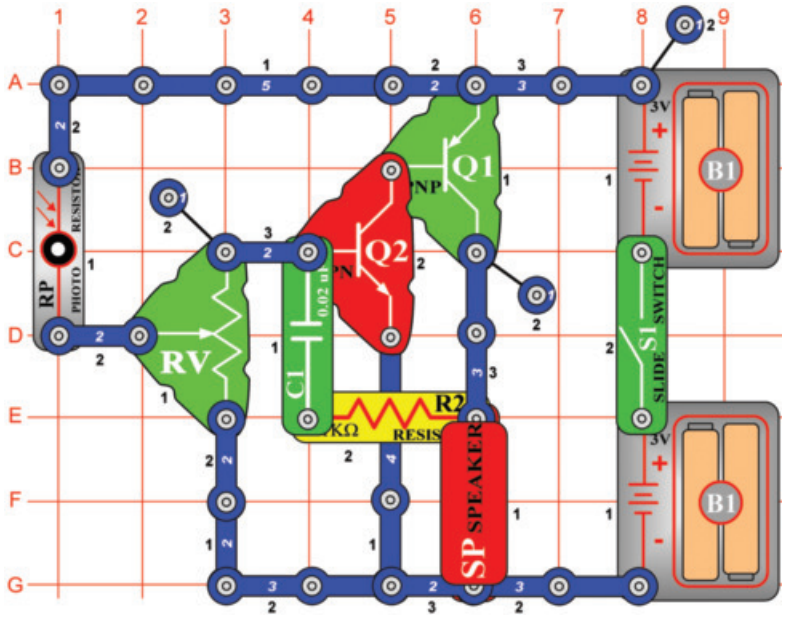
Bonus Circuits

These are additional circuits that are not in the manuals. These circuits require you to have the 300 project set or larger (model SC-300, SC-500, or SC-750).

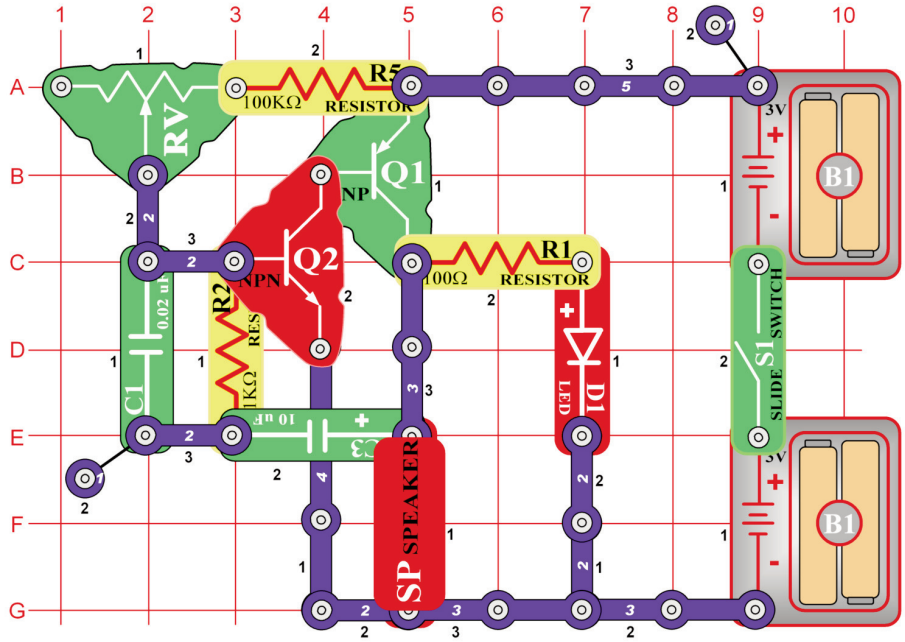
☐ Project W1 Light Oscillator



OBJECTIVE: To control an oscillator circuit using light.

Set the variable resistor (RV) to the middle position and then turn on the switch (S1). Wave your hand over the photoresistor (RP) and the sound changes. You can adjust the sensitivity by moving the RV to a different position.

☐ Project W2 Blink & Beep



OBJECTIVE: To build a circuit that blinks an LED and drives a speaker.

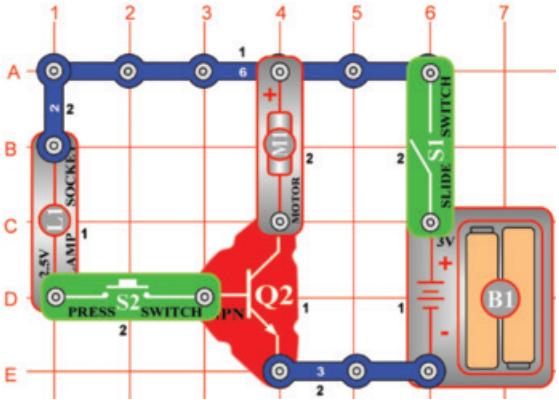
Set the variable resistor (RV) to the far left and turn on the switch (S1). The LED (D1) lights and the speaker (SP) sounds once per second. Adjusting the variable resistor to the right increases the rate.

Project W3
The Transistor

Place the fan on the motor and turn on the slide switch (S1) - nothing happens. Push the press switch (S2), the lamp lights and the motor spins.

The NPN transistor (Q2) uses the lamp current to control the motor current. A small current through the lamp branch creates a large current through the motor branch. They combine in the transistor and leave through the 3-snap branch.

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

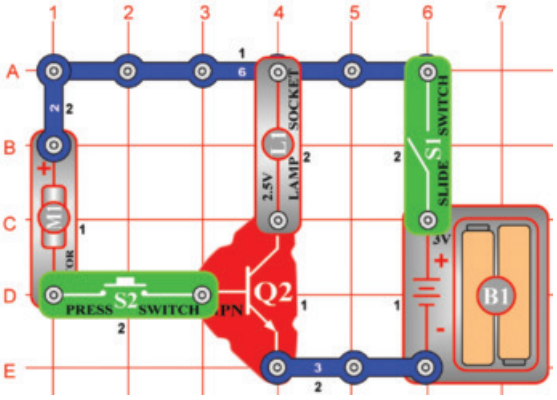


Project W4
The Transistor (II)

Compare this circuit to project W3. It works the same way, but the lamp is brighter here and the motor is slower.

