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LIGHT

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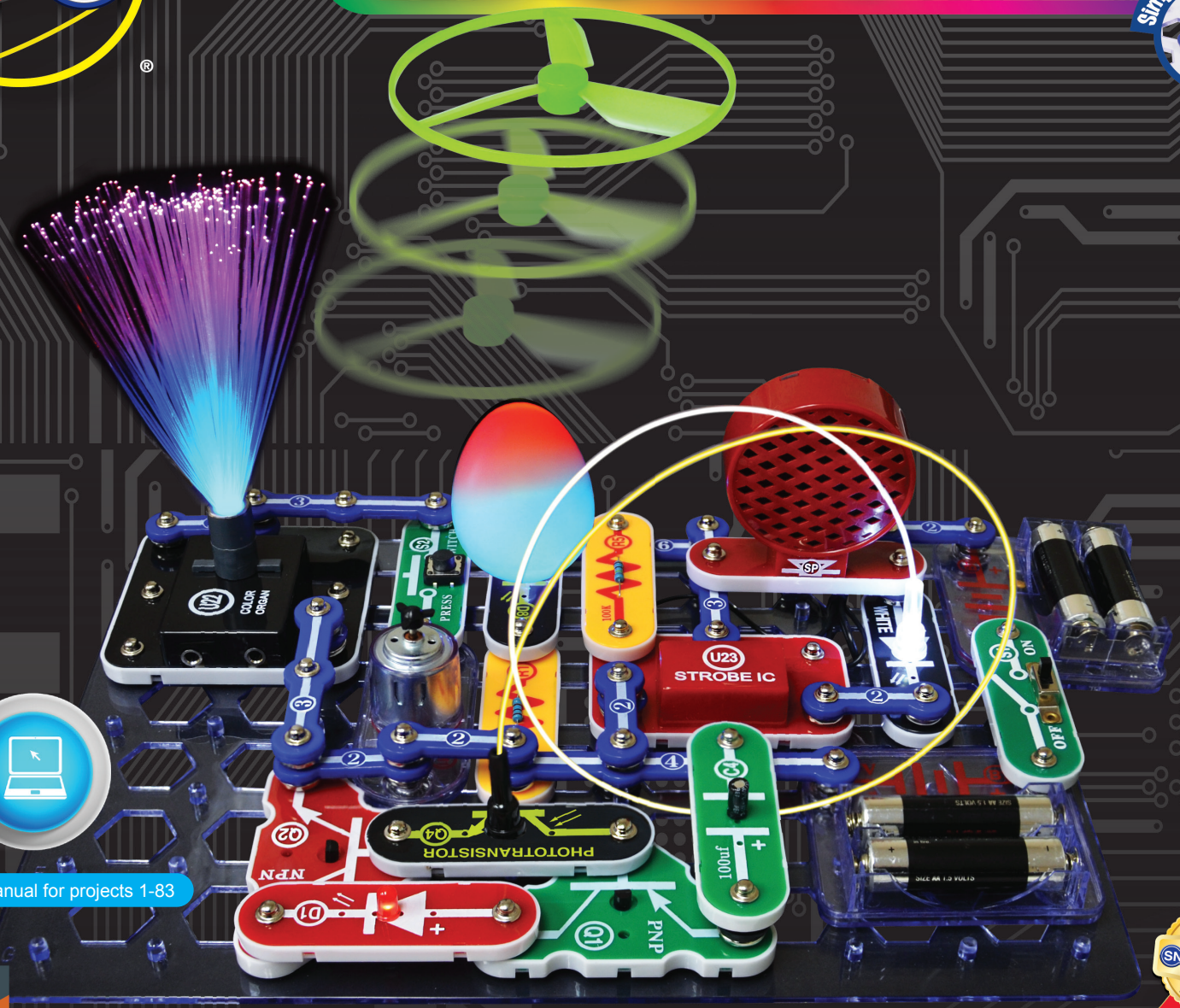

PRINTED Projects **83**

94+ **ONLINE** Projects

Projects 87-177 + 11 Bonus. See your printed manual for projects 1-83

Ages 8-108

MADE WITH CIRCUITSAFE® fuse technology

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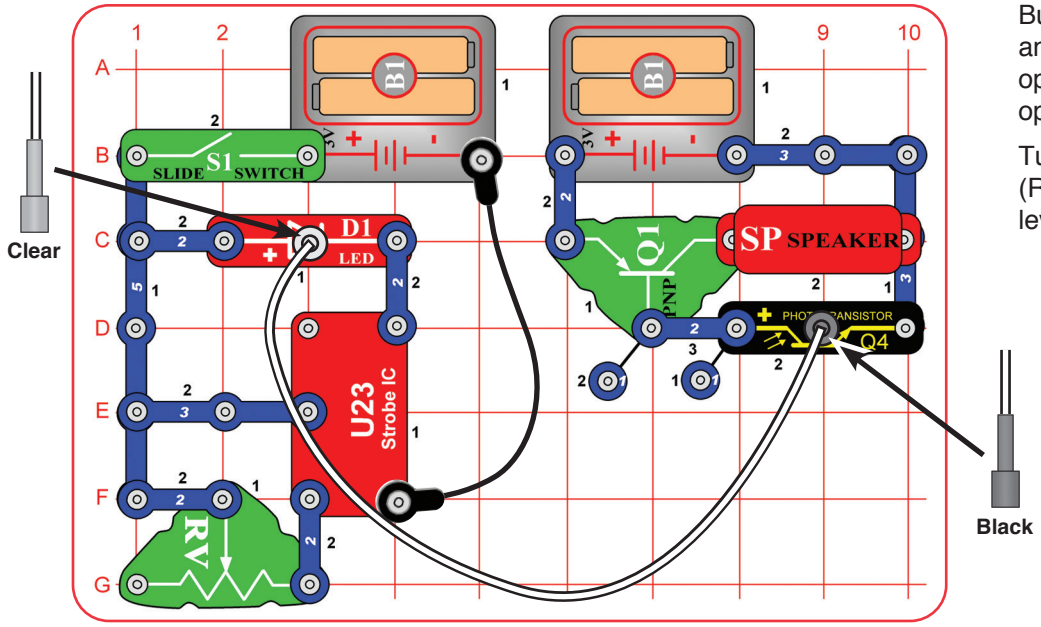
Project 84

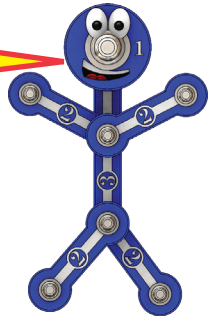


Tones Over Light

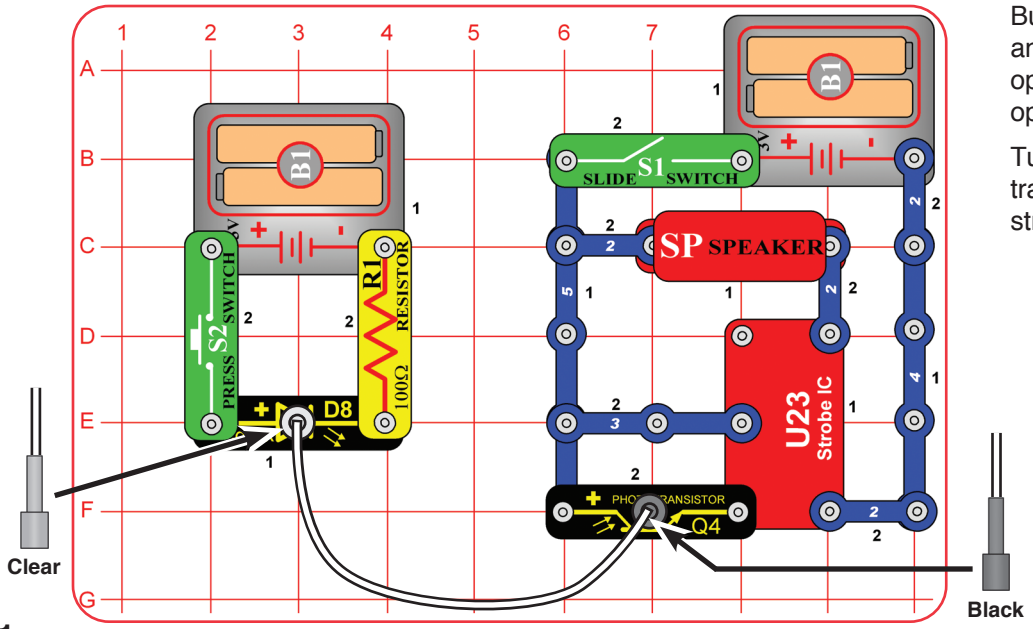
Build the circuit as shown. Place the clear cable holder on the red LED (D1) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

Turn on the slide switch (S1) and move the lever on the adjustable resistor (RV) around. The sound from the speaker (SP) changes as you move the lever on RV.

This is similar to project 20 but not as loud. The project 20 circuit uses a two-transistor amplifier while this circuit only has one transistor.



Project 85

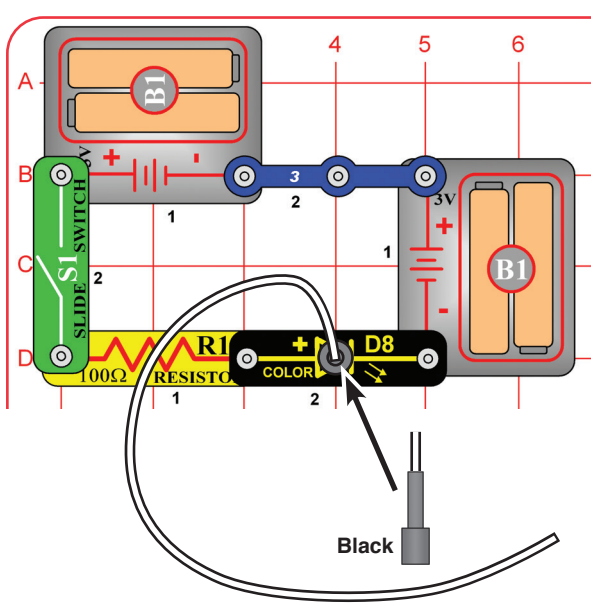


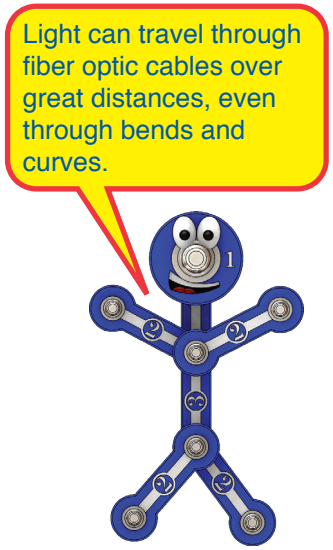
Color Optic Sounds

Build the circuit as shown. Place the clear cable holder on the color LED (D8) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

Turn on the slide switch (S1) and push the press switch (S2). Light is transmitted from the color LED, through the fiber optic cable, to control the strobe IC (U23) and speaker (SP).

Project 86





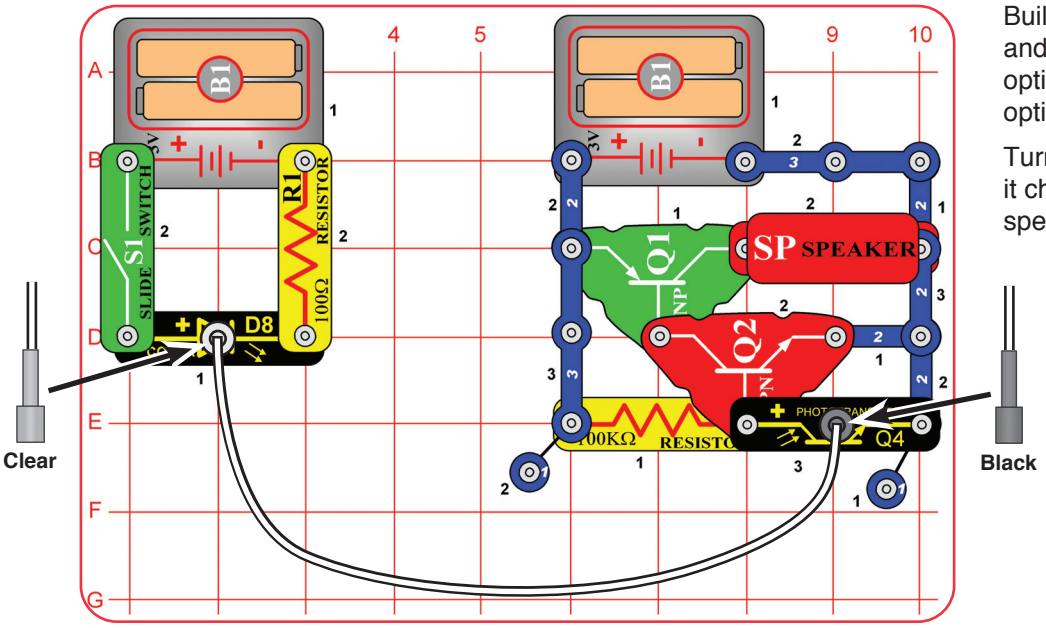
Color Light Transporter

Build the circuit as shown. Place the black cable holder on the color LED (D8), then place the fiber optic cable into the holder as far as it will go. For best performance the fiber optic cable should stand straight up in the holder, without bending it. Leave the other end of the cable free.

Turn on the switch (S1), and look into the loose end of the fiber optic cable. Flex the cable into loops but don't dent it. Take the circuit into a dark room and see how the cable looks.

You can use the clear cable holder on the color LED instead of the black holder.

Project 87

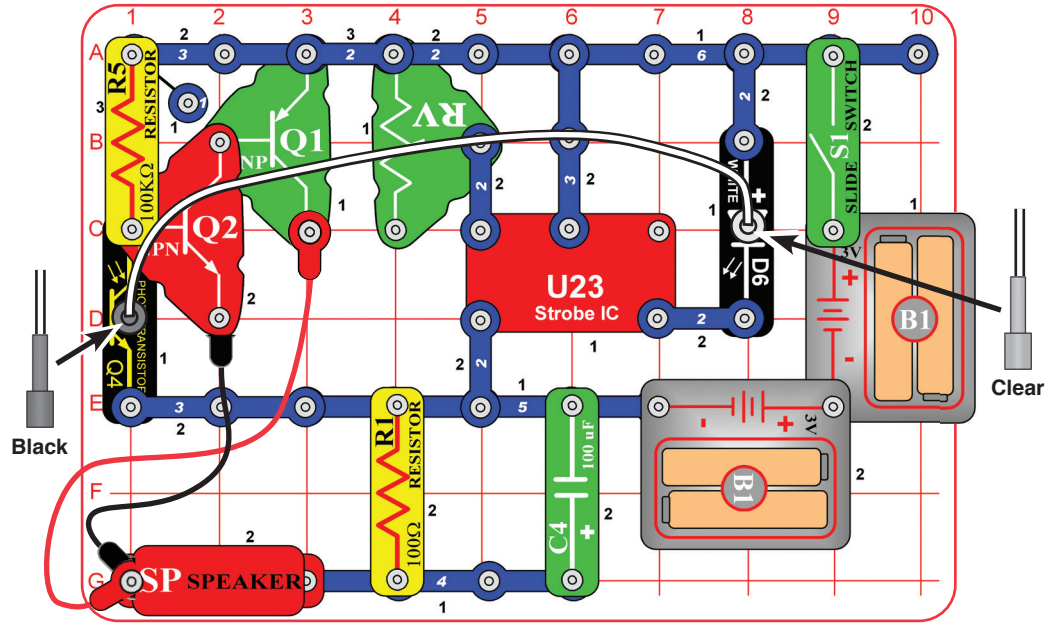


Color Optics

Build the circuit as shown. Place the clear cable holder on the color LED (D8) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

Turn on the switch (S1). The color LED (D8) turns on and off repeatedly as it changes colors. This produces interesting effects when connected to the speaker circuit through the fiber optic cable.

