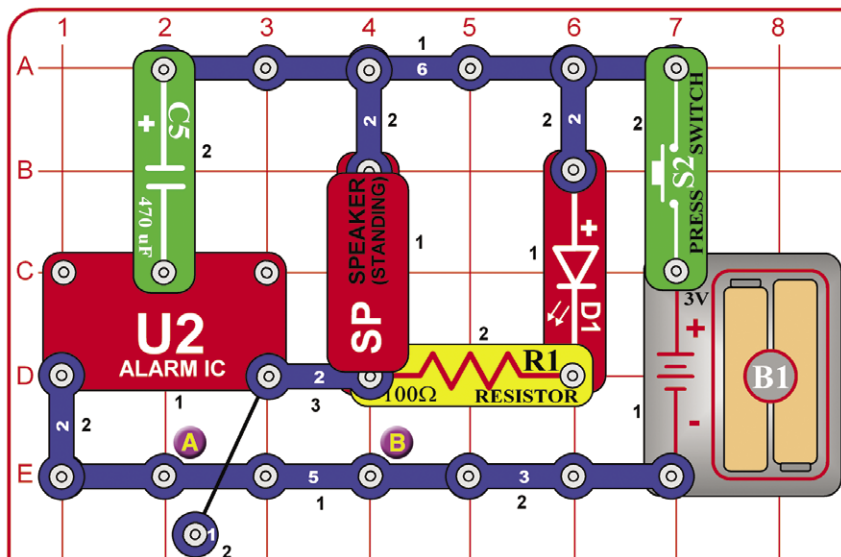
This circuit shows how capacitors can be used to provide a delay. This type of circuit is used in house lighting to fade out the lights when you turn the switch off.

Project 114



Set the slide switch (S1) on, a space war sound plays and the LED (D1) flashes. Cover the photoresistor (RP) and press the press switch (S2) to change the sound. See how many sounds are programmed into the space war sound IC (U3).

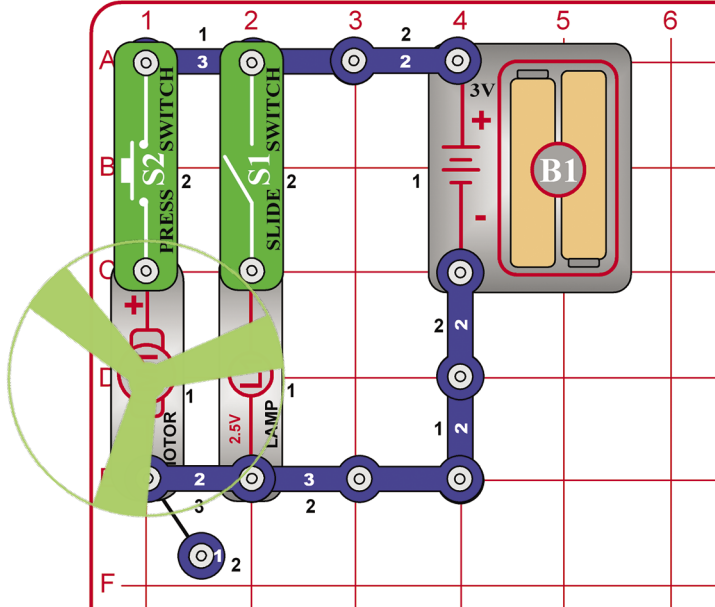
Project 115



First, place the 470µF capacitor (C5) across points A & B to discharge it. Then build the circuit as shown on the left. 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 116