This time the NPN transistor (Q2) uses the motor current to control the lamp current. A current through the motor branch creates a larger current through the lamp branch. They combine in the transistor and leave through the 3-snap branch.

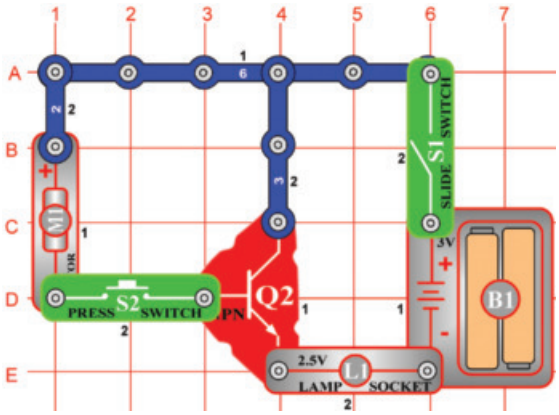
WARNING: Moving parts. Do not touch the fan or motor during operation. Do not lean over the motor.



Project W5
The Transistor (III)

Compare this circuit to project W4. It works in a similar way, but the motor does not spin even though the lamp is bright.

The currents in the motor branch and 3-snap branch are combined into the lamp branch. Since the 3-snap has no resistance, the current through its branch will be much larger than the motor branch current.

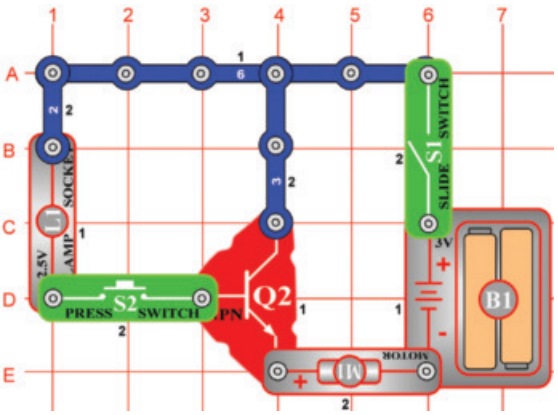


Project W6
The Transistor (IV)

Compare this circuit to project W5. It works in a similar way, the lamp is off but the motor spins. But the motor does not spin as fast as in project #A4.

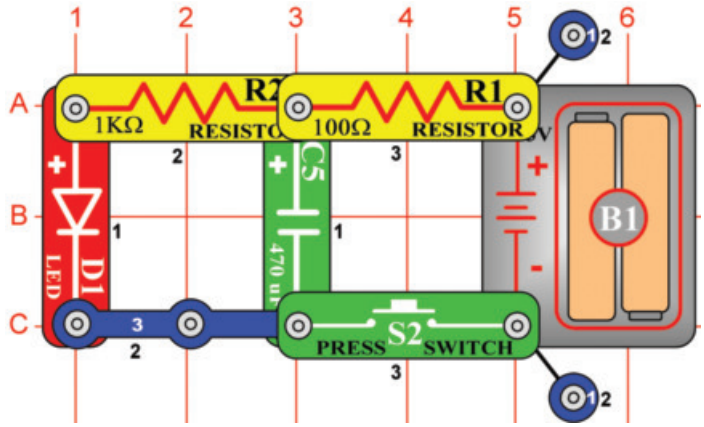
The currents in the lamp branch and 3-snap branch are combined into the motor branch. Since the 3-snap has no resistance, the current through its branch will be much larger than the lamp branch current.

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



Project W7 Slow Off Switch

OBJECTIVE: To learn about a device that is used to delay actions in electronics.



Build the circuit and press the switch (S2). You see that the LED (D1) turns off slowly after you release the switch.

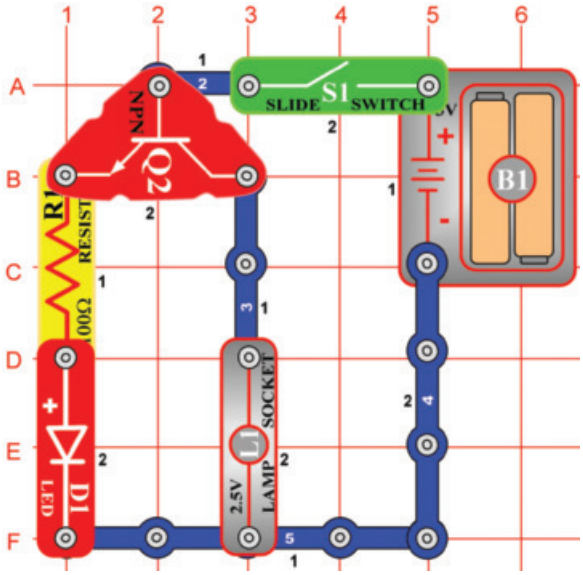
This delay in turning off the LED is caused by the 470µF capacitor (C5). Capacitors can store electricity and are used to delay changes in voltage. They can block unchanging voltages while passing fast-changing voltages.

Project W8 Transistor Diodes

OBJECTIVE: To learn about transistors.

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.

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.

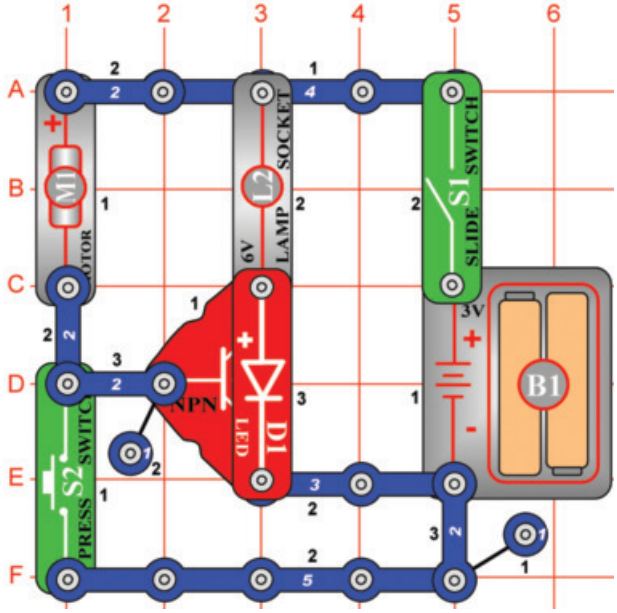


Project W9 Two-speed Motor Lights

OBJECTIVE: To control the motor speed.