Project 88



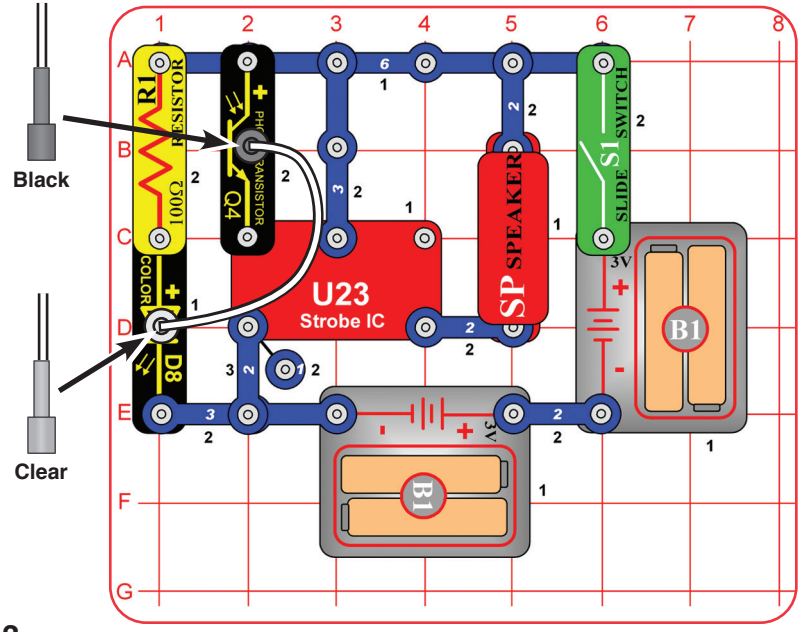
High Power Fiber Optics

Build the circuit as shown. Place the clear cable holder on the white LED (D6) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

Turn on the slide switch (S1) and move the lever on the adjustable resistor (RV) around. The sound from the speaker (SP) changes as you move the lever on RV.

Try removing the black cable holder and just holding the fiber optic cable next to the phototransistor with your fingers. Hold it at different angles and compare the sound. You may not hear anything, due to background light in the room. Take the circuit into a dark room or place your fingers around the phototransistor to block the room light to it. Now put the black cable holder back on, remove the clear cable holder, and try holding the fiber optic cable at different positions around the white LED. You can also replace the white LED with the red LED (D1) or the color LED (D8).

Project 89

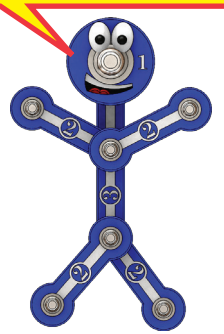


High Color Optics Sounds

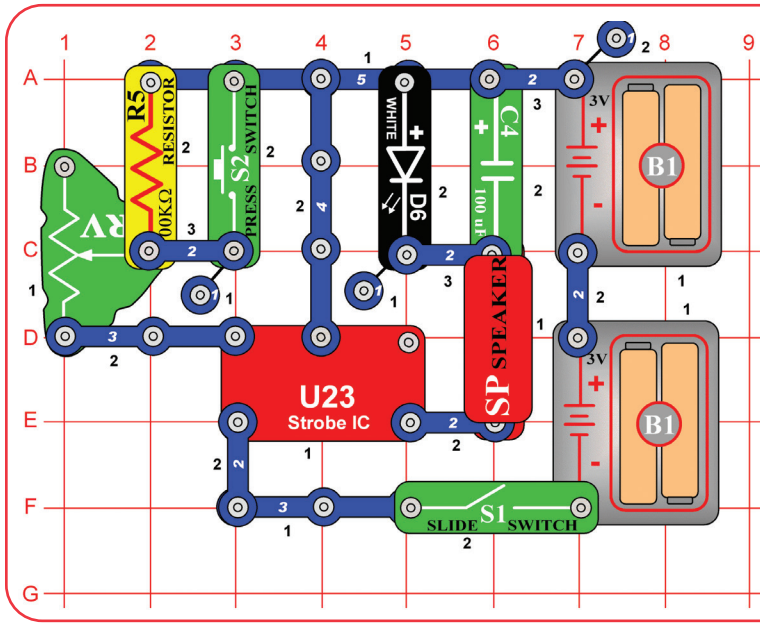
Build the circuit as shown. Place the clear cable holder on the color LED (D8) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

Turn on the slide switch (S1). Light is transmitted from the color LED, through the fiber optic cable, to control the strobe IC (U23) and speaker (SP).

The circuits on this page are similar to projects 20 and 85, but have the fiber optic transmitting sub-circuit (with the LED) and the receiving sub-circuit (with the phototransistor) using the same voltage sources. Normally the transmitting and receiving circuits will be in different locations with separate voltage sources, but they were combined here to increase the power.



☐ Project 90



Noisy Strobe Light

Build the circuit and turn on the switch (S1). Adjust the blink rate and sound using the lever on the adjustable resistor (RV), and by pushing the press switch (S2).

Note: In rare cases the circuit may not work at all settings on RV. If this happens, move the RV lever to the side near the strobe IC, turn the slide switch off and on to reset the circuit, and only move the RV lever over a small range.

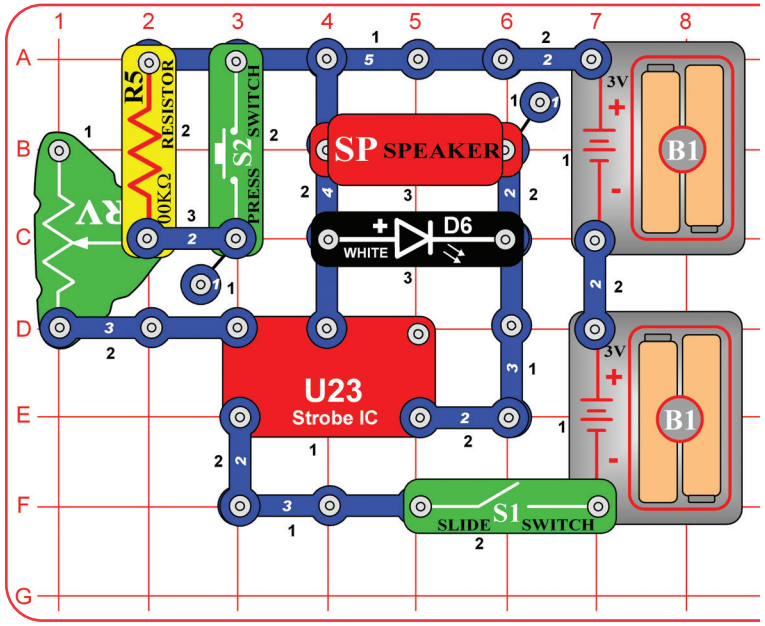
☐ Project 91 Noisy Red Strobe Light

Use the preceding circuit but replace the white LED (D6) with the red LED (D1) or the color LED (D8).

☐ Project 92 Double Strobe Light

Use the preceding circuit but replace the speaker and LED with any two LEDs (red, white, or color).

☐ Project 93



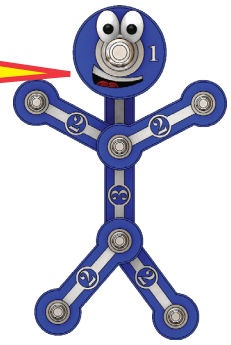
Louder Strobe Light

Modify the preceding circuit to be this one, which has the white LED (D6) in parallel with the speaker (SP). Build the circuit and turn on the switch (S1). Adjust the blink rate and sound using the lever on the adjustable resistor (RV), and by pushing the press switch (S2).

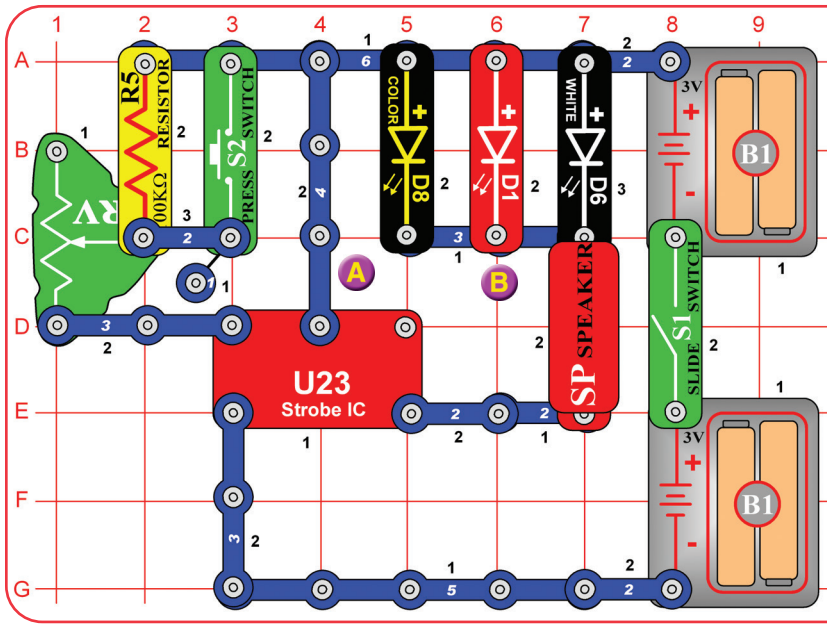
☐ Project 94 Louder Color Strobe Light

Use the preceding circuit but replace the white LED (D6) with the red LED (D1) or the color LED (D8).

This circuit is louder than the previous circuits because the speaker is in parallel with the LED instead of in series with it. This increases the voltage across the speaker, making it louder.



☐ Project 95



Noisy Triple Strober

Build this circuit and turn on the slide switch (S1). Adjust the blink rate and sound using the lever on the adjustable resistor (RV), and by pushing the press switch (S2).

Note: In rare cases the circuit may not work at all settings on RV. If this happens, move the RV lever to the side near the strobe IC, turn the slide switch off and on to reset the circuit, and only move the RV lever over a small range.

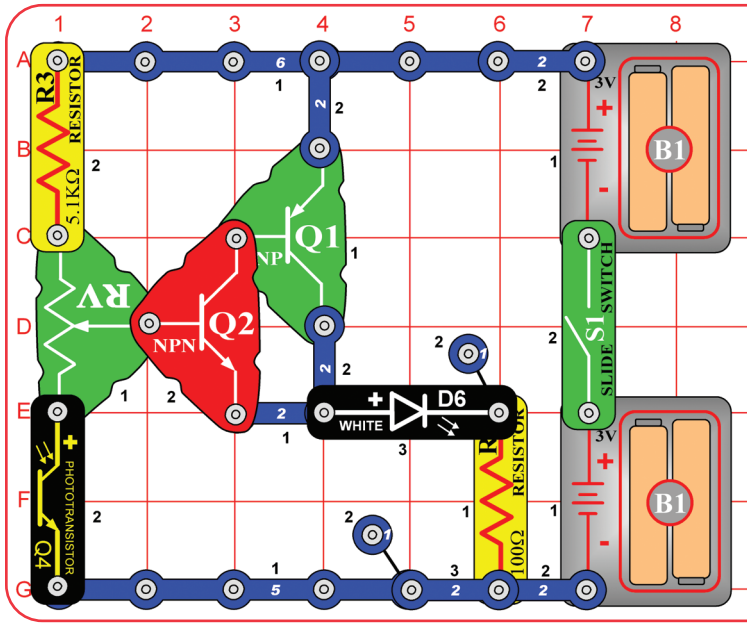
☐ Project 96 Triple Light Noisy Motion Strober

Use the preceding circuit but replace the speaker (SP) with the motor (M1, "+" toward white LED), then place the speaker across the points marked A & B in the drawing. Do not place any fan on the motor.

The LEDs (D1, D6, & D8) flash, the speaker makes noise, and the motor shaft spins or wiggles. Adjust the blink rate, sound, and motor spin using the lever on the adjustable resistor (RV), and by pushing the press switch (S2).

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

☐ Project 97



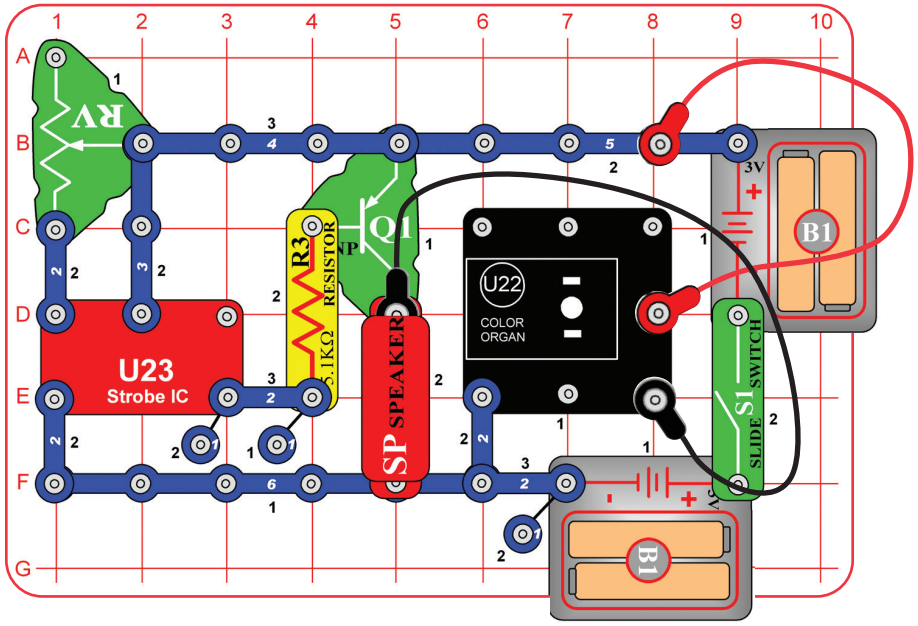
Automatic Light

Build the circuit and turn on the slide switch (S1). Set the lever on the adjustable resistor (RV) so the white LED (D6) just turns off. Slowly cover the phototransistor (Q4) and the white LED brightens. Adjust the light to the phototransistor to turn the white LED on or off.

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

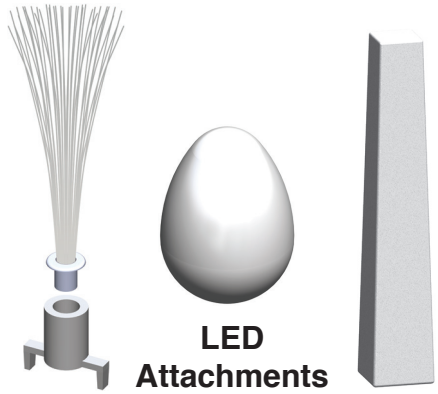
You can replace the white LED with the color LED (D8) or the red LED (D1), but you may need to readjust the sensitivity using the lever on RV.

☐ Project 98



Adjustable Light Dance

Build the circuit as shown. For best effects, place one of the LED attachments over the light on the color organ. Turn on the switch (S1) and move the lever on the adjustable resistor (RV) to change the tone of the sound and "speed" of the light.