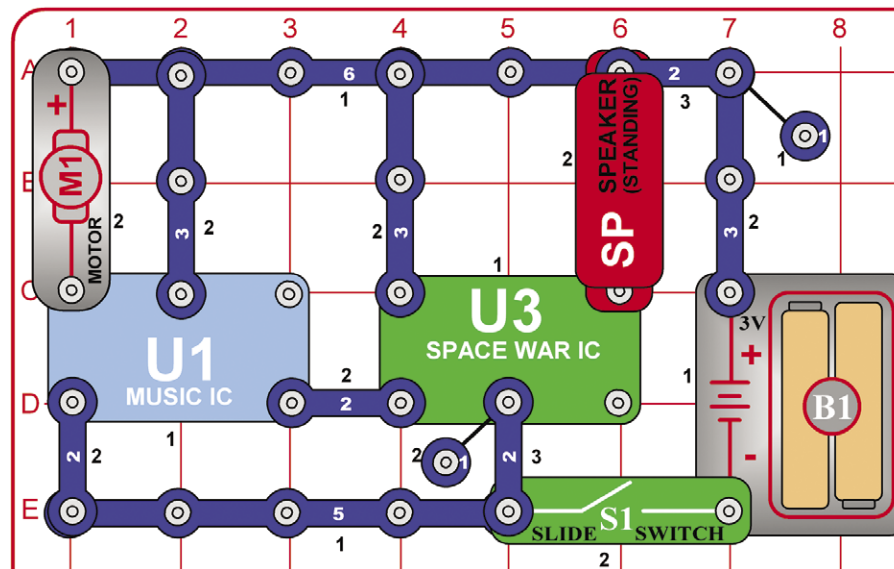


Light the Motor

Build the circuit and place the fan on the motor (M1). Depending on which of the switches (S1 and S2) are on, you can turn on either the lamp (L1) (Project #1), the motor (M1) (Project #2), or both together (Project #10).

WARNING: Moving parts. Do not touch the fan or motor during operation.

Project 117



Motor Space Sounds

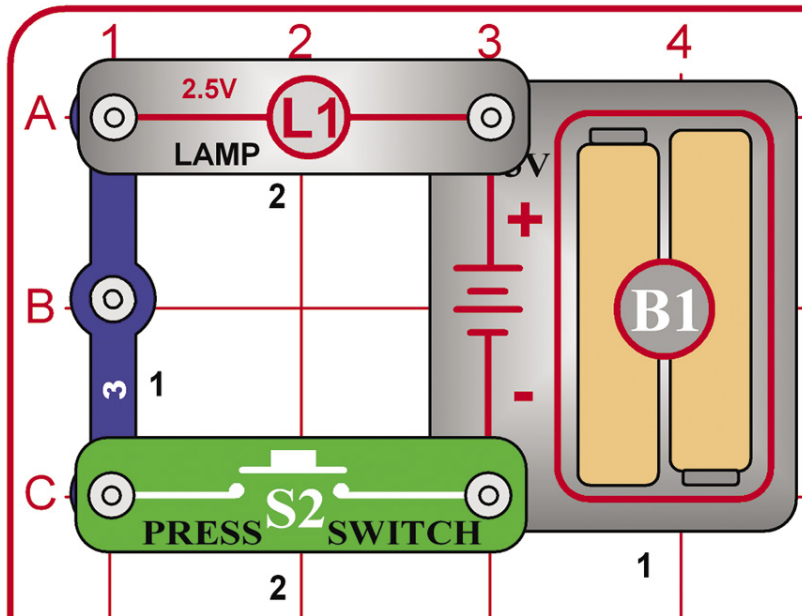
Turn it on and wait for any sounds to stop. Then, spin the motor (M1) and the sounds play again.

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 118 Twist & Blink

This circuit is loud and may bother other people around you so replace the speaker (SP) with the LED (D1), ("+" on top); the circuit operates in the same manner but now the LED flashes instead of the speaker making sounds.

Project 119



Morse Code

This simple circuit can be used for communication. Press the press switch (S2) in long and short bursts to make a pattern of light flashes representing the dots and dashes shown in the Morse Code table below. You can use Morse Code and this circuit to send secret messages to some friends in the room without others knowing what you're saying.

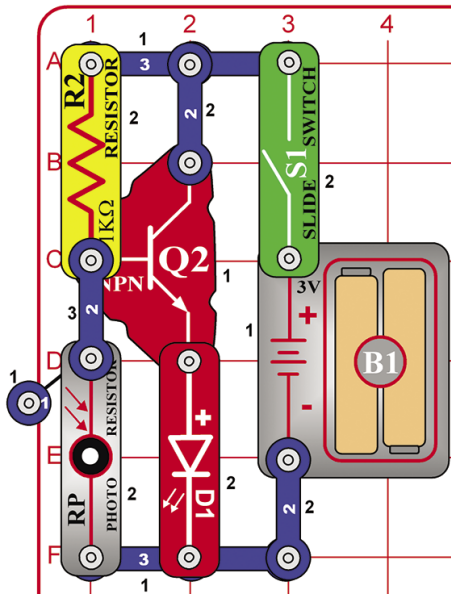
If you have a strong flashlight or searchlight then you can send messages to friends far away at night. During World War II Navy ships sometimes communicated by flashing Morse Code messages between ships using searchlights (because radio transmissions might reveal their presence to the enemy).