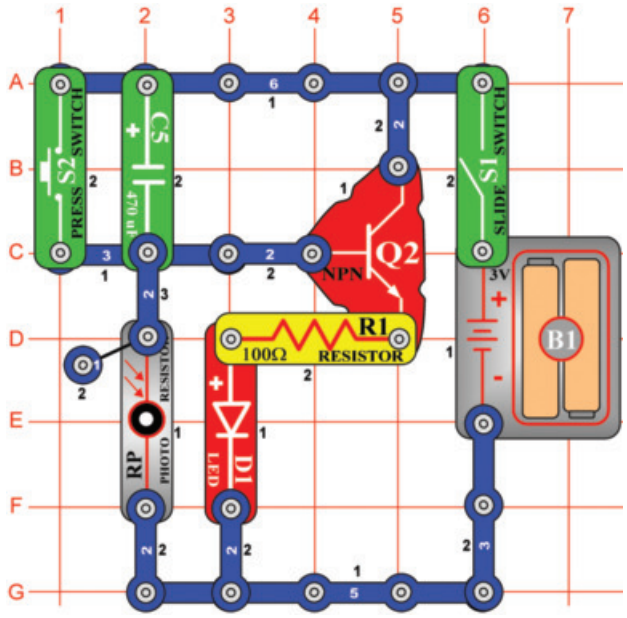
Place the fan on the motor (M1). Turn on the slide switch (S1), the motor spins and the lamp (L2) lights. Push the press switch (S2), the motor spins faster and the LED (D1) lights but the lamp is off.

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



☐ Project W10 Auto-Off Night Light (II)

OBJECTIVE: To learn about one device that is used to delay actions in electronics.



Cover the photoresistor (RP) and turn on the slide switch (S1). The LED (D1) is bright, but it will very slowly get dimmer and dimmer as the 470µF capacitor (C5) charges up. If you turn the slide switch (S1) off and back on after the light goes out it will NOT come on again. Push the press switch (S2) to discharge the capacitor and reset the circuit.

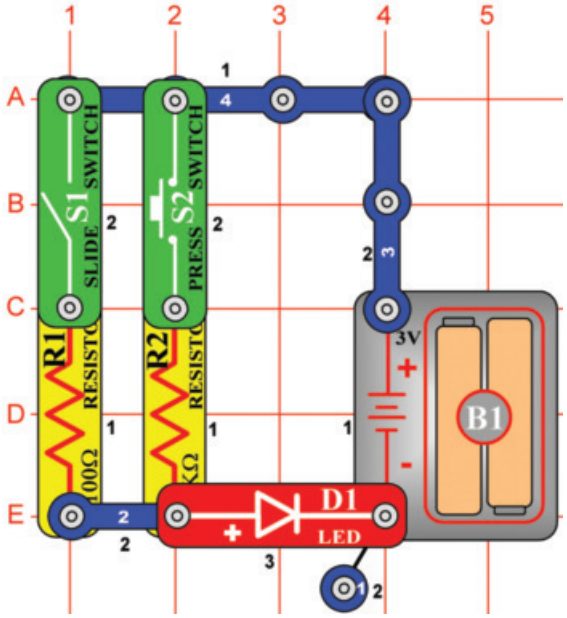
If you uncover the photoresistor and to let light shine on it, then the LED will get dark quickly. The photoresistor has much lower resistance with light on it, and this lower resistance allows the capacitor to charge up faster.

☐ Project W11 Parallel Resistors

OBJECTIVE: To learn about resistors.

Turn on either or both switches and compare the LED brightness.

This circuit has the 100Ω and 1KΩ resistors (R1 and R2) arranged in parallel. You can see that the smaller 100Ω resistor controls the brightness in this arrangement.

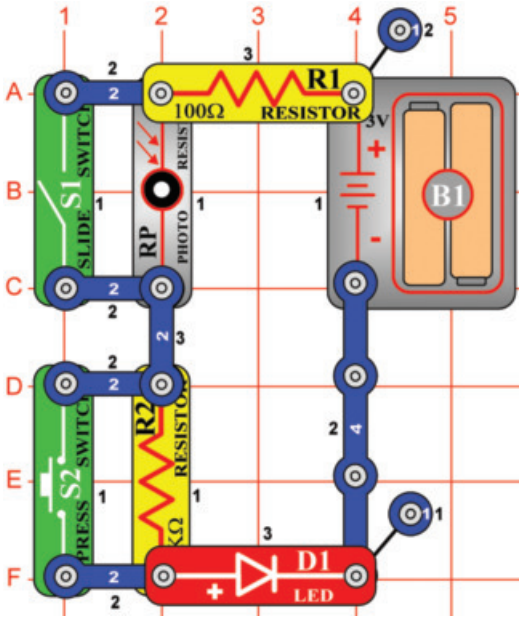


☐ Project W12 Series Resistors

OBJECTIVE: To learn about resistors.

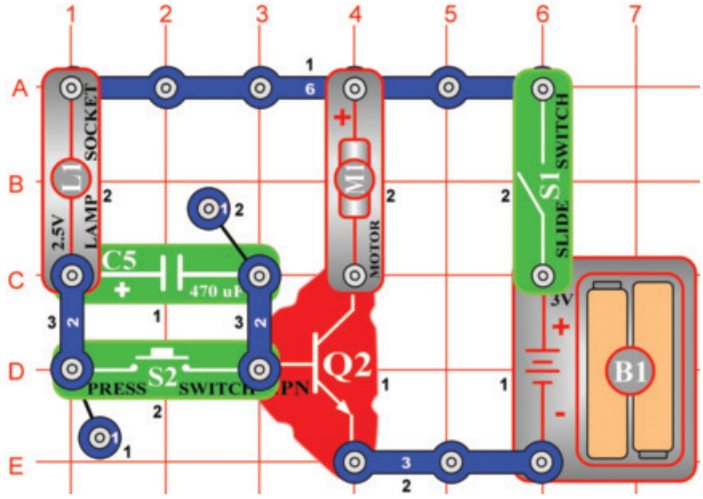
Turn on either or both switches and compare the LED brightness.