LED Attachments

☐ Project 99

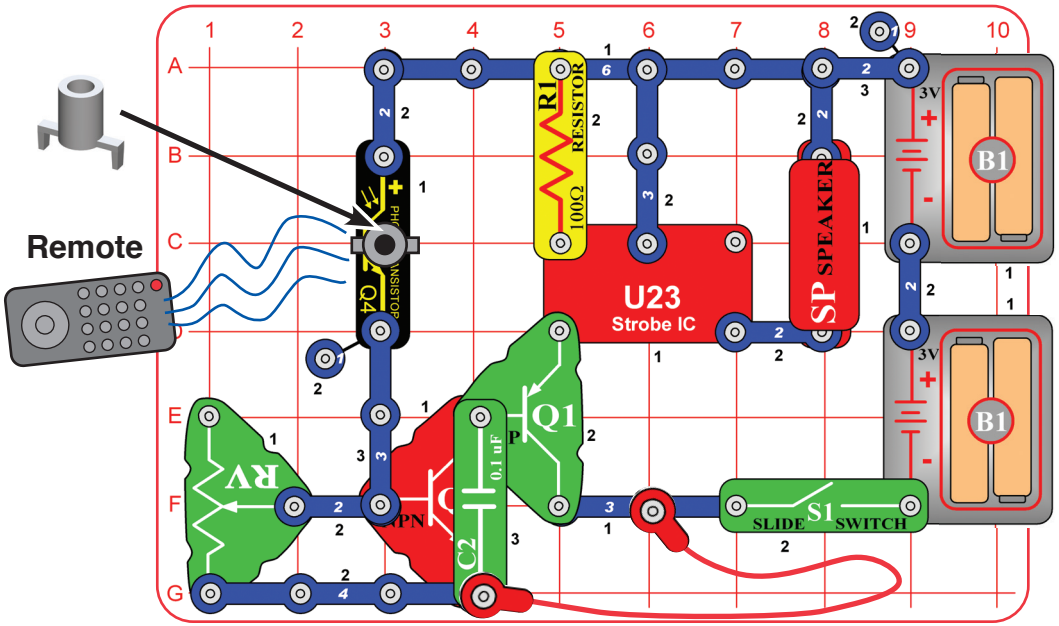


Photo Audio Infrared Detector

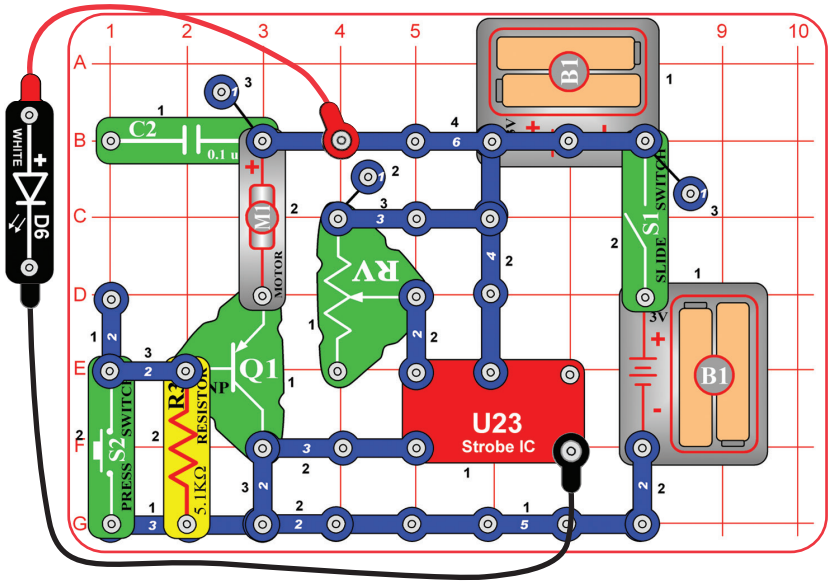
You need an infrared remote control for this project, such as any TV/ stereo/DVD remote control in your home.

Build the circuit and turn on the switch (S1). Place the mounting base (normally used with the fiber optic tree) on the phototransistor (Q4). Set the lever on the adjustable resistor (RV) so the sound just turns off (if it never turns off, move away from room lights. Point your remote control directly into the mounting base on Q4, and press any button to activate the sound.

☐ Project 100 Photo Audio Infrared Detector (II)

Use the preceding circuit, but replace the 0.1μF capacitor (C2) with the 100μF capacitor (C4). The circuit works the same way, but the sound stays on longer and is more pleasant.

☐ Project 101



Another Strobe Light

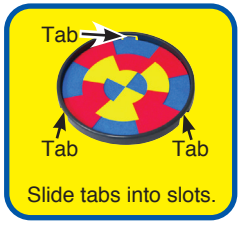
Build the circuit as shown. Take one of the colored discs and install it into the disc holder, then place the disc holder on the motor (M1). Connect the white LED (D6) to the red & black jumper wires.

For best effects, do this in a dimly lit room. Turn on the slide switch (S1). Push the press switch (S2) until the motor spins continuously (if it stops after you release the press switch, replace your batteries). Hold the white LED upside down over the disc holder so it shines on the spinning disc, and move the lever on the adjustable resistor (RV) slowly while watching the pattern on the spinning disc.

The motor spins the disc so fast that it looks like a blur. However, as you slowly adjust RV the pattern on the disc appears to slow down, stop, and reverse direction. Patterns close to the disc center may be moving at different speeds, or in different directions, from patterns farther from the center!

If the motor does not continue spinning after you release S2, then replace your batteries. If it still won't keep spinning then replace the 5.1kΩ resistor (R3) with the 100Ω resistor (R1).

You can reduce the strobe speed by replacing the 3-snap on the adjustable resistor (RV) with the 100kΩ resistor (R5), just as is done in project 48.

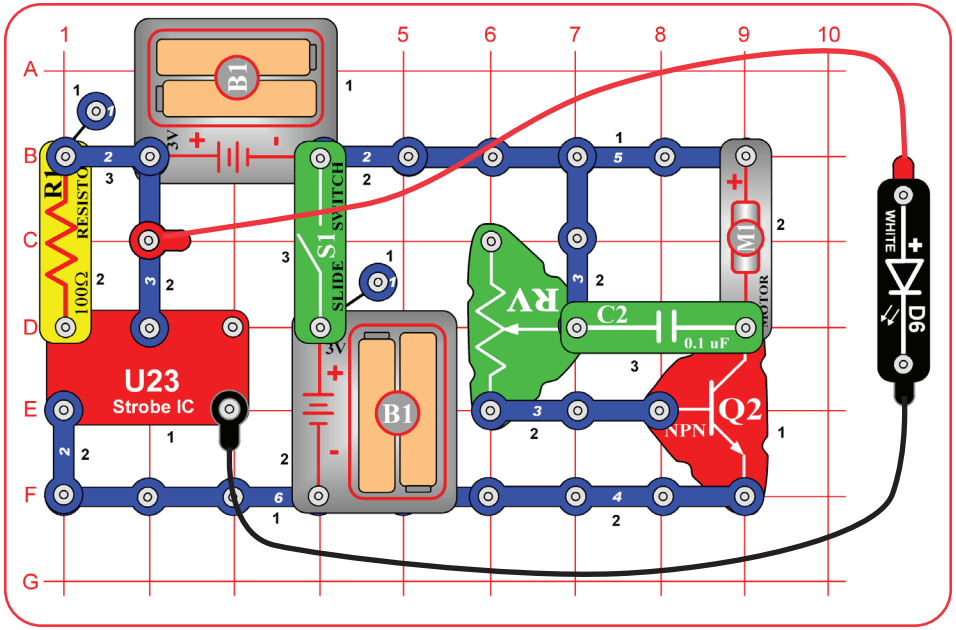


Slide tabs into slots.


Place disc holder onto the motor as shown.

Hold white LED (D6) over disc as shown.

☐ Project 102



Motor Strobe Effects

This project is similar to project 31. Build the circuit as shown. Take one of the colored discs and install it into the disc holder, then place the disc holder on the motor (M1). Connect the white LED (D6) to the red & black jumper wires.

For best effects, do this in a dimly lit room. Turn on the slide switch (S1). Set the lever on the adjustable resistor (RV) down towards the 4-snap. Hold the white LED upside down over the disc holder so it shines on the spinning disc, and move the lever on the adjustable resistor (RV) slowly while watching the pattern on the spinning disc.

The motor spins the disc so fast that it looks like a blur. However, as you slowly adjust RV the pattern on the disc appears to slow down, stop, and reverse direction. Patterns close to the disc center may be moving at different speeds, or in different directions, from patterns farther from the center!

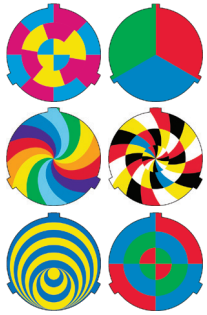
Compare this circuit to the one in project 31. This project changes the strobe effects by using RV to control the motor speed, while project 31 does it by using RV to control the LED flash rate. Getting the best strobe effects by adjusting the motor speed is more difficult, because the motor takes time to adjust its speed, while the LED flash rate adjusts instantly.

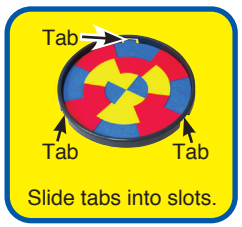
☐ Project 103 Motor Strobe Effects (II)

Use the preceding circuit, but replace the 100Ω resistor (R1) with the 5.1kΩ resistor (R3). The circuit works the same, but the LED flash rate is slower, so the strobe effects are different. Adjust the setting on RV as before, and watch the patterns on the spinning discs.

☐ Project 104 Motor Strobe Effects (III)

Use the preceding circuit, but replace the 5.1kΩ resistor (R3) with the 100kΩ resistor (R5). The circuit works the same, but the LED flash rate is slower (now you can see the LED flashing), so the strobe effects are different. Adjust the setting on RV as before, and watch the patterns on the spinning discs.



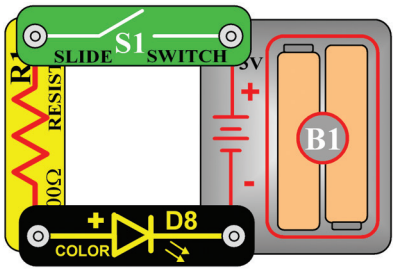


Slide tabs into slots.

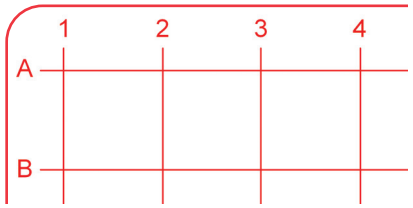

Place disc holder onto the motor as shown.


Hold white LED (D6) over disc as shown.

☐ Project 105



Side view of base grid

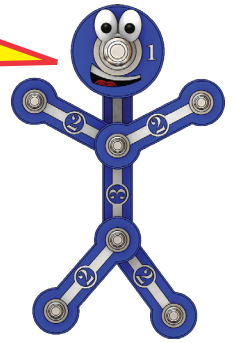


One Way Plastic

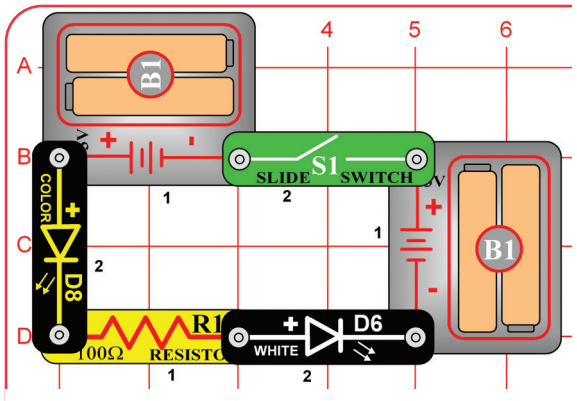
Build the circuit shown, but build it without using the base grid. Turn on the switch (S1) and view the color LED (D8) light through the base grid. Then turn the base grid on its side and try to see through it; you can't.

Try viewing other lights through other clear materials.

The main surface of the base grid is flat and smooth, giving a nice transition for light rays to pass through. If you look closely at the side edges (using a magnifying glass helps), you will see they are slightly curved. These curves, and the angle of the light hitting them, cause more light to be scattered or reflected than light hitting the main surface. Some materials can also pass light better in some directions than in other directions, due to their physical structure.



☐ Project 106



White Blinker

Build the circuit as shown and turn on the switch (S1). Both LEDs are blinking.

☐ Project 107 Red Blinker

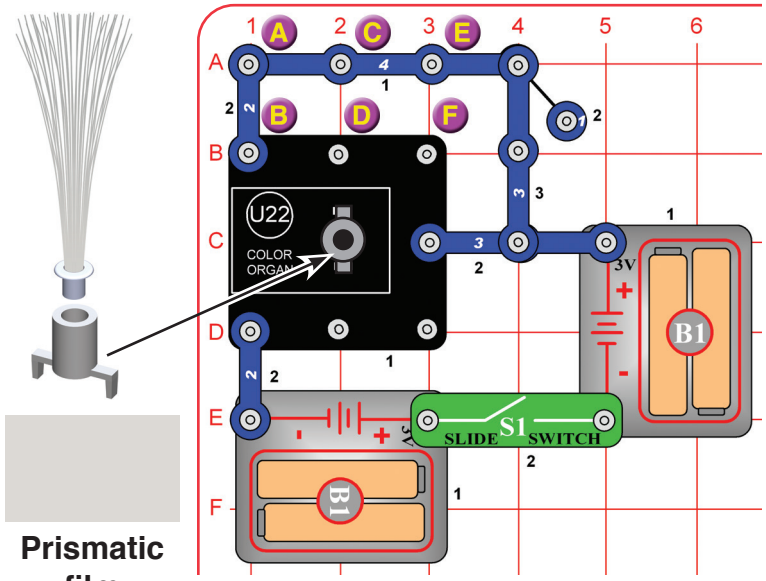
Use the preceding circuit, but replace the white LED (D6) with the red LED (D1).

☐ Project 108 Red & White

Use the preceding circuit, but replace the color LED (D8) with the white LED (D6). Both LEDs light, but neither in blinking.

The color LED (D8) has a microcircuit that changes the light colors. As it does this, it changes the current through the circuit - which also affects the brightness of the white LED (D6).

☐ Project 109



Color Selector - Red

Build the circuit as shown. Place the fiber optic tree and mounting base on the color organ (U22). Turn on the switch (S1). The color organ makes a red light. Remove the fiber optic tree and mounting base, and look at the light through the prismatic film.

☐ Project 110 Color Selector - Green

Use the preceding circuit, but remove the 2-snap between points A & B, and add one between points C & D. Now the color is green. Look at it using the fiber optic tree, and then the prismatic film.

☐ Project 111 Color Selector - Blue

Use the preceding circuit, but remove the 2-snap between points C & D, and add one between points E & F. Now the color is blue. Look at it using the fiber optic tree, and then the prismatic film.

☐ Project 112 Color Selector - Cyan

Use the preceding circuit, but add a 2-snap between points C & D. Now the color is cyan, which is a combination of green and blue. Look at it using the fiber optic tree, and then the prismatic film.

☐ Project 113 Color Selector - Yellow

Use the preceding circuit, but remove the 2-snap between points E & F, and add one between points A & B. Now the color is yellow, which is a combination of red and green. Look at it using the fiber optic tree, and then the prismatic film.

☐ Project 114 Color Selector - Purple

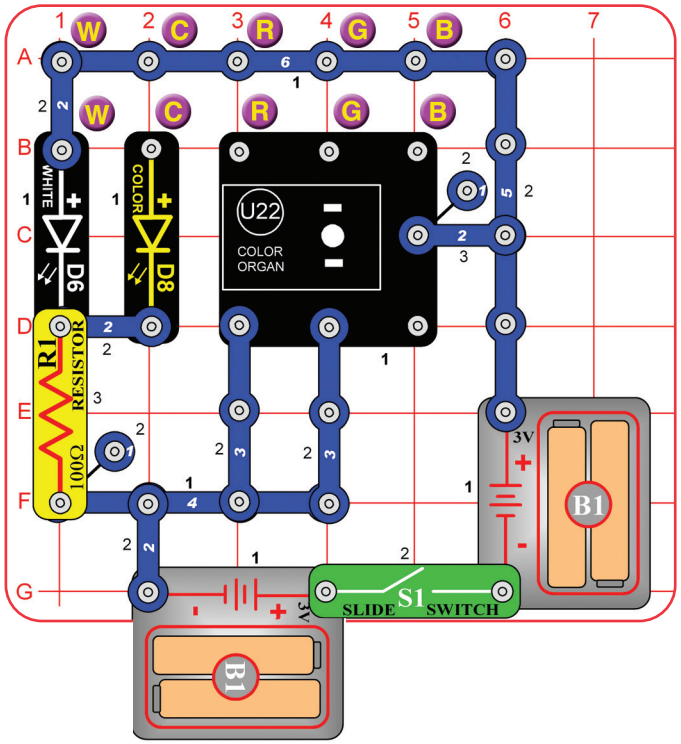
Use the preceding circuit, but remove the 2-snap between points C & D, and add one between points E & F. Now the color is purple, which is a combination of red and blue. Look at it using the fiber optic tree, and then the prismatic film.

☐ Project 115 Color Selector - White

Use the preceding circuit, but add a 2-snap between points C & D. Now the color is white, which is a combination of red, green, and blue. Look at it using the fiber optic tree, and then the prismatic film.

Black is made by turning off all the colors.

☐ Project 116



LED Color Spectrum

Build the circuit as shown, and turn on the switch (S1). The white LED (D6) will be on. Look at the white LED through the prismatic film to see the color spectrum of white light, which is all the colors of a rainbow. For best effects, do this in a dimly lit room.

Now remove the 2-snap across points W-W, and place it across points C-C (the color LED), then points R-R, G-G, and B-B (for the color organ). Using the prismatic film, look at the color spectrum produced by the color LED, and the different colors from the color organ. Compare them to the white LED spectrum.

☐ Project 117 LED Color Spectrum (II)

Use the preceding circuit, but remove the 2-snap across points W-W and place 2-snaps across R-R and G-G. Use the prismatic film to look at the color spectrum. View from different directions and different angles.