Years ago, some civilizations would send messages to other tribes using smoke signals and a special code.

Morse Code: The forerunner of today's telephone system was the telegraph, which was widely used in the latter half of the 19th century. It only had two states - on or off (that is, transmitting or not transmitting), and could not send the range of frequencies contained in human voices or music. A code was developed to send information over long distances using this system and a sequence of dots and dashes (short or long transmit bursts). It was named Morse Code after its inventor. It was also used extensively in the early days of radio communications, though not in wide use today. It is sometimes referred to in Hollywood movies.

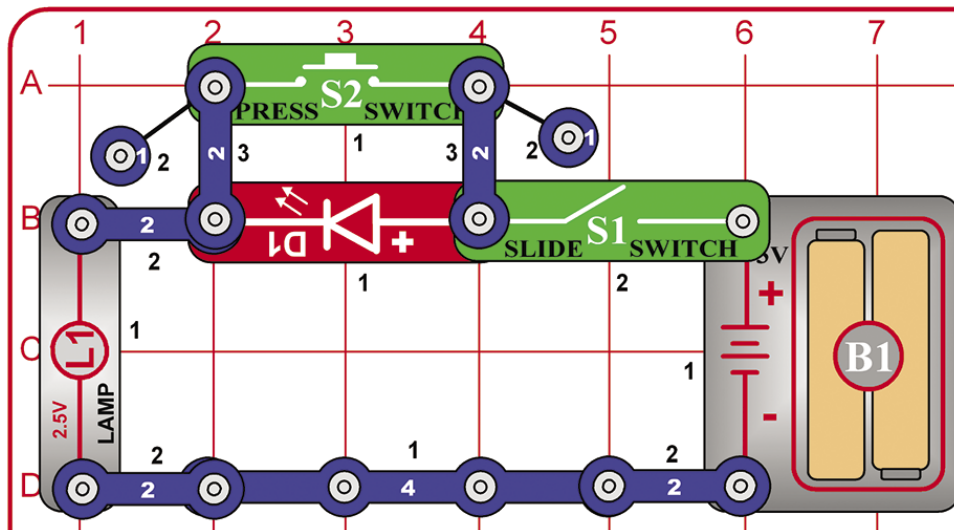
A	· —	N	— ·	Period	· — · — · —
B	— · · ·	O	— — —	Comma	— — · — —
C	— · — ·	P	· — — ·	Question	· · — — · ·
D	— · ·	Q	— — · —	1	· — — — —
E	·	R	· — ·	2	· · — — —
F	· · — ·	S	· · ·	3	· · · — —
G	— — ·	T	—	4	· · · · —
H	· · · ·	U	· · —	5	· · · · ·
I	· ·	V	· · · —	6	— · · · ·
J	· — — —	W	· — —	7	— — · · ·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

Project 120



Turn on the slide switch (S1), the brightness of the LED (D1) depends on how LITTLE light shines on the photoresistor (RP). The resistance drops as more light shines, diverting current away from the NPN transistor (Q2).

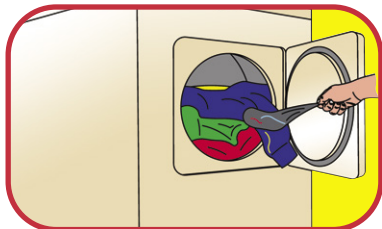
Project 121



When you turn on the slide switch (S1), the LED (D1) is on and the lamp (L1) is off.

Push the press switch (S2) to bypass the LED. The lamp turns on and the LED turns off. This shows how switches can be used to shift power between different devices.

Project 122



Find some clothes that cling together in the dryer, and try to uncling them.