This circuit has the 100Ω resistor (R1), the 1KΩ resistor (R2), and the photoresistor (RP) arranged in series. You can see that the larger photoresistor controls the brightness in this arrangement (the resistance of the photoresistor will be much higher than the others, unless the light is very bright).



☐ Project W13 Capacitor Slow-down

OBJECTIVE: To learn about a device that is used to delay actions in electronics.



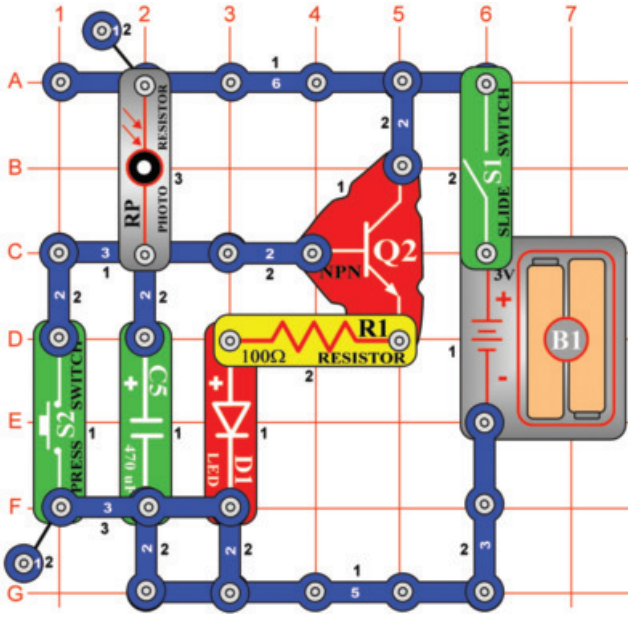
Place the fan on the motor and turn on the slide switch (S1). The motor spins briefly as the 470µF capacitor (C5) charges up. Turn off the slide switch and push the press switch (S2) to discharge the capacitor and reset the circuit.

You can bypass the capacitor by pushing the press switch while the slide switch is on. This lets the motor spin at full speed and also lights the lamp.

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

☐ Project W14 Sunrise Light

OBJECTIVE: To learn about one device that is used to delay actions in electronics.

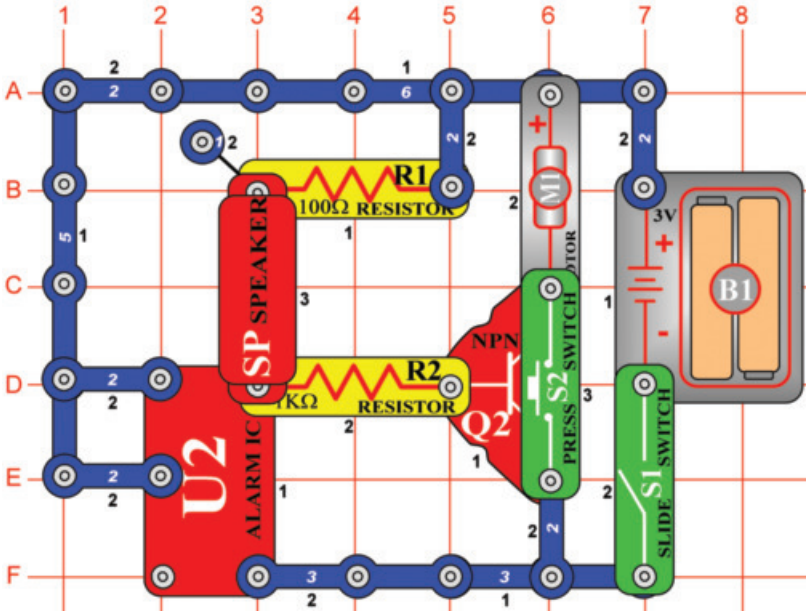


Cover the photoresistor (RP) and turn on the slide switch (S1). The LED (D1) is off, but if you wait a long time then it will eventually light up. Uncover the photoresistor and the LED will light up in just a few seconds. Push the press switch (S2) and reset the circuit.

The resistance of the photoresistor controls how long it takes to charge up the 470µF 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 W15 Alarm Motor

OBJECTIVE: To build a circuit that uses the alarm IC to control the speed of the motor.

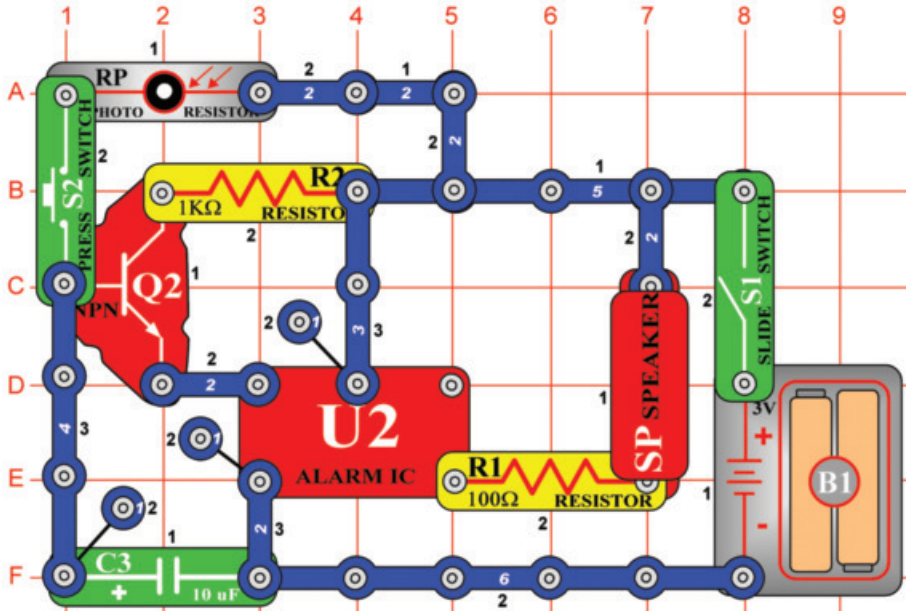


Place the fan on the motor on turn on the slide switch (S1). A machine gun sound is heard and the fan spins unevenly. The fan speed is being controlled by the alarm IC (U2).