Next, move the 2-snaps to R-R and B-B, and look at the spectrum. Then move the 2-snaps to G-G and B-B and look at the spectrum. View from different directions and different angles.

For each combination, the color spectrum should be mostly light of the 2 individual colors you are combining.

☐ Project 118 LED Color Spectrum (III)

Use the preceding circuit, but place 2-snaps across points R-R, G-G, and B-B. Use the prismatic film to look at the color spectrum. View from different directions and different angles.

With the above connections, the color organ (U22) produces white light. The actual color spectrum you see will vary with your viewing angle, because the light is produced using separate red, green, and blue LEDs next to each other.

Now remove the 2-snaps from R-R, G-G, and B-B, and place one across W-W, so the circuit is like the project 82 drawing. Use the prismatic film to view the color spectrum from the white LED (D6) again, and compare it to the white light spectrum from U22. The D6 spectrum does not vary as much with the viewing angle because the light is produced by a single LED, and it is brighter.

☐ Project 119 LED Color Spectrum (IV)

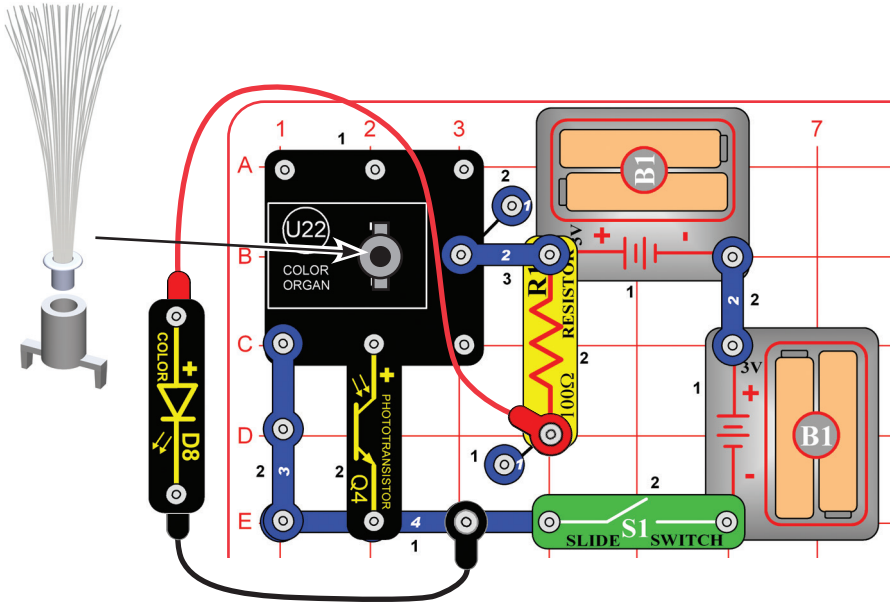
Use the circuit combinations from projects 116-118, but look at the different lights through the red, green, or blue filters instead of the prismatic film. Each filter only allows you to see light of that color, and blocks the other colors. If you put all three filters together then all light is blocked.

Actually, the red filter will pass a little of the green light, the blue filter will pass a little of the green light, and the green filter will pass a little of the green and blue light. This is because green light is between red and blue light in the color spectrum, and the filters are not perfect. See page 13 for more information about the color spectrum.

☐ Project 120 LED Color Spectrum (V)

Repeat project 116, but place the black fiber optic cable holder with the fiber optic cable on the LED you want to view. Look at the light coming out the other end of the cable using the prismatic film, and view in a dimly lit room. The light is not as bright but the beam is narrower, so the color spectrum may be clearer.

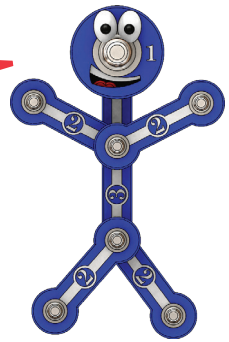
Project 121



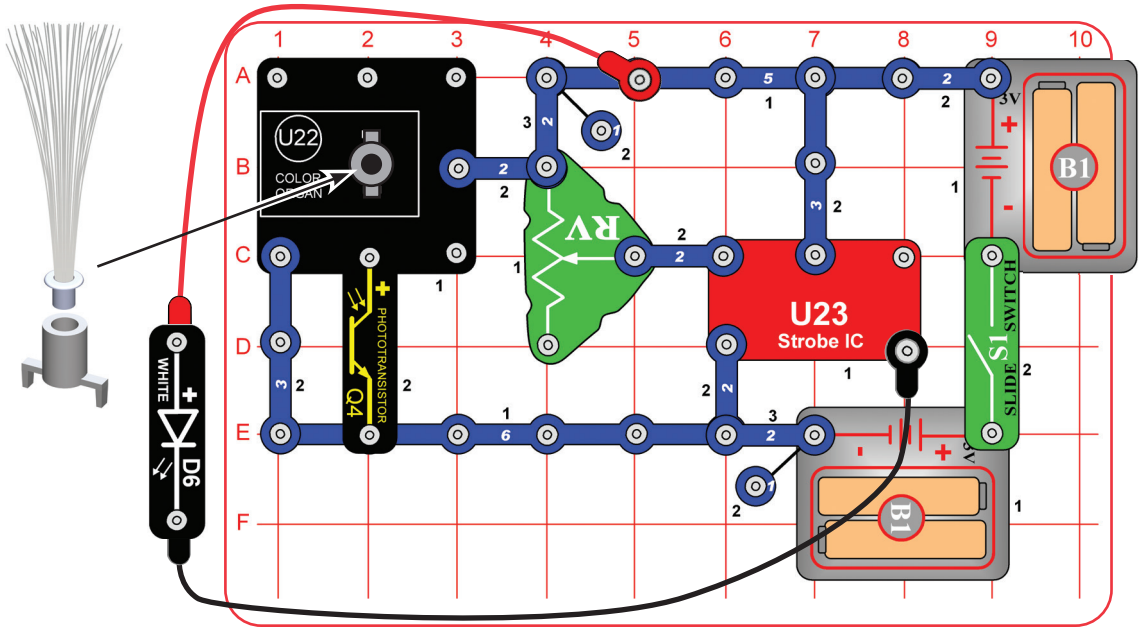
Counting Light

Build the circuit as shown and turn on the switch (S1). Place one of the LED attachments over the LED on the color organ (U22). Connect the color LED (D8) using the red & black jumper wires and hold it just above the phototransistor (Q4), so that it shines directly into the phototransistor. For best effects, do this in a dimly lit room. Every few seconds, the color organ light will change colors.

The color organ is counting how many times light turns the phototransistor on or off. At some count levels, the color organ changes colors.



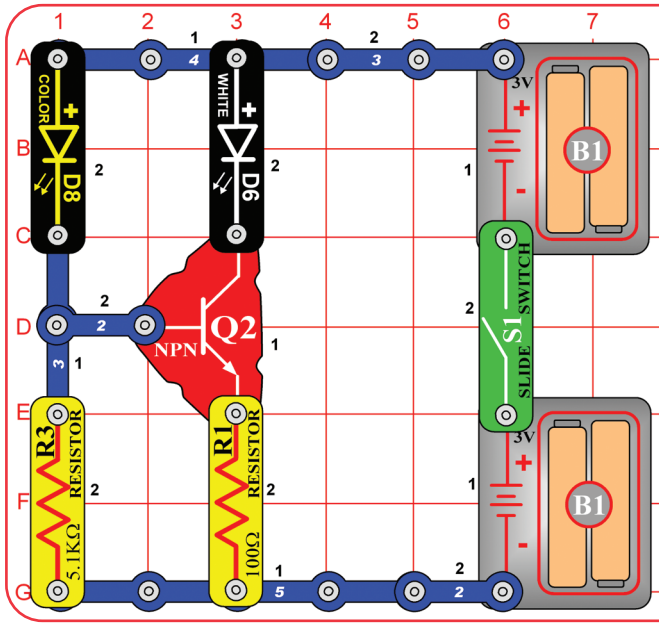
Project 122



Adjustable Counting Light

Build the circuit as shown and turn on the switch (S1). Place one of the LED attachments over the LED on the color organ (U22). Connect the white LED (D6) using the red & black jumper wires and hold it just above the phototransistor (Q4), so that it shines directly into the phototransistor. For best effects, do this in a dimly lit room. The color organ light will change colors, the lever on the adjustable resistor (RV) controls how fast the colors change.

☐ Project 123



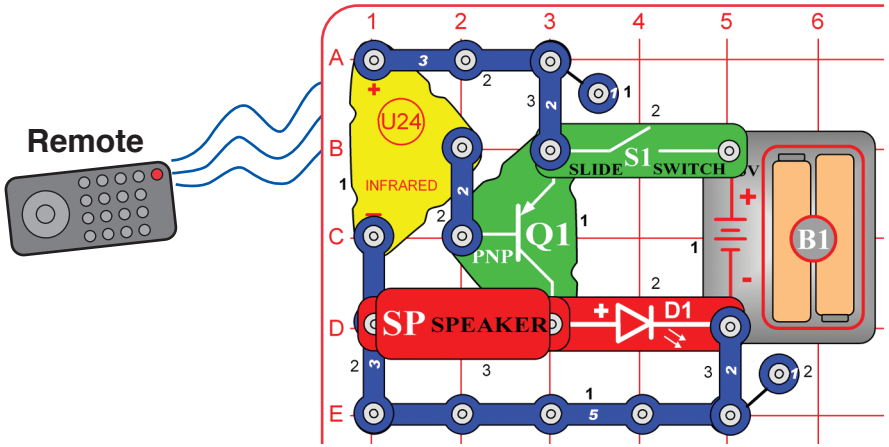
Blinking Control

Build the circuit as shown and turn on the switch (S1). The color LED (D8) and white LED (D6) will both be blinking. The color LED will be brighter than in the preceding circuit.

The white LED is controlled by the color LED using the transistor (Q2). If you remove the color LED from the circuit then the white LED will not blink.

You can replace the white LED (D6) with the speaker (SP). Now the blinking LED controls a beeping sound, but the sound will not be very loud.

☐ Project 124



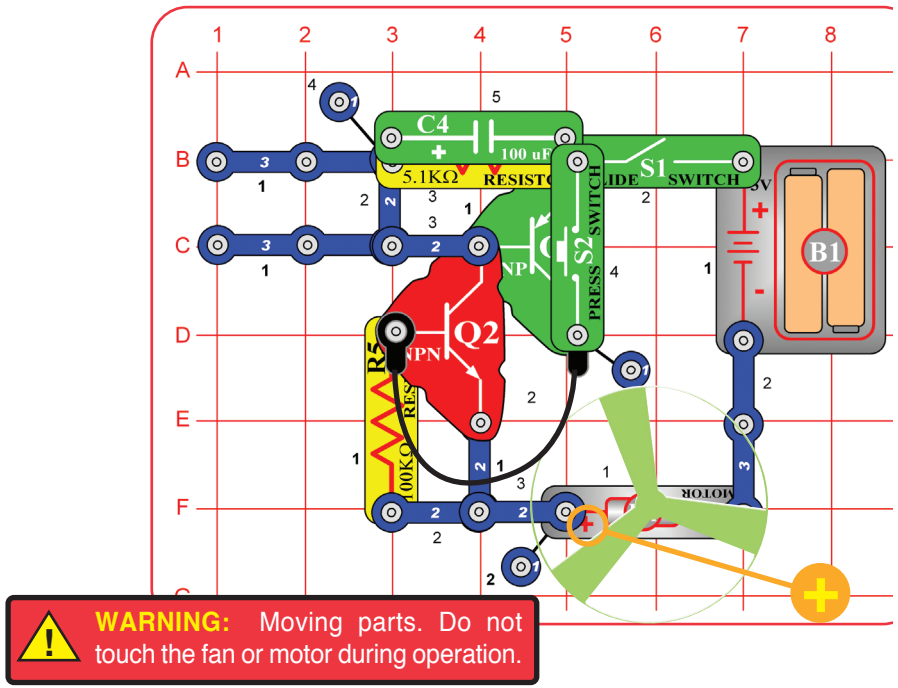
R/C Blink & Beep

You need an infrared remote control for this project, such as any TV/stereo/ DVD remote control in your home.

Build the circuit and turn on the switch (S1). Point your remote control toward the infrared module (U24) and press any button to activate the red LED (D1) and speaker (SP).

Sometimes this circuit may activate without a remote control, due to infrared in sunlight or some room lights. If this happens, try moving to a dark room.

☐ Project 125



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

Stuck on Motor

Build the circuit as shown, and note that several parts are stacked over others. Turn on the slide switch (S1); nothing happens.

Now push the press switch (S2); the motor (M1) turns on and stays on. The motor will stay on until you turn off the slide switch.

☐ Project 126 Low Voltage Stuck On Lights

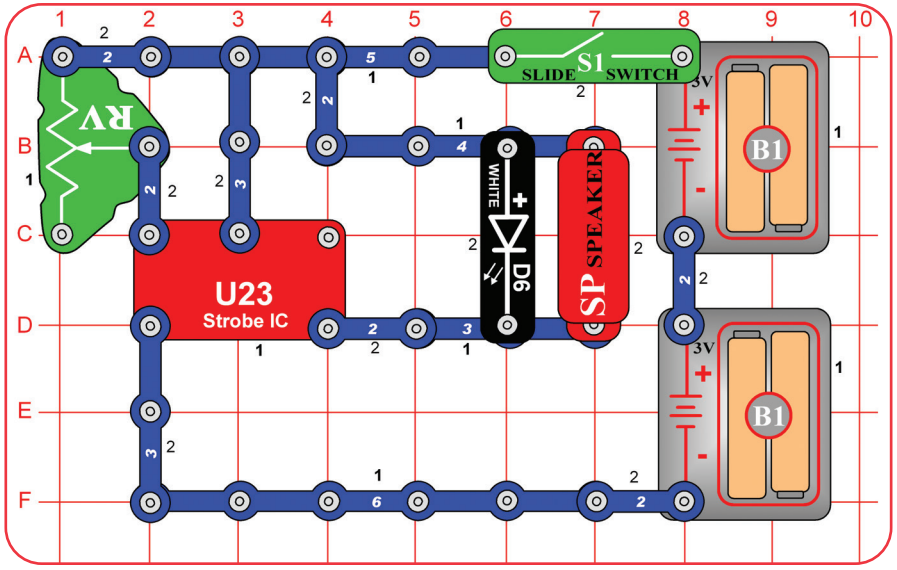
Use the preceding circuit, but replace the motor with the red LED (D1).

☐ Project 127 Stuck On Motor & Lights

Use the project 125 circuit but connect the red LED (D1) across the motor using a 4-snap wire or the red jumper wire (LED "+" to motor "+"); note that one side of the LED will be hanging above the base grid. Make sure the snap/jumper wire does not touch the fan.

Turn on the slide switch (S1), then push the press switch (S2). The motor spins and the red LED is dim. Turn off the circuit, remove the fan from the motor, and turn the circuit back on. Now the red LED is bright because it takes less electricity to spin the motor without the fan, leaving more electricity for the red LED.

☐ Project 128



Adjustable Light & Sound

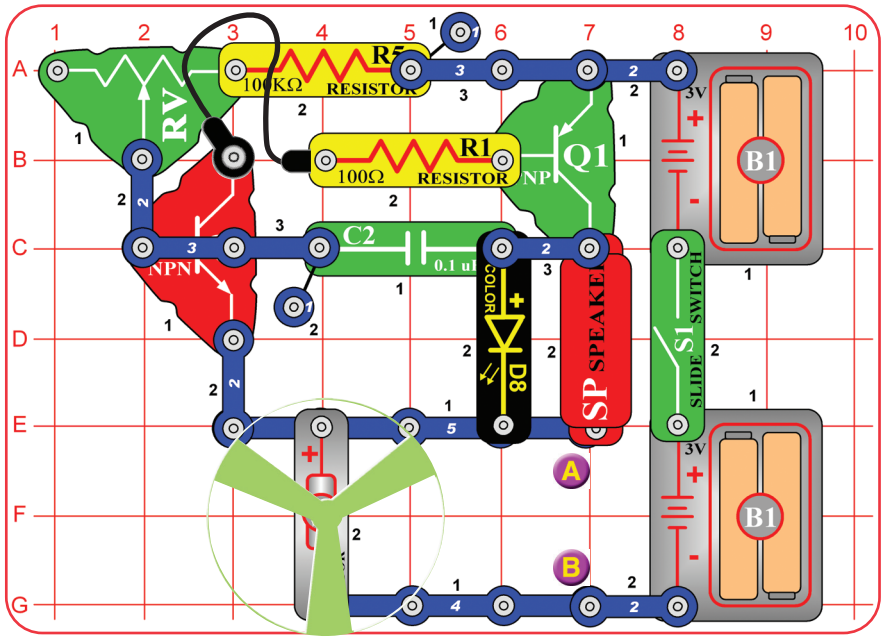
Modify the preceding circuit to match the one shown here. Use the lever on the adjustable resistor (RV) to control the light & sound. At some settings the white LED (D6) will not light, or will appear to be on continuously.