The crackling noise you hear when taking off a sweater is static electricity. You may see sparks when taking one off in a dark room.

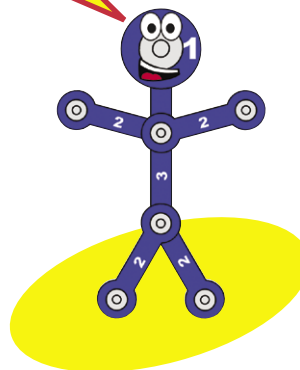


Rub a sweater (wool is best) and see how it clings to other clothes.

Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

Electricity You Can Wear

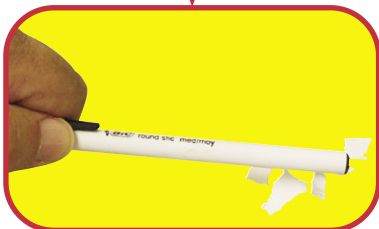
Snappy says: clothes can cling together because electricity is all around us.



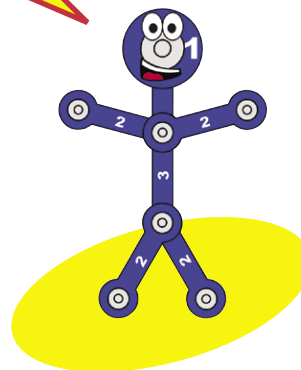
Did you ever wonder why clothes cling together when they come out of the dryer? Did you ever hear a crackling sound when you take off a sweater? (If the room is dark you might even see sparks.) Did you ever feel a “zap” when you touch someone wearing a sweater on a dry day?

These effects are caused by electricity. We call this static electricity because the electrical charges are not moving, although pulling clothes apart sounds like static on a radio. When electricity is moving (usually through wires) to do something in another place, we call it an electric current.

Project 123



Snappy says: notice how your hair can “stand up” or be attracted to the comb when the air is dry. Wetting your hair dissipates the static charge.



You need a comb (or a plastic ruler) and some paper for this project. Rip up the paper into small pieces. Run the comb through your hair several times then hold it near the paper pieces to pick them up. You can also use a pen or plastic ruler, rub it on your clothes (wool works best).

Rubbing the comb through your hair pulls extremely tiny charged particles from your hair onto the comb. These give the comb a static electrical charge, which attracts the paper pieces.

Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

Project 124 Bending Water

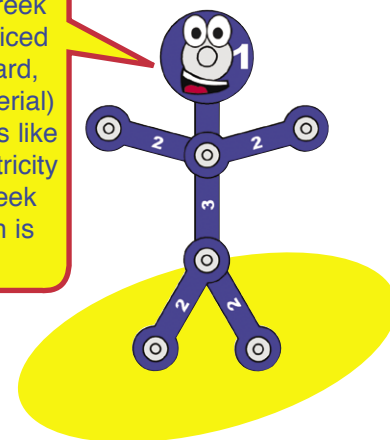


You need a comb (or plastic ruler) and a water faucet for this project. Run the comb through your hair several times then hold it next to a slow, thin stream of water from a faucet. The water will bend towards it. You can also use a plastic ruler. Rub it on your clothes (wool works best).

Rubbing the comb through your hair builds up a static electrical charge on it, which attracts the water.

Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

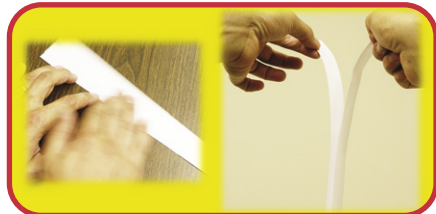
Static electricity was discovered more than 2,500 years ago when the Greek philosopher Thales noticed that when amber (a hard, clear, yellow-tinted material) is rubbed, light materials like feathers stick to it. Electricity is named after the Greek word for amber, which is electron.



Project 125



Take a piece of newspaper or other thin paper and rub it vigorously with a sweater or pencil. It will stick to a wall.



Cut the paper into two long strips, rub them, then hang them next to each other. See if they attract or repel each other.



If you have two balloons, rub them to a sweater and then hang the rubbed sides next to each other. They repel away. You could also use the balloons to pick up tiny pieces of paper.

Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

Static Tricks

Electricity vs. Gravity:

Electricity is immensely more powerful than gravity (gravity is what causes things to fall to the ground when you drop them). However electrical attraction is so completely balanced out that you don't notice it, while gravity's effects are always apparent because they are not balanced out.

Gravity is actually the attraction between objects due to their weight (or technically, their mass). This effect is extremely small and can be ignored unless one of the objects is as big as a planet (like the earth). Gravity attraction never goes away and is seen every time you drop something. Electrical charge, though usually balanced out perfectly, can move around and change quickly.

For example, you have seen how clothes can cling together in the dryer due to static electricity. There is also a gravity attraction between the sweaters, but it is always extremely small.



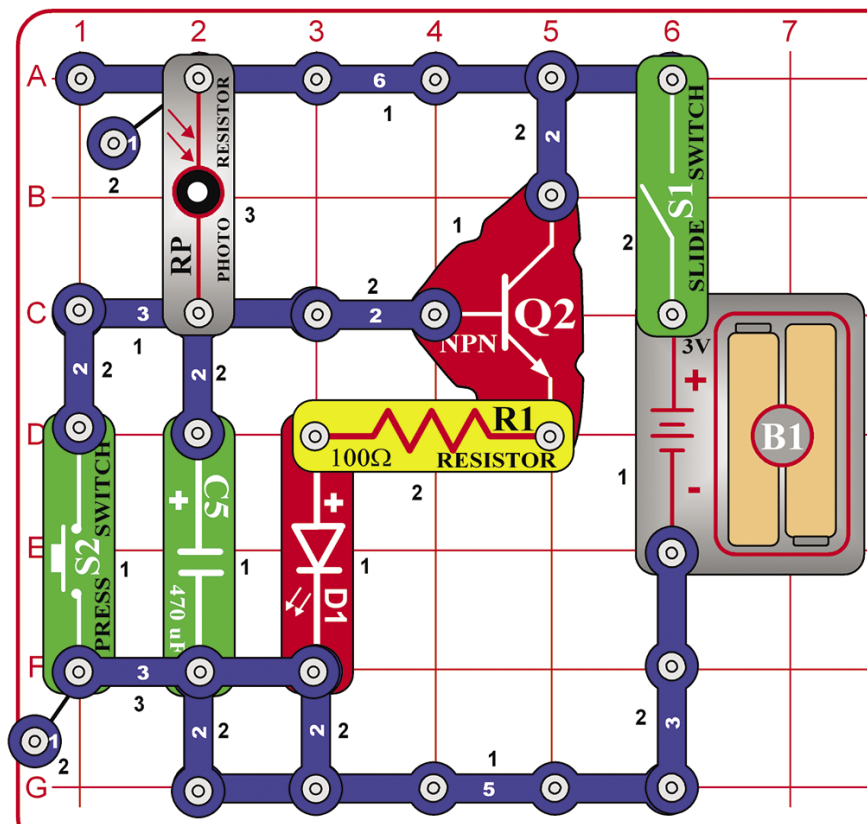
Electricity



Gravity

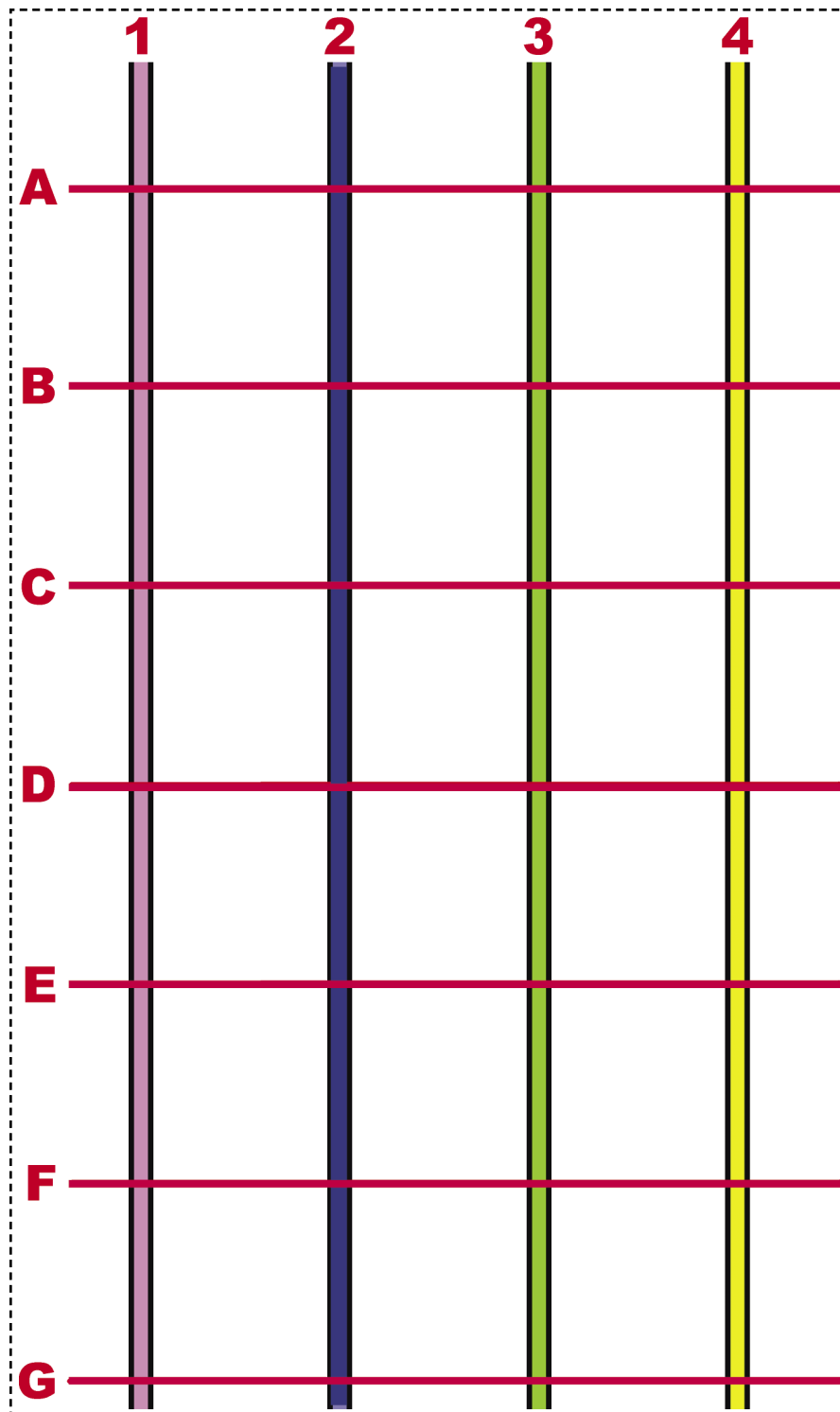
Project 126

Sunrise Light



Cover the photoresistor (RP) and turn on the slide switch (S1). The LED (D1) is off, but if you wait a long time then it will eventually light up. Uncover the photoresistor and the LED will light up in just a few seconds. Push the press switch (S2) and reset the circuit.

The resistance of the photoresistor controls how long it takes to charge up the $470\mu\text{F}$ capacitor (C5). Once the capacitor is charged, current can flow into the NPN transistor (Q2) and turn on the LED. Pushing the press switch discharges the capacitor.

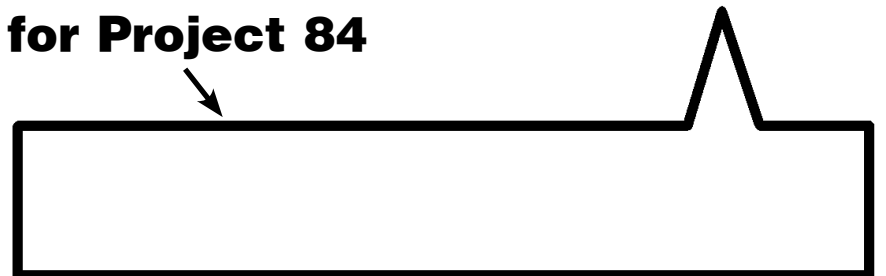


Project Cut Outs



for Project 82

← **for Project 84**



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