Now push the press switch (S2) to control the motor directly, and the motor spins much faster.

☐ Project W16 Slow Siren Changer

OBJECTIVE: To change siren sounds with a delay.



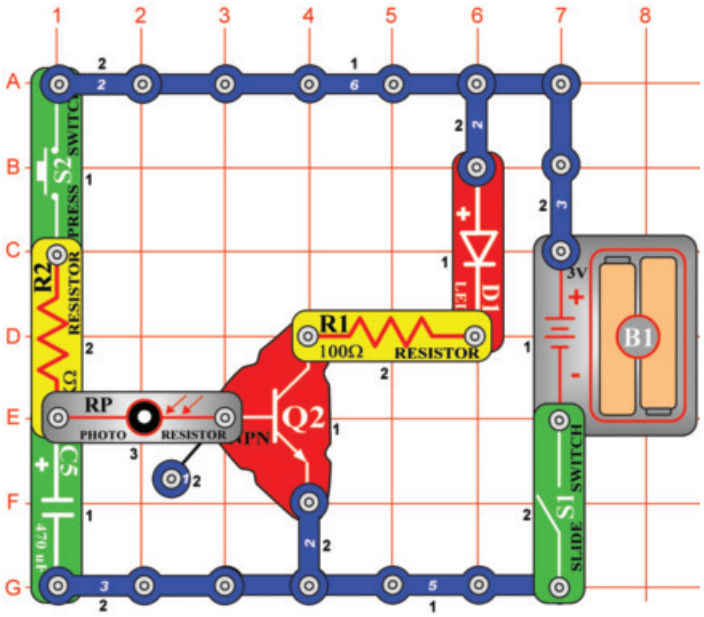
Turn on the slide switch (S1) and you hear a siren sound.

Now hold down the press switch (S2) until the sound becomes a fire engine sound. This delay is due to the 470µF capacitor charging up and is controlled by the photoresistor (RP). If there is bright light on the photoresistor then the delay will be only a few seconds.

Release the press switch and after a while the sound will be a siren again. The capacitor slowly discharges through the NPN transistor (Q2).

☐ Project W17 Capacitor Photo Control

OBJECTIVE: To learn about a device that is used to delay actions in electronics.

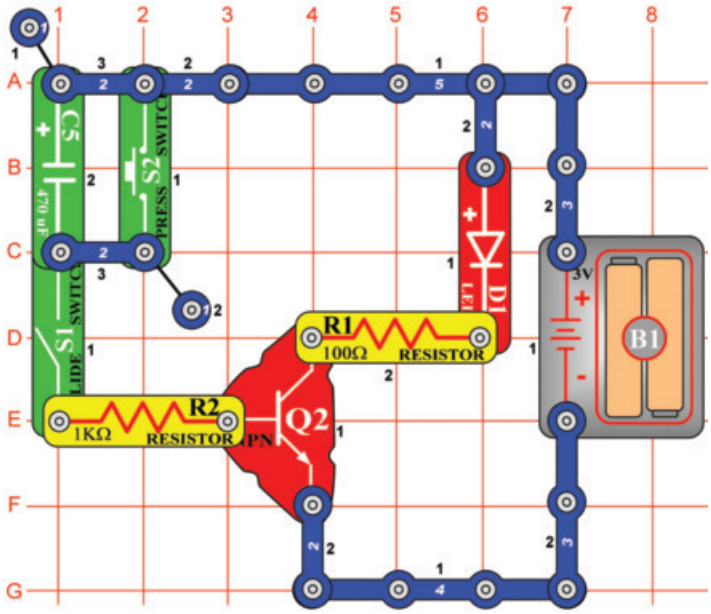


Turn on the slide switch (S1) and push the press switch (S2). If there is light on the photoresistor (RP) then the LED (D1) will stay on for a long time after you release the press switch.

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 W18 Capacitor Control

OBJECTIVE: To learn about a device that is used to delay actions in electronics.

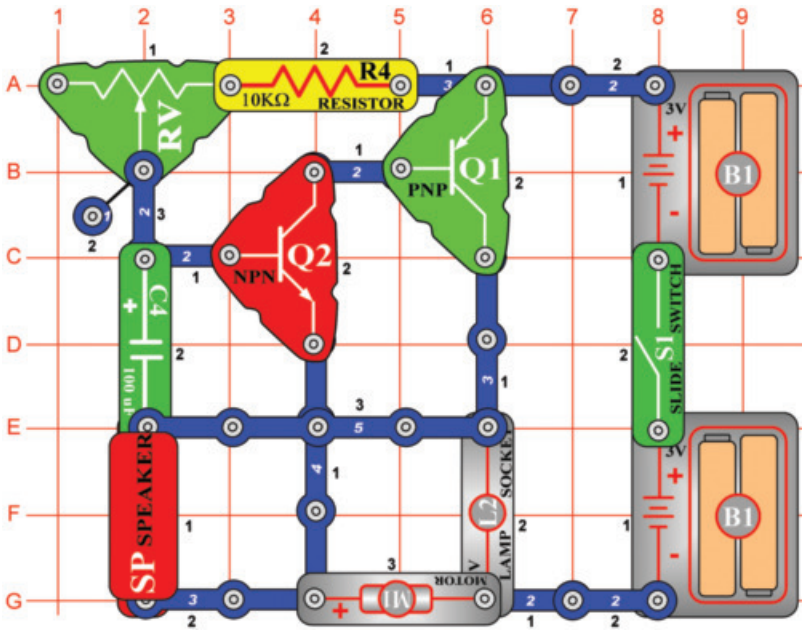


Build the circuit and turn on the slide switch (S1). The LED is bright but slowly gets dark as the 470µF capacitor (C5) charges up.

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

☐ Project W19 Motor Oscillator

OBJECTIVE: To experiment with oscillator circuits.



This circuit flashes the lamp and turns the motor about once a second. Moving the control lever on the adjustable resistor (RV) makes these occur more or less often. This works with the fan on or off the motor.