☐ Project 129 Adjustable Light & Motion

Use the preceding circuit, but replace the speaker with the motor (M1) and glow fan (motor "+" toward S1).

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

☐ Project 130



Project 133 Step Beeper

Use the circuits from projects 130-132, but replace the 0.1μF capacitor (C2) with the 100μF capacitor (C4), "+" to the right. The motor will move in small bursts, with long intervals or almost continuously, depending on the resistors and phototransistor.

Next, replace the color LED (D8) with the white LED (D6). See how the circuit works now.

High Power Buzzer

Build the circuit as shown and turn on the switch (S1). Move the lever on the adjustable resistor (RV) to vary the pitch of the buzzing sound. The motor (M1) may not spin.

Project 131 Buzz Fan

Use the preceding circuit, but place the 5.1kΩ resistor (R3) directly over the 100kΩ resistor (R5) using a 1-snap. The pitch of the tone is higher now, and the fan spins. The circuit may not make noise on all settings for the adjustable resistor. The motor may not spin.

Project 132 Photo Buzzer

Use the circuits from projects 130-132, but add the phototransistor (Q4) across base grid locations B2-B4 (between RV and R1, "+" on the left), on level 3. Shine a bright light on the phototransistor to change the sound, while also moving the lever on RV.

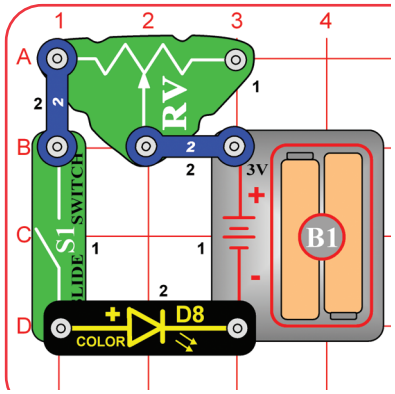
You can also place the phototransistor directly over the 100kΩ resistor, as done for the 5.1kΩ resistor in project 122. For this arrangement, "+" on Q4 should be on the right.

Project 134 Wacky Buzzer

Repeat projects 130-132, but add the 100μF capacitor (C4) across the points marked A & B in the drawing ("+" to A). The motor may not spin but the sound is different. The sound may not be very loud.

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

☐ Project 135



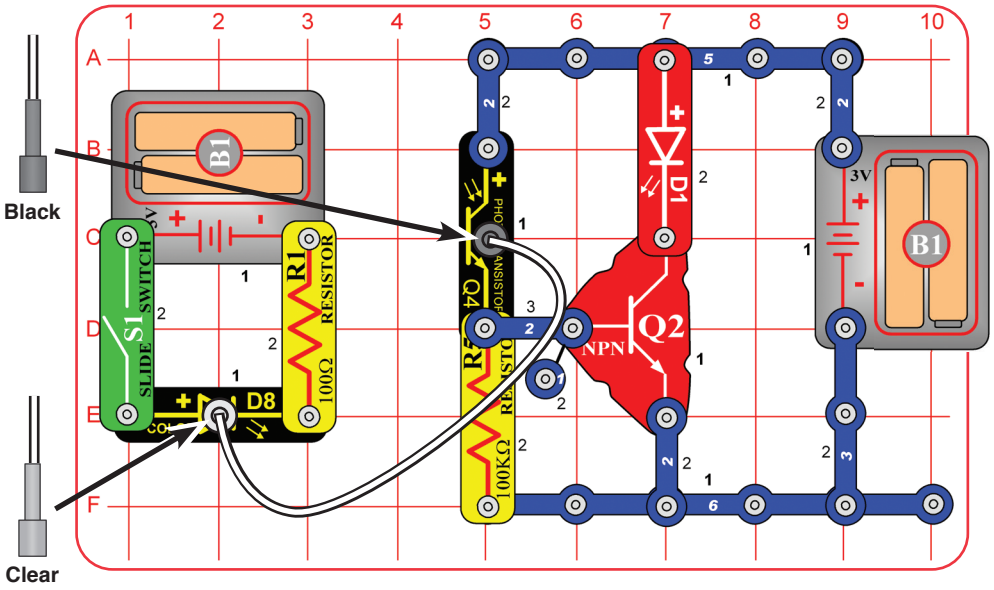
Low Power Brightness Control

Build the circuit and turn on the slide switch (S1). Move the lever on the adjustable resistor (RV) to vary the brightness of the light from the color LED (D8). For best effects, do this in a dimly lit room. At some RV settings the LED will be very dim, and some of its colors may be totally off.

Project 136 Low Power Resistors & LEDs

Use the preceding circuit but replace the color LED (D8) with the red LED (D1) or white LED (D6). Vary the adjustable resistor lever to see how the light varies with each LED. The white LED may not be on at all.

Project 137



Fiber Fun

Build the circuit as shown. Place the clear cable holder on the color LED (D8) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go.

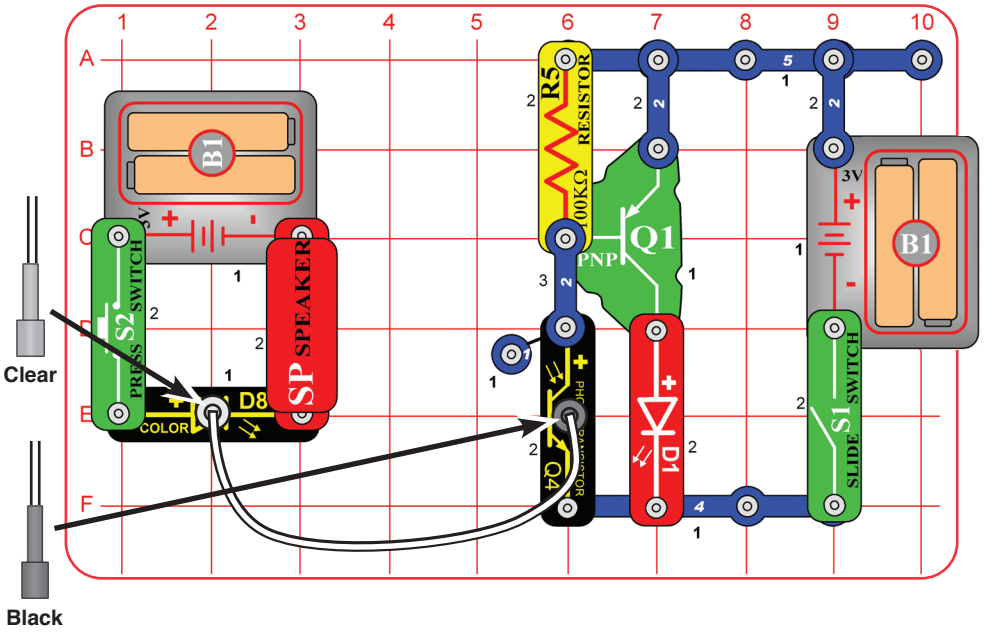
Turn on the slide switch (S1). Light is transmitted from the color LED, through the fiber optic cable, to control the NPN transistor (Q2) and red LED (D1).

You can replace the red LED with the white LED (D6), but the white LED may be dim or not light.

Project 138 Fiber Fun Backwards

Use the preceding circuit but swap the locations of the phototransistor (Q4) and the 100kΩ resistor (R5), keep the "+" side of Q4 in the same direction. Now the red LED will be on whenever the color LED is off.

Project 139



More Fiber Fun

Build the circuit as shown. Place the clear cable holder on the color LED (D8) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

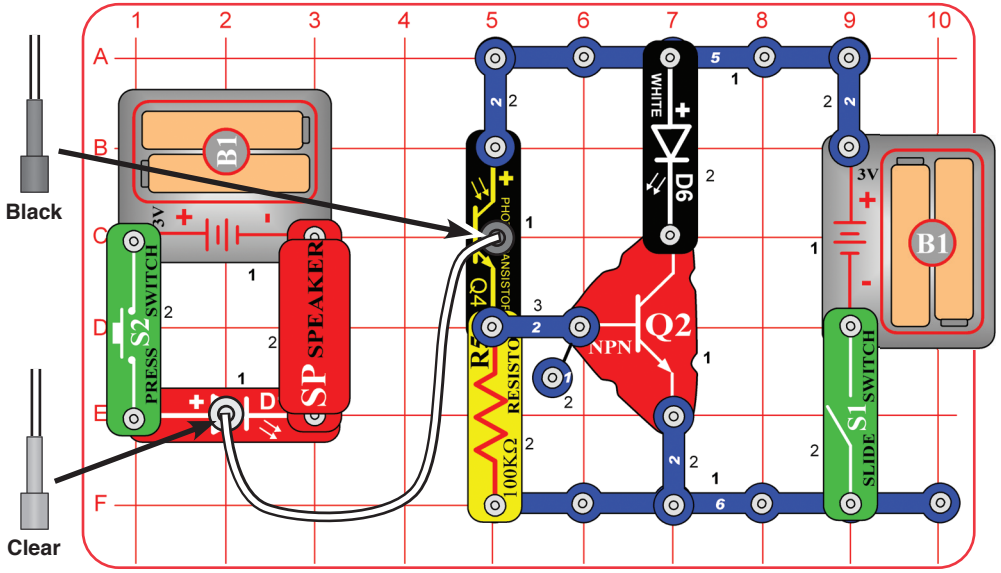
Turn on the slide switch (S1). Light is transmitted from the color LED, through the fiber optic cable, to control the PNP transistor (Q1) and red LED (D1). The speaker is used to help limit the current through the color LED, and will not make noise.

For more fun, swap the locations of the color LED (D8) and red LED (D1). You may also replace either LED with the white LED (D6), but the white LED may be dim or not light.

Project 140 Other Fiber Fun

Use the preceding circuit but swap the locations of the phototransistor (Q4) and the 100kΩ resistor (R5), keep the "+" side of Q4 in the same direction. Now the red LED will be on whenever the color LED is on.

☐ Project 141



Morse Code

Build the circuit as shown. Place the clear cable holder on the red LED (D1) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.Turn on the slide switch (S1), then push the press switch (S2) several times to send secret messages between the circuits using Morse Code. If your fiber optic cable was a lot longer, you could use this circuit to send messages to your friends in different cities. The speaker is used to help limit the current through the red LED, and will not make noise.

If desired, you can swap the locations of the red and white LEDs (D1 & D6).

Note: If the white LED (D6) does not light or is dim, replace it with the color LED (D8). The white LED can be brighter and won't change colors, but requires higher voltage to activate.

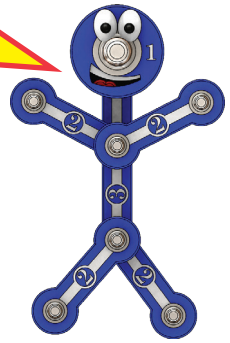
☐ Project 142 Fiber Shut-Off

Use the preceding circuit but swap the locations of the phototransistor (Q4) and the 100kΩ resistor (R5), keep the "+" side of Q4 in the same direction. Now pushing the press switch will turn off the LED in the right half of the circuit.

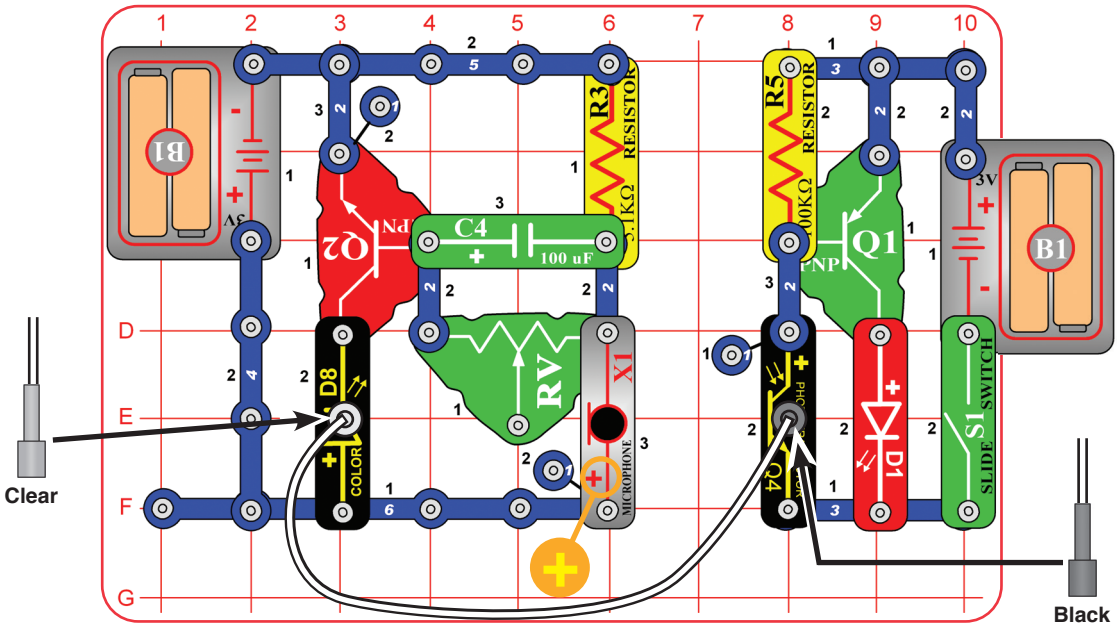
Morse Code: The forerunner of today's telephone system was the telegraph, which was widely used in the latter half of the 19th century. It only had two states - on or off (that is, transmitting or not transmitting), and could not send the range of frequencies contained in human voices or music. A code 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 it isn't in wide use today. It is sometimes referred to in Hollywood movies, especially Westerns. Modern fiber optics communications systems send data across the country using similar coding systems, but at much higher speeds.

MORSE CODE

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 143

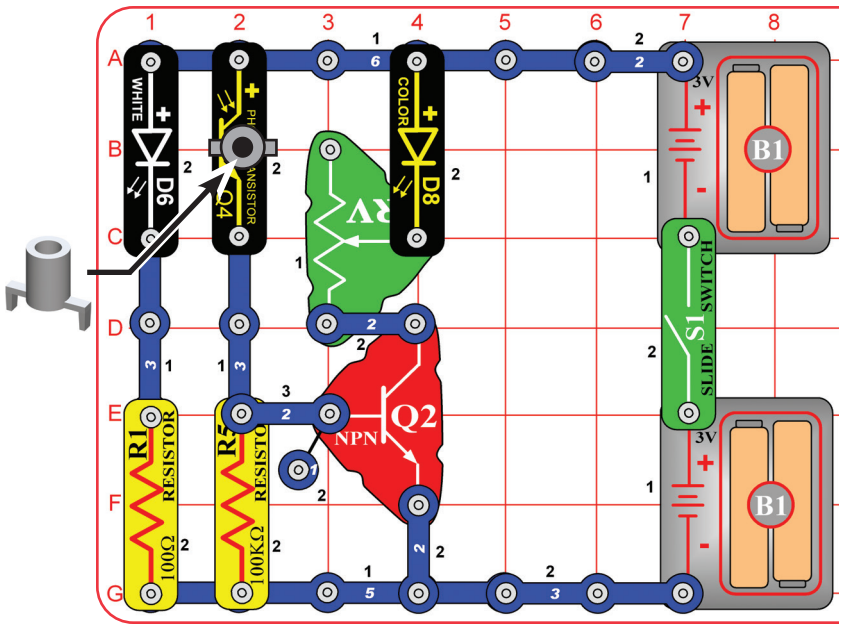


Blow On Fiber

Build the circuit as shown. Place the clear cable holder on the color LED (D8) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

Turn on the slide switch (S1), and blow on the microphone or talk loudly into it. The signal from the microphone will be sent through the fiber optic cable to the right half of the circuit, to activate the red LED (D1).