Nothing happens while the capacitor (C4) charges up through resistors RV and R5. Then the capacitor discharges in a burst that lights the lamp and turns the motor.

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

☐ Project W20 Motor Oscillator (II)

OBJECTIVE: To experiment with oscillator circuits.

Replace the 100µF capacitor (C4) with the larger 470µF capacitor (C5). Now the circuit activates less often, but the lamp flash is brighter and the motor turns farther. This is due to more capacitance. The adjustable resistor control works the same way, and the fan can be on or off the motor.

You can decrease the frequency of an oscillator circuit by increasing either the resistance or the capacitance.

☐ Project W21 Motor Oscillator (III)

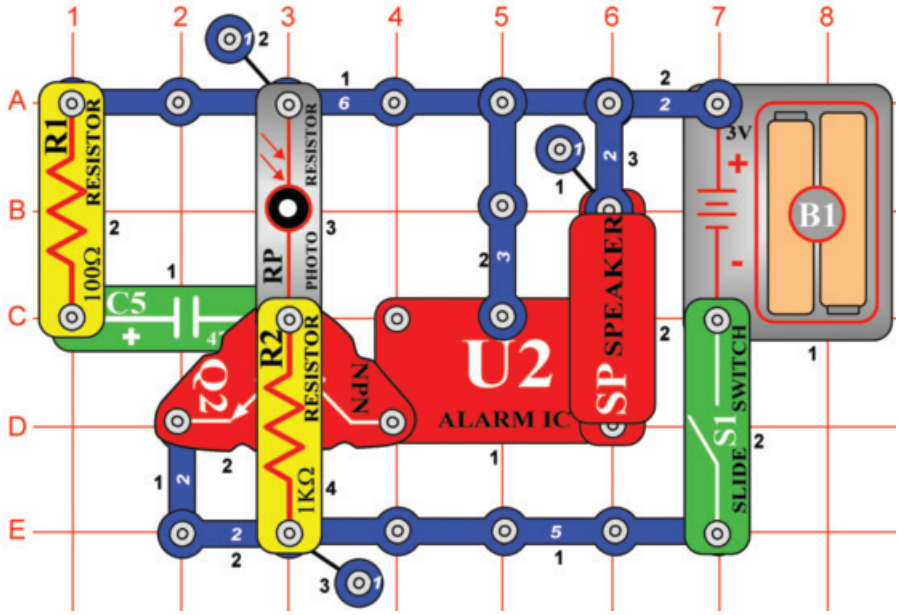
OBJECTIVE: To experiment with oscillator circuits.

Now replace the 470µF capacitor (C5) with the smaller 10µF capacitor (C3). Now the circuit activates more frequently, but the lamp is too dim to see and the motor barely moves.

The adjustable resistor control works the same way, and the fan can be on or off the motor.

☐ Project W22 Short-time Sound

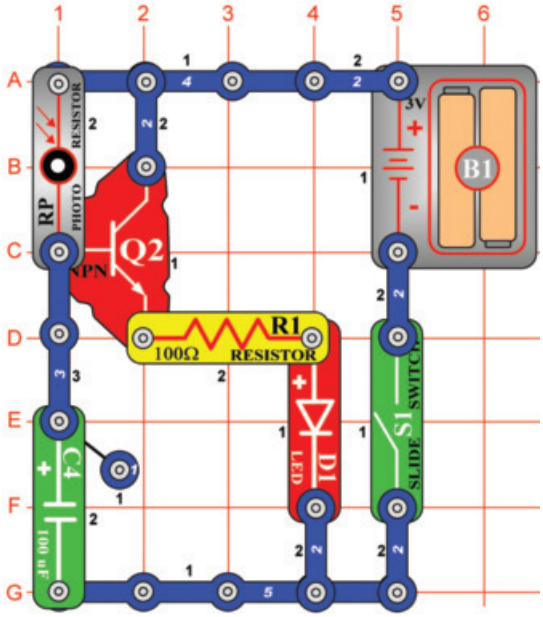
OBJECTIVE: To make a brief sound.



Turn on the switch and you a siren sound for only a second or two, increase the light on the photoresistor to make it last longer.

☐ Project W23 Slow Light Dimmer

OBJECTIVE: To show how capacitors delay circuit changes.

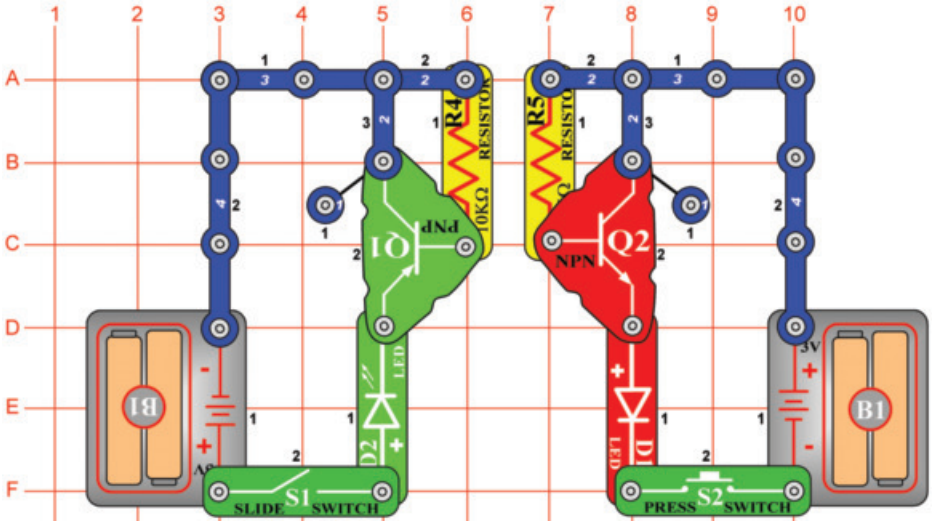


Turn on the switch (S1) and the LED (D1) comes on if there is light on the photoresistor (RP). If you cover the photoresistor now then the LED will stay on for a while, until the 100µF capacitor (C4) discharges.

You can replace the 100µF capacitor with the other values to change how long the LED stays on for when the photoresistor is covered.

☐ Project W24 Mirror Circuit

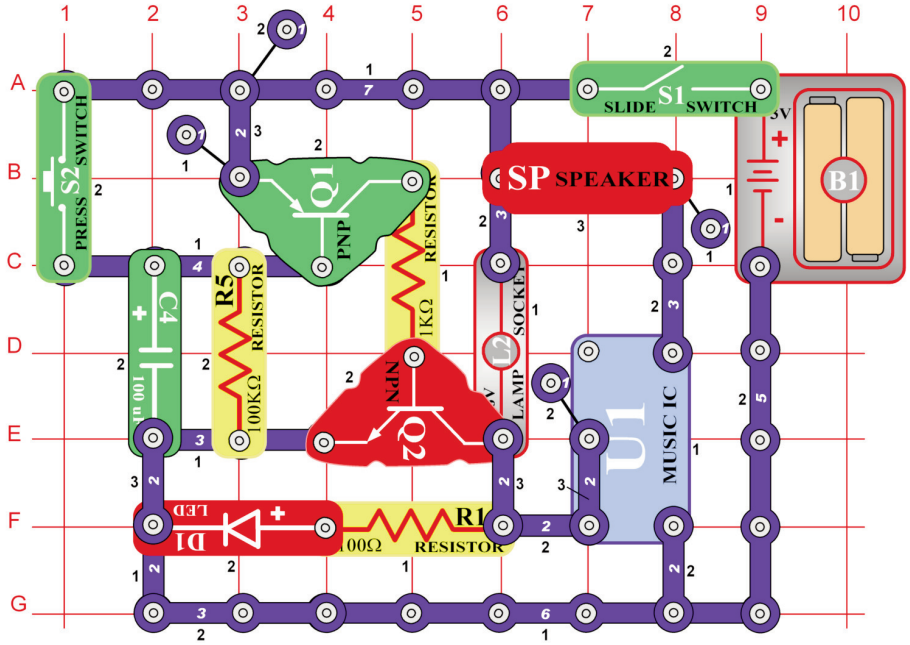
OBJECTIVE: To build a mirror view of a circuit.



Using PNP (Q1) and NPN (Q2) transistors, you can make two circuits that look the same, but are electrically opposite. When you turn on the switch (S1), the base of Q1 connects to the negative (–) side of the battery, turning on Q1 and the green LED (D2) lights. When you press down the switch (S2), the base of Q2 connects to the positive (+) side of the battery, turning on Q2 and the red LED (D1) lights.

☐ Project W25 Music with Timer

OBJECTIVE: To connect the music IC to a timer circuit.

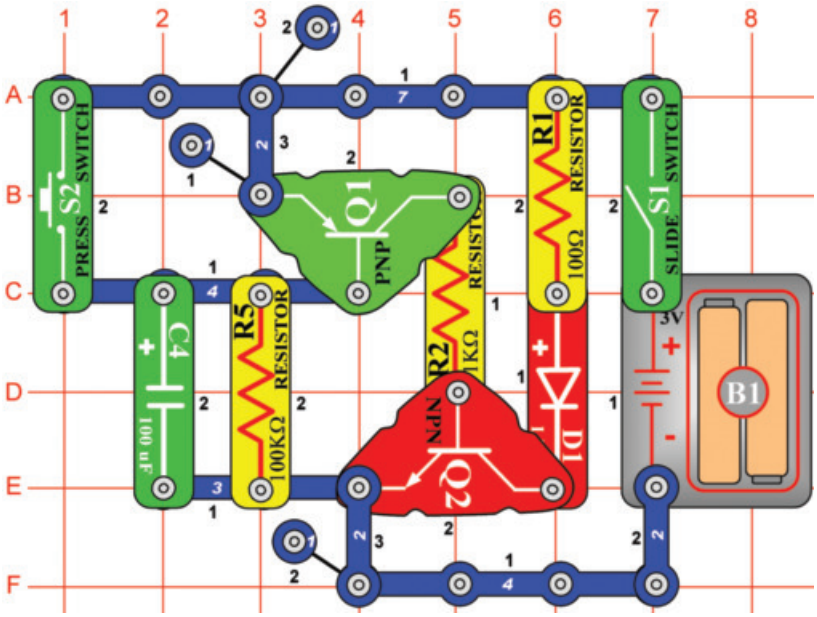


Turn on switch S1 and bulb lights as the music IC plays and stops. The music will not play as long as Q2 is on. Press switch S2; transistors Q1, Q2 and bulb turn off as the LED lights. As the song plays once at full volume, the LED slowly turns off.

Replace capacitor C5 with different values and see how it affects the circuit.

☐ Project W26 Turn Off Timer

OBJECTIVE: To build a circuit that turns off an LED for 4 seconds.



Pressing S2 down increases the voltage at the base of Q1. This turns the Q1, Q2, and LED off as the capacitor charges up. As you release switch S2 the capacitor starts discharging through resistor R5. When the voltage from the discharging capacitor drops low enough, Q1,Q2, and the LED turns off for about 4 seconds. Now change the 100µF capacitor (C4) to 470µF (C5) and the LED should stay off for about 10 seconds.

☐ Project W27

Turn Off Timer (II)

OBJECTIVE: To modify project #A41 to use the 6V bulb.

Replace the LED and 100Ω resistor with a 3-wire snap and 2.5V lamp (L1).

☐ Project W28

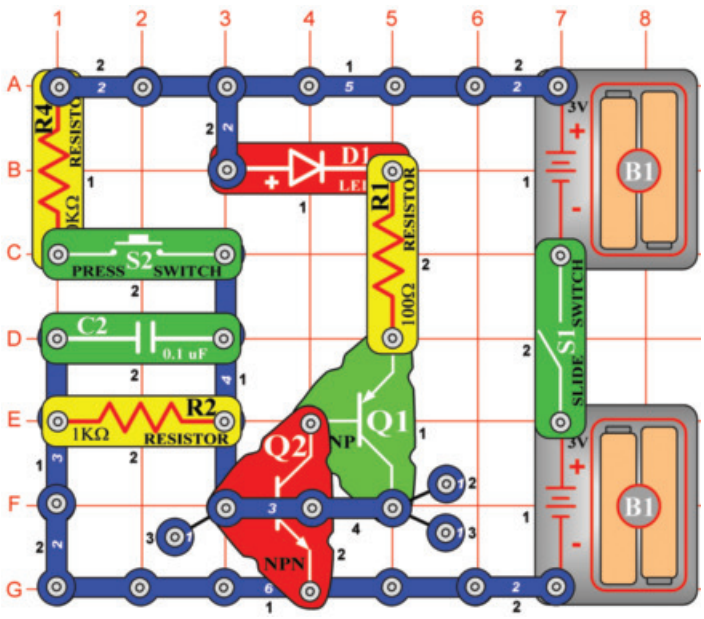
LED & Bulb Timer

OBJECTIVE: To build a circuit that turns off the bulb and turns on the LED for 4 seconds.