☐ Project 144



Reflection Detector

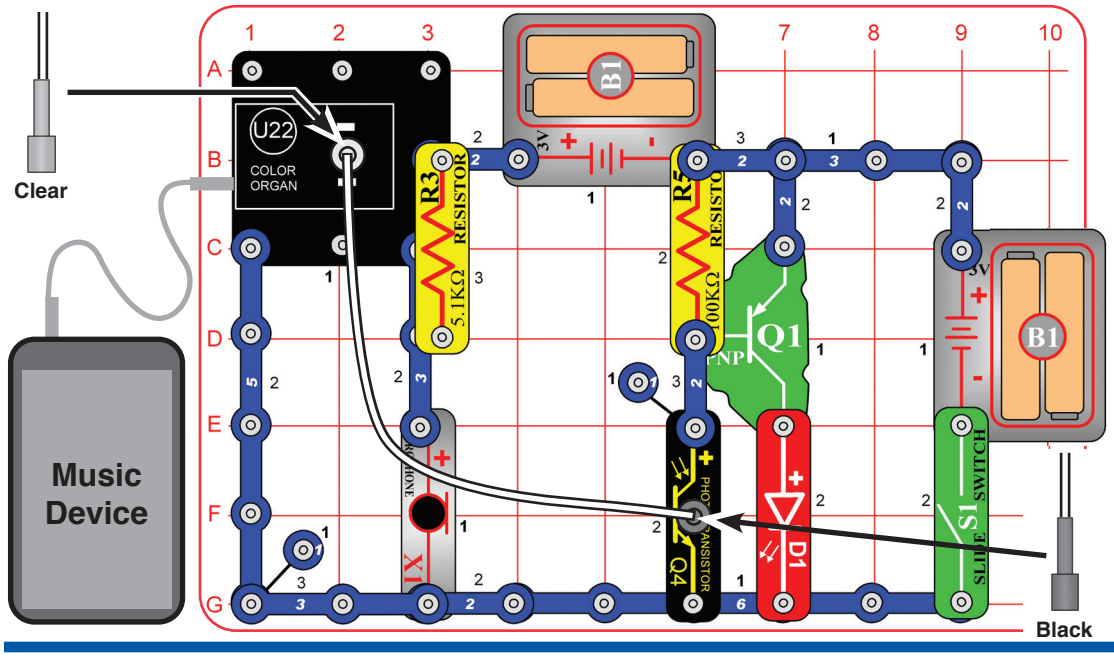
Build the circuit as shown and turn on the switch (S1). Place the mounting base over the phototransistor (Q4). Set the lever on the adjustable resistor (RV) all the way toward the NPN transistor (Q2). Move the circuit into a dimly lit room, so that the color LED (D8) is off.

Place a mirror directly over the white LED (D6) and photo-transistor (Q4), or hold it facing a wall mirror. When enough light from the white LED reaches the phototransistor, the color LED will turn on, indicating that a reflection has been detected.

The mounting base is used to block direct light from the white LED to the phototransistor, and to shield the phototransistor from room light. If your room is very dark, you may get better results by placing the mounting base over the white LED instead of the phototransistor.

Project 145

Requires connection to a music device (not included)



Fiber Color Organ

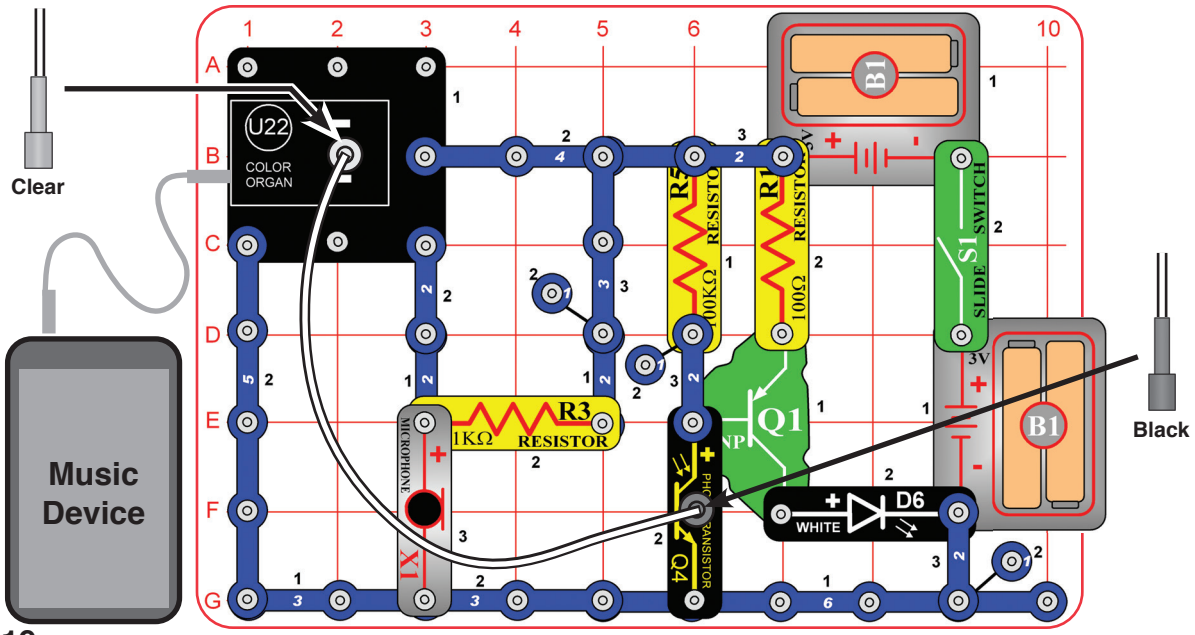
Build the circuit as shown. Place the clear cable holder on the color organ (U22) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.The clear holder will be a loose fit.

Turn on the slide switch (S1), and blow on the microphone or talk loudly into it. The signal from the microphone will change the LED on the color organ, then send the light through the fiber optic cable to the phototransistor, which controls the red LED (D1).

Optional: Connect a music device (not included) to the color organ as shown, and start the music on it. The music device will control the red LED. Set the volume control on your music device for best light effects. If you replace the red LED with the speaker (SP), then you get sound effects (beeping, not music).

Project 146

Requires connection to a music device (not included)



Bright Fiber Color Organ

Build the circuit as shown. Place the clear cable holder on the color organ (U22) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them. The clear holder will be a loose fit.

Turn on the slide switch (S1), and blow on the microphone or talk loudly into it. The signal from the microphone will change the LED on the color organ, then send the light through the fiber optic cable to the phototransistor, which controls the white LED (D6).

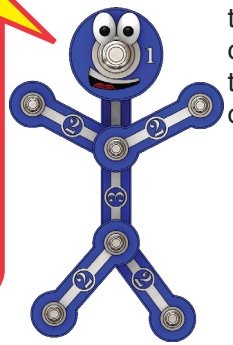
Optional: Connect a music device (not included) to the color organ as shown, and start the music on it. The music device will control the white LED. Set the volume control on your music device for best light effects.

☐ Project 147

Cup & String Communication

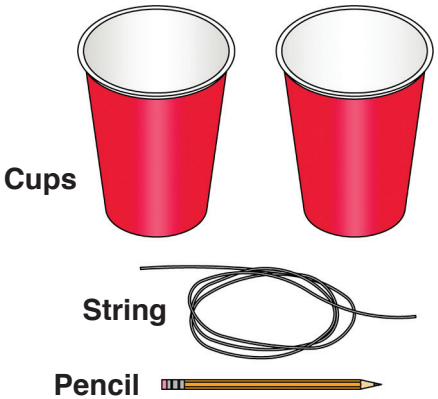
How it works: When you talk into the cup, the cup bottom vibrates back and forth from your sound waves. The vibrations travel through the string by pulling the string back and forth, and then make the bottom of the second cup vibrate just like the first cup did, producing sound waves that the listener can hear. If the string is tight, the received sound waves will be just like the ones sent, and the listener hears what the talker said.

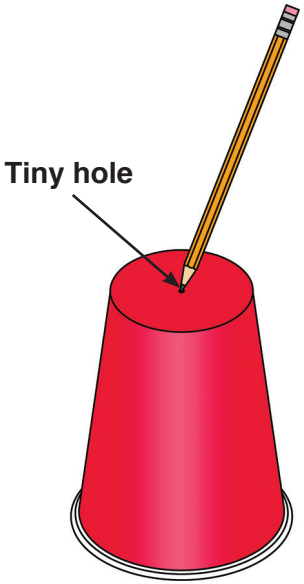
Telephones work the same way, except that electric current replaces the string. In radio, the changing current from a microphone is used to encode electromagnetic waves sent through the air, then decoded in a listening receiver.

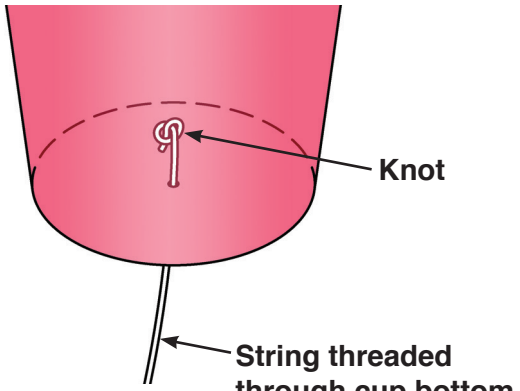


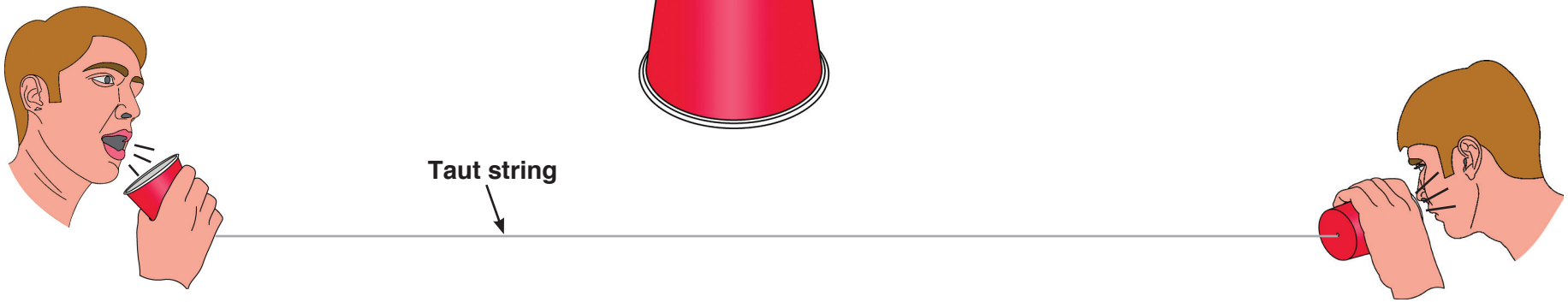
Light, radio signals, and sound all travel through air like waves travel through water. To help you understand how they are like waves, you can make a cup & string telephone. This common trick requires some household materials (not included with this kit): two large plastic or paper cups, some non-stretchable thread or kite string, and a sharp pencil. Adult supervision is recommended.

Take the cups and punch a tiny hole in the center of the bottom of each with a sharp pencil (or something similar). Take a piece of string (use between 25 and 100 feet) and thread each end through each hole. Either knot or tape the string so it cannot go back through the hole when the string is stretched. Now with two people, have each one take one of the cups and spread apart until the string is tight. The key is to make the string tight, so its best to keep the string in a straight line. Now if one of you talks into one of the cups while the other listens, the second person should be able to hear what the first person says.

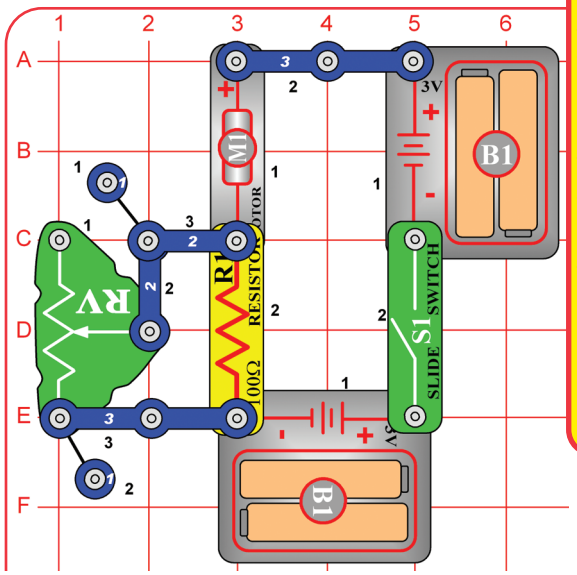






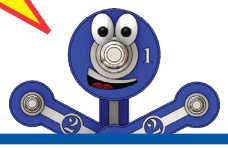


☐ Project 148



The motor needs a lot of electricity to start spinning, but needs less the faster it is spinning. The resistors (R1 & RV) are limiting how much electricity flows, so the motor can barely spin.

The capacitor allows a short surge of electricity to flow through it until it charges up. This short surge bypasses the higher resistance of the resistors, and helps the motor get going.



Slow Motor Speed Control

Build the circuit as shown; do not place the fan on the motor. Set the lever on the adjustable resistor (RV) toward the 3-snap. Turn on the switch (S1) to start the motor (M1). If the motor does not spin, then give it a push to get it started. Use the lever on the adjustable resistor to control the motor speed. If the motor does not spin even after giving it a push then replace your batteries.

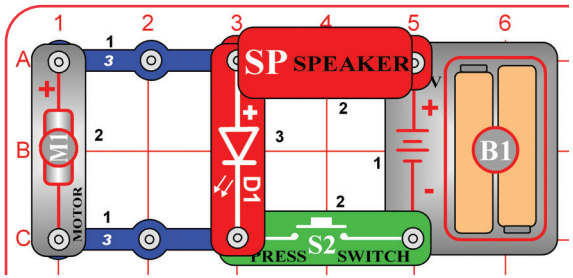
Turn off the switch and turn the motor shaft counter-clockwise with your fingers. Now turn the switch on try turning the motor counterclockwise; now it is harder because the circuit is trying to turn the motor clockwise at the same time.

☐ Project 149 Slow Motor Start Aid

Use the preceding circuit but add the 100µF capacitor (C4) directly over the 100Ω resistor (R1), "+" side towards the motor. The circuit works the same, but starts more easily.

If you have a larger 470µF capacitor (C5), which is included with some other Snap Circuits® sets, then you can use it in place of the 100µF capacitor. It will make the motor start even more easily.

☐ Project 150



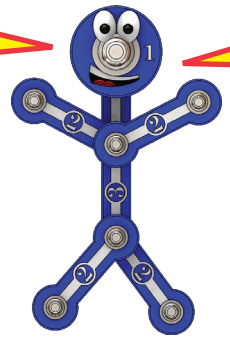
Motor Power

Build the circuit as shown, push the press switch (S2), and look at the brightness of the red LED (D1). Try it three ways: with no fan on the motor, with the glow fan on the motor, and keeping the motor from spinning with your fingers. When the motor is spinning, you will hear noise from the speaker (SP).

☐ Project 151 More Motor Power

Use the preceding circuit but replace the red LED (D1) with the color LED (D8) or the white LED (D6), see how they compare to the red LED.

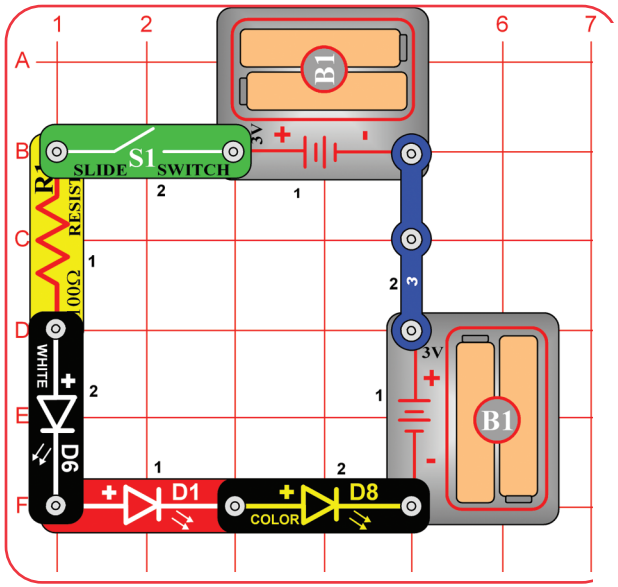
The motor needs a lot of electricity to start spinning, but needs less the faster it is spinning. When kept from spinning by your fingers, the motor sucks up all the electricity, leaving none to light the red LED. With the fan on the motor, the LED gets enough electricity to light. When the motor is spinning without the fan, the LED gets lots of electricity and is bright.