Modify the circuit from project #A42 by placing a 1-snap on top of the NPN transistor at base grid location E6 (on level 3). Then place the red LED over it, across base grid locations E4-E6 (on level 4), (+) is on E4. When you press S2 the lamp turns off and now the LED lights. When the voltage from the discharging capacitor drops low enough, Q1, Q2, and the lamp turn on and the LED turns off.

☐ Project W29 The SCR

OBJECTIVE: To use two transistors to make an SCR.



The transistors are connected so when the base of Q2 goes high, both Q2 and Q1 turn on. They will remain on until the switch (S1) is turned off. Turn on the switch (S1) and the LED should not light. Now press the switch (S2) and the LED lights. Turn the LED off by turning the switch (S1) off.

The two transistors act as an electronic device called an SCR (Silicon Controlled Rectifier). A three-pin device that once its base is triggered, remains on until the current flow through it stops.

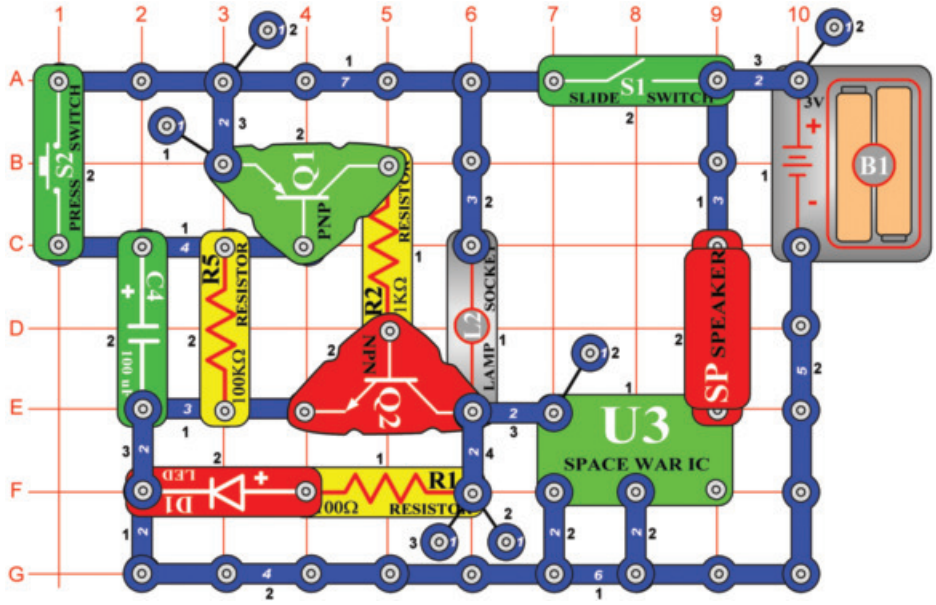
☐ Project W30 Light-controlled SCR

OBJECTIVE: To modify project #A49 to use the photoresistor (RP).

Replace resistor R4 with the photoresistor (RP). The LED will only light when S2 is pressed and there is enough light on the RP. Turn S1 on and place your finger over the RP. Press S2 and the LED should not light. Remove you finger and press S2 again, the LED should light now.

☐ Project W31 Space War Timer

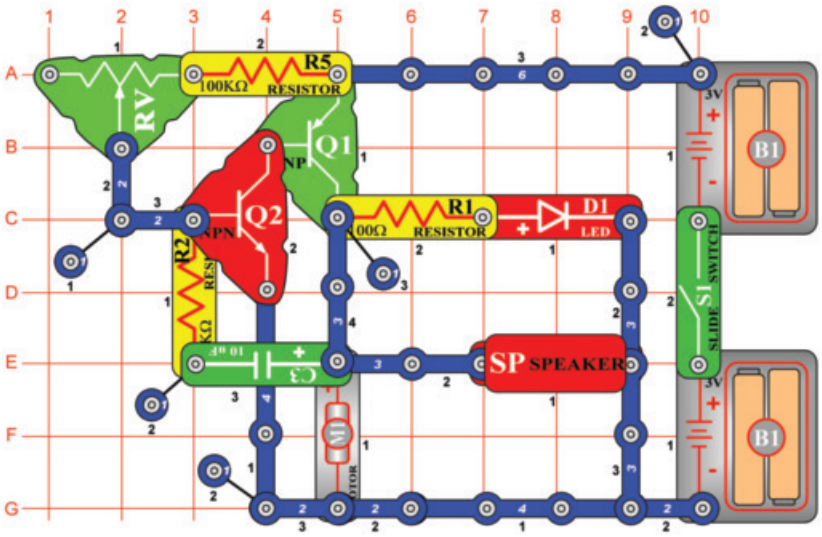
OBJECTIVE: To build a space war timer.



Turn on the switch (S1) and the bulb lights and you hear the speaker sound. Now press the switch (S2); the LED lights and the bulbs turns off as the speaker sounds. You can change the length of time the speaker sounds by the changing the values of C5 and R5.

☐ Project W32 Sound, Light & Motor Stepper Circuit

OBJECTIVE: To build a stepper circuit that powers a motor, speak and LED.



Set the variable resistor (RV) to the far left and turn on the switch (S1). The circuit produces around two pulses per second, which power the motor (M1), speaker (SP) and LED (D1). Increase the rate by moving RV to the left.

Change the 10µF capacitor (C5) to the 100µF(C4) and see how the time changes.

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