The color and white LEDs need more electricity to light than the red LED. The motor "noise" that you hear on the speaker can also confuse the color LED and disrupt its color pattern.

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

☐ Project 152



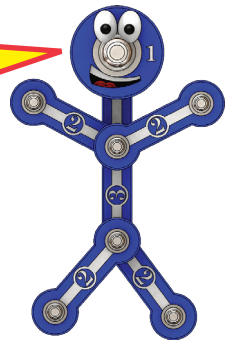
Series Lights

Build the circuit and turn on the switch (S1). Place the circuit in a dimly lit room. Some of the LEDs (D1, D6, & D8) will be blinking, but none will be very bright. If nothing lights then replace your batteries.

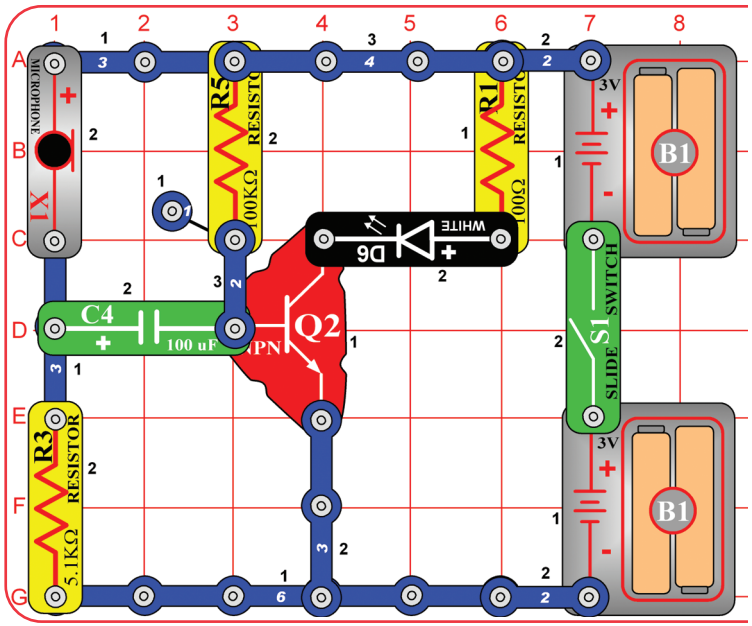
The LEDs are blinking because a color-changing circuit in the color LED is turning that LED on and off, which also affects the other LEDs.

This circuit has all the parts connected in a series. Swapping the locations of any parts in the circuit (without changing the direction of their "+" side) will not change how the circuit works. Try it.

The LEDs are dim because the batteries need to overcome the activation voltage level for every LED in the series before any can light. That doesn't leave much voltage to overcome the resistance in the circuit. If you replace one of the LEDs with a 3-snap, the others will be much brighter. Try it.



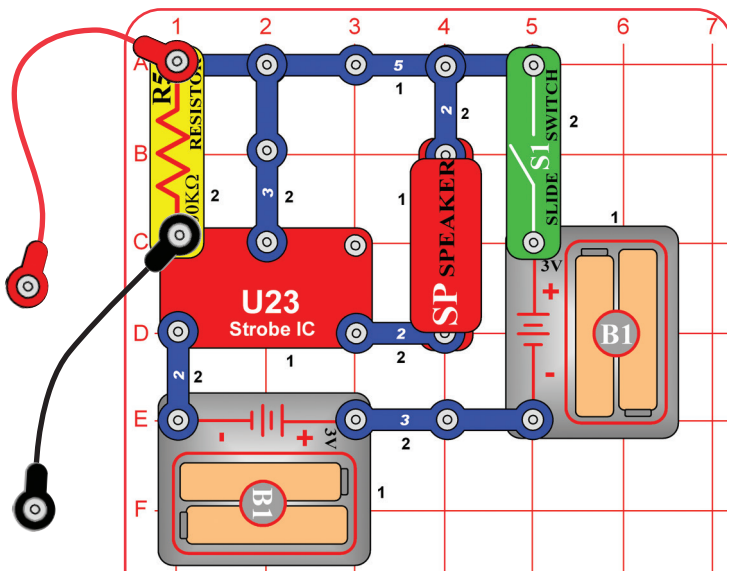
☐ Project 153



Blow Off the Light

Build the circuit and turn on the slide switch (S1). Wait for the white LED (D6) to come on. Blow into the microphone (X1) to make the white LED flicker. If you blow hard enough, the LED will turn off for a moment.

☐ Project 154



Long, narrow shapes have more resistance than short, wide ones. The black core of pencils is graphite, the same material used in resistors.

Musical Shapes

Build the circuit and turn on the switch (S1). Make your parts using either the water puddles method (A), the drawn parts method (B), or the pencil parts method (C). Touch the metal in the jumper wires to your parts and listen to the sound.

Method A (easy): Spread some water on the table into puddles of different shapes, perhaps like the ones shown here. Touch the jumper wires to points at the ends of the puddles.

Method B (challenging): Use a SHARP pencil (No. 2 lead is best) and draw shapes, such as the ones here. Draw them on a hard, flat surface. Press hard and fill in several times until you have a thick, even layer of pencil lead. Touch the jumper wires to points at the ends of the drawings. You may get better electrical contact if you wet the metal with a few drops of water. Wash your hands when finished.

Method C (adult supervision and permission required): Use some double-sided pencils if available, or VERY CAREFULLY break a pencil in half. Touch the jumper wires to the black core of the pencil at both ends.

☐ Project 155 Human & Liquid Sounds

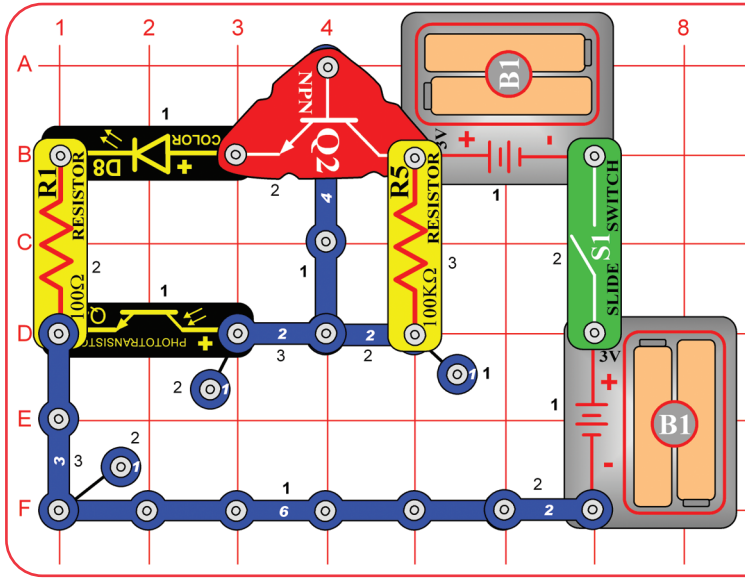
Use the preceding circuit but touch the metal in the jumper wires snaps with your fingers. Wet your fingers for best results. Your fingers will change the sound, because your body resistance is less than the 100kΩ resistor (R5) in the circuit.

Next, place the loose ends of the jumper wires in a cup of water, make sure the metal parts aren't touching each other. The water should change the sound.

Now add salt to the water and stir to dissolve it. The sound should have higher pitch now, since salt water has less resistance than plain water.

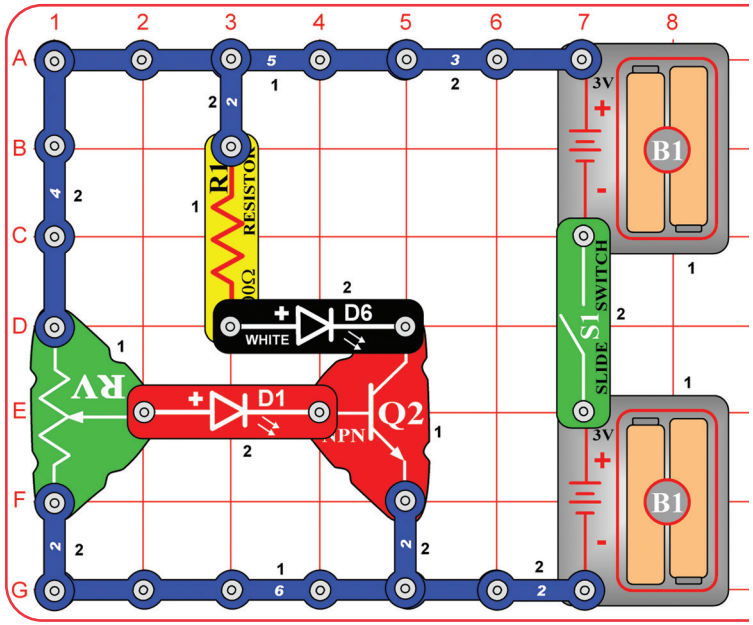
Don't drink any water used here.

☐ Project 156 Bright Off Light



Build the circuit as shown and turn on the switch (S1). Place the circuit in a dark room or cover the phototransistor (Q4); the color LED (D8) should be on. Shine light on the phototransistor and the color LED turns off.

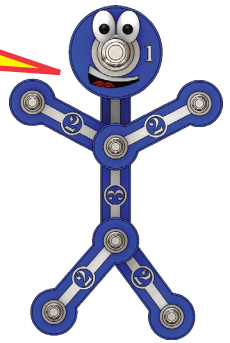
☐ Project 157



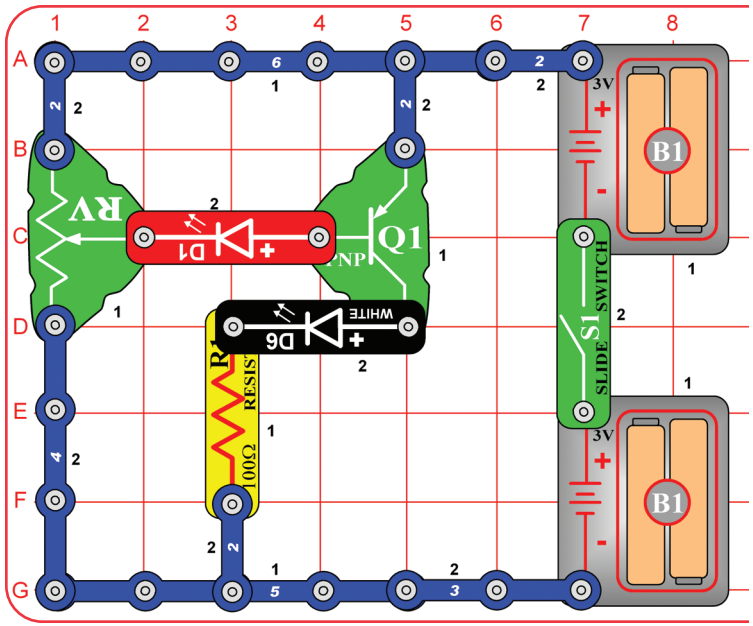
Transistor

Build the circuit and turn on the slide switch (S1). Slowly move the lever on the adjustable resistor (RV) across its range while watching the brightness of the red & white LEDs (D1 & D6).

Transistors, such as the NPN transistor (Q2), can amplify electric currents. In this circuit, the adjustable resistor controls a small current going to the transistor through the red LED. The transistor uses this small current to control a larger current through the white LED. At some RV settings, the control current is too small to light the red LED, but the transistor-amplified is large enough to light the white LED.



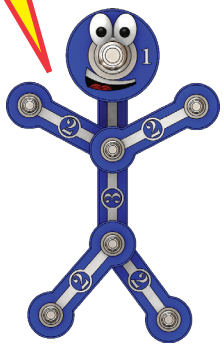
☐ Project 158



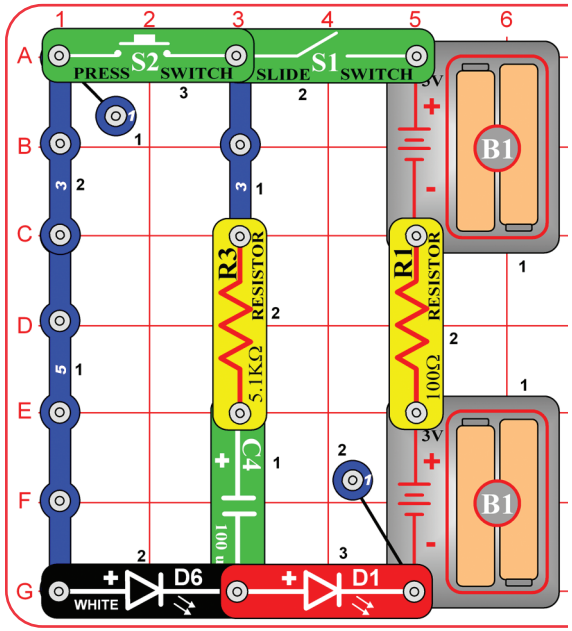
Another Transistor

This circuit is just like the preceding one, except uses a different type of transistor. Build the circuit and turn on the slide switch (S1). Slowly move the lever on the adjustable resistor (RV) across its range while watching the brightness of the red & white LEDs (D1 & D6).

The PNP transistor (Q1) is just like the NPN transistor (Q2), except that the currents flow in opposite directions.



☐ Project 159



Charging & Discharging

Turn on the slide switch (S1) for a few seconds, then turn it off. The red LED (D1) is dimly lit for a few moments but goes completely dark as the batteries (B1) charge up the 100µF capacitor (C4). The capacitor is storing electrical charge.

Now press the press switch (S2) for a few seconds. The white LED (D6) is initially bright but goes dim as the capacitor discharges itself through it.

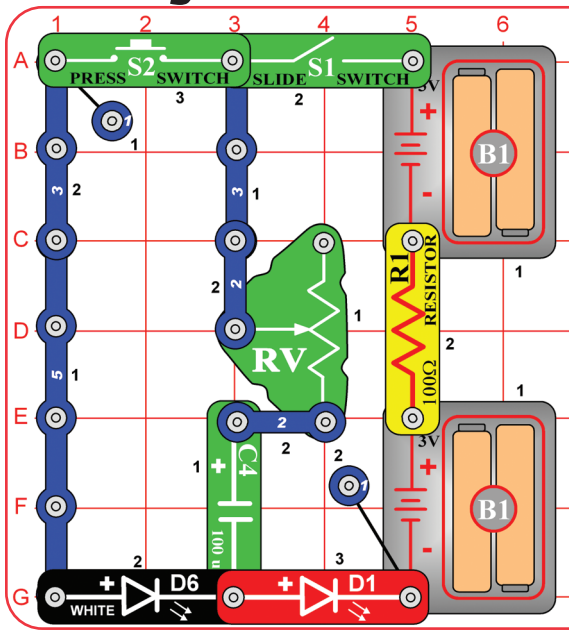
The C4 capacitor value (100µF) sets how much charge can be stored in it, and the R3 resistor value (5.1kΩ) sets how quickly that charge can be stored or released.

Now swap the locations of the white & red LEDs, and try the circuit again. Both LEDs have the same electrical current flowing through them, but white LED is much brighter than the red LED because it is a super-bright LED while the red one isn't.

☐ Project 160 Mini Capacitor

Use the preceding circuit but replace the 100µF capacitor (C4) with the 0.1µF capacitor (C2). The circuit works the same, but the LEDs will only light very briefly, because the smaller 0.1µF capacitor stores much less electricity than the larger 100µF capacitor.

☐ Project 161



Adjustable Charging & Discharging

Modify the project 159 circuit to be this one, which has the adjustable resistor (RV) instead of the 5.1kΩ resistor (R3). Use the lever on RV to adjust the capacitor charge & discharge rate, setting it towards the red LED (D1) will make the LEDs flash brighter but get dim faster.

Project 162

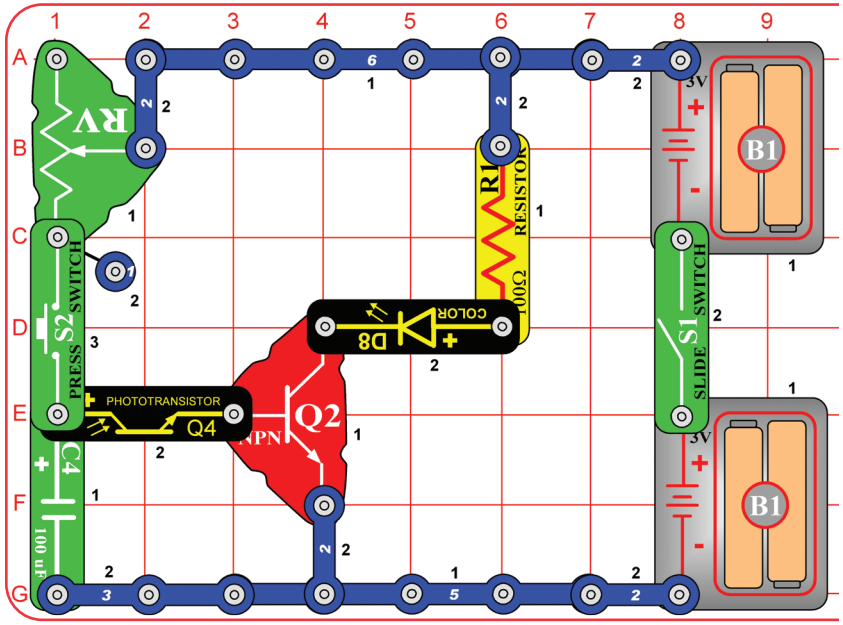
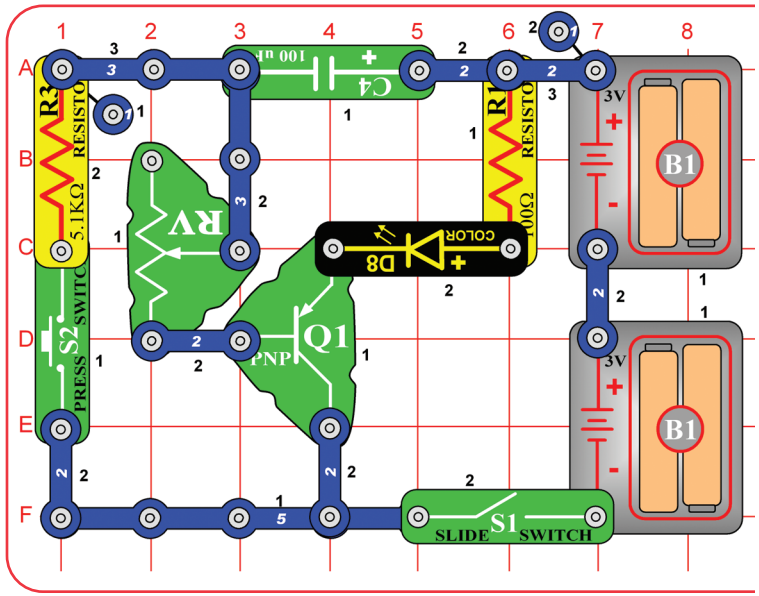


Photo Control

Set the lever on the adjustable resistor (RV) all the way towards the press switch (S2). Turn on the slide switch (S1), and push the press switch. The color LED (D8) will light for a while and then slowly turn off. The brighter the light on the phototransistor (Q4), the shorter the color LED stays on.

You can replace the color LED with the red LED (D1) or the white LED (D6).

Project 163

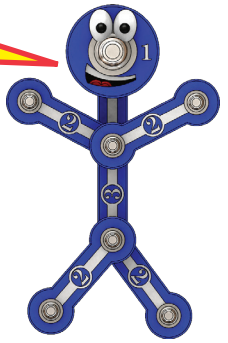


Slow On, Slower Off

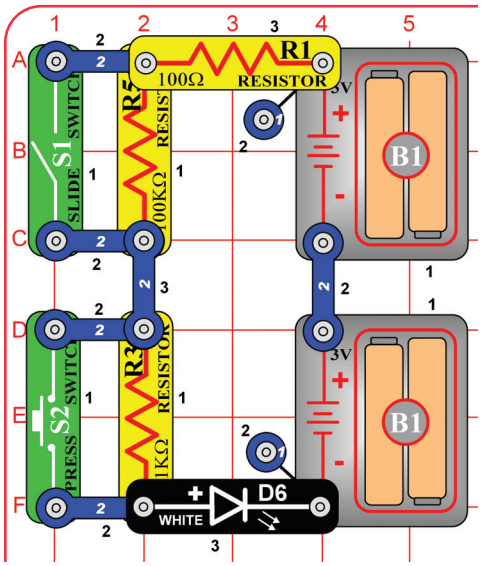
Turn on the slide switch (S1), nothing happens. Now push the press switch (S2) and hold it down. The color LED (D8) takes a few seconds to turn on, then will very slowly get dim after S2 is released. The adjustable resistor (RV) controls the shut-off time.

You can replace the color LED with the red LED (D1) or the white LED (D6).

The 100µF capacitor (C4) controls the color LED through the PNP transistor (Q1). Pressing S2 quickly charges up the capacitor, and releasing S2 allows the capacitor to slowly discharge. Capacitors can store electric charge and release it when needed, so they are often used in timing circuits like this.



☐ Project 164

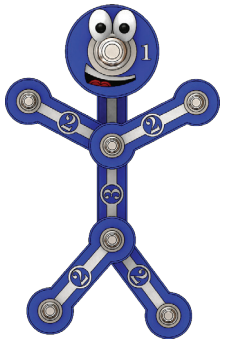


Current Controllers - Series

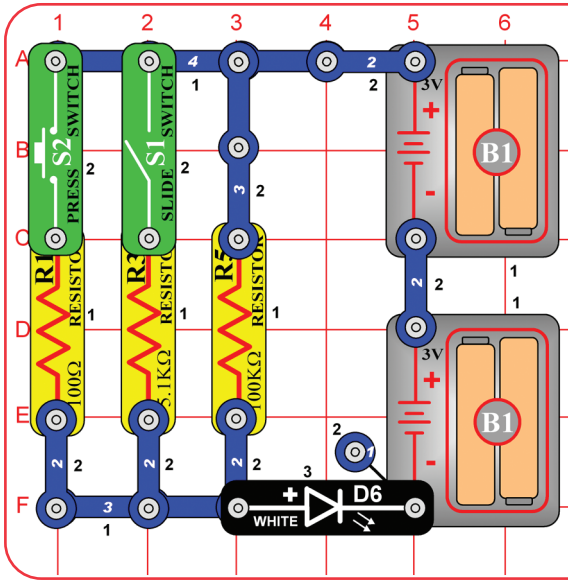
Turn on either or both switches (S1 & S2) and compare the white LED (D6) brightness.

This circuit has the 100Ω resistor (R1), the 5.1kΩ resistor (R3), and the 100kΩ resistor (R5) arranged in series. The switches are used to bypass the larger resistors. The largest resistor controls the brightness in this arrangement.

Resistors are used to control the amount of current through a circuit. Increasing the resistance decreases the current.



☐ Project 165

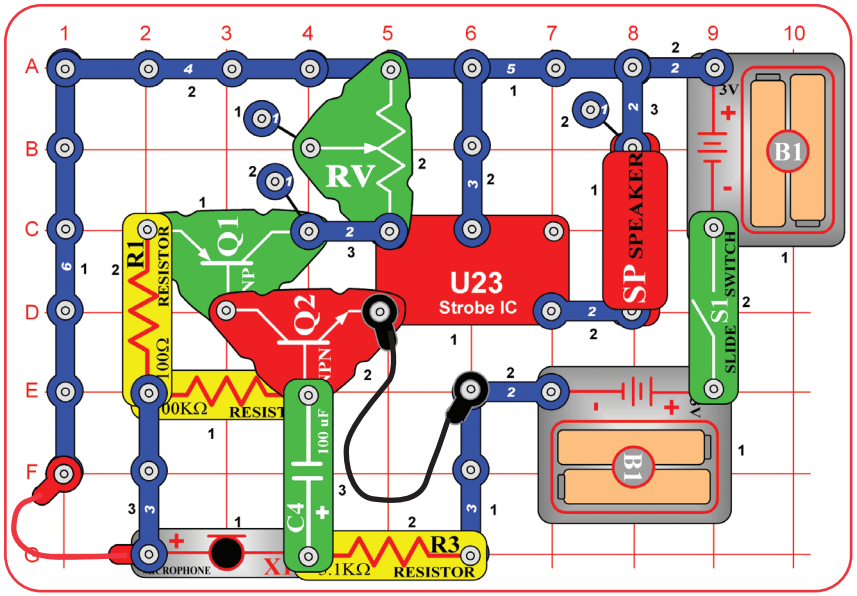


Current Controllers - Parallel

Turn on either or both switches (S1 & S2) and compare the white LED (D6) brightness.

This circuit has the 100Ω resistor (R1), the 5.1kΩ resistor (R3), and the 100kΩ resistor (R5) arranged in parallel. The switches are used to disconnect the smaller resistors. The smallest resistor controls the brightness in this arrangement.

☐ Project 166

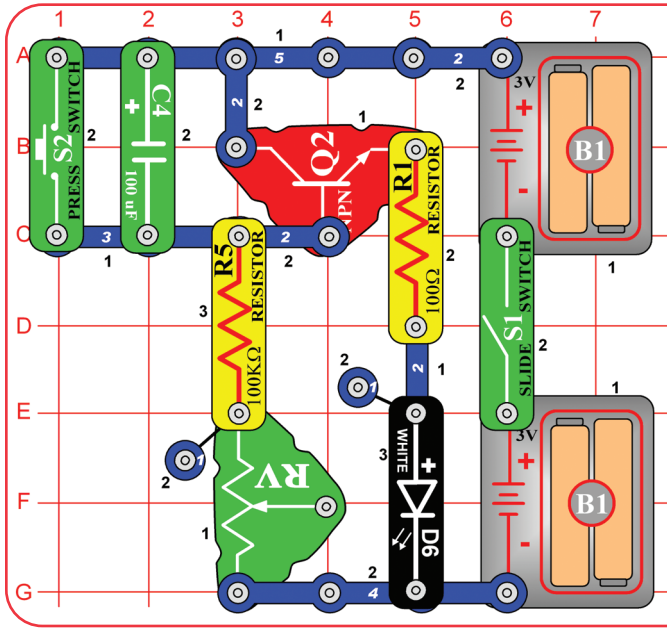


Blow Sound Changer

When you turn on the switch (S1), you hear a siren sound. Blow into the microphone (X1) to change the sound.

RV is used as a fixed resistor (50kΩ); so moving its control lever will have no effect.

☐ Project 167



Short Light

Build the circuit, turn on the slide switch (S1), and push the press switch (S2). The white LED (D6) is on for a while and then shuts off. Turning S1 off and back on will not get the light back on. Push S2 to get the light back on.

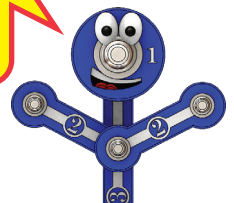
Replace the white LED with the color LED (D8) to change the light style.

RV is used as a fixed resistor (50kΩ); so moving its control lever will have no effect.

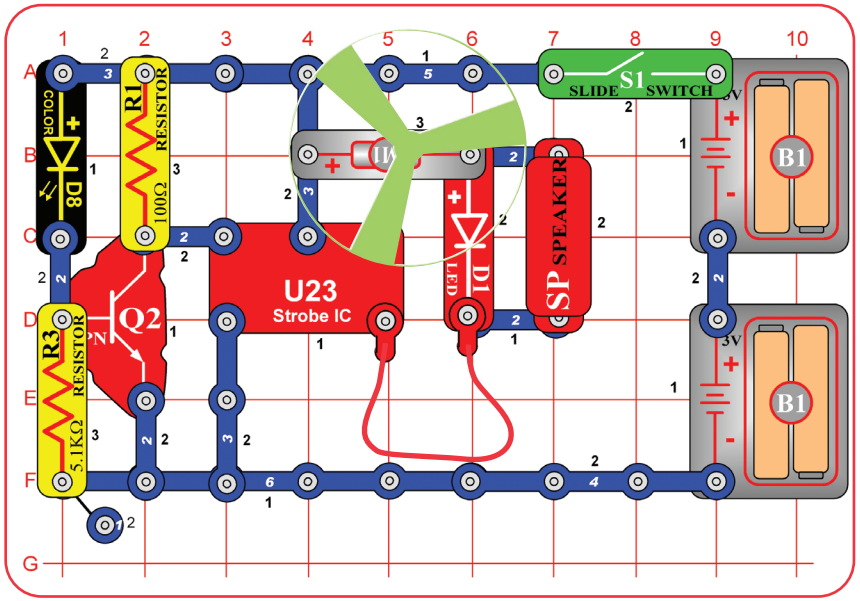
☐ Project 168 Shorter Light

Use the preceding circuit but replace the 100kΩ resistor (R5) with the smaller 5.1kΩ resistor (R3). Now the light doesn't stay on as long.

The light is on while the 100μF capacitor (C4) is charging, and shuts off when the capacitor gets fully charged. Pressing S2 discharges the capacitor. The charge-up time is set by the capacitor's value and resistors R5 and RV.



Project 169



Blink Step Beep

Build the circuit as shown and turn on the switch (S1). The color LED (D8) is used to control the strobe IC (U23), which turns on the motor (M1), red LED (D1), and speaker (SP) in short bursts. The circuit also works without the fan on the motor.

If you replace the motor with the black jumper wire, the red LED will be a little brighter.

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

Project 170

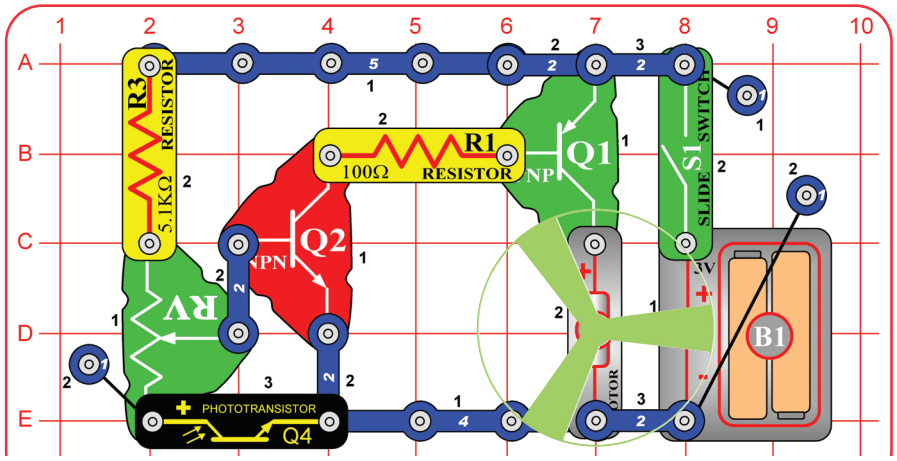
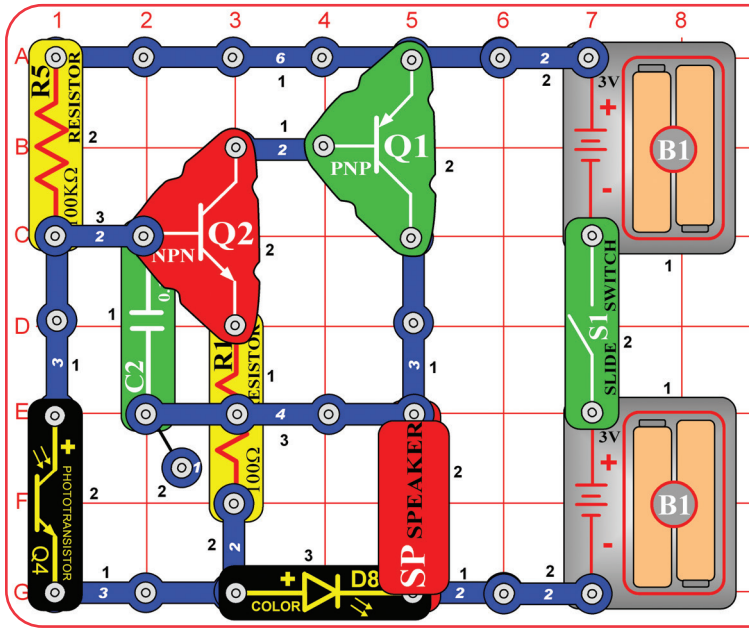


Photo Speed Control

Turn on the switch (S1), and set the adjustable resistor (RV) so the motor (M1) just spins. Slowly cover the phototransistor (Q4) and the motor spins faster. Place more light on the phototransistor and the motor slows down.

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

☐ Project 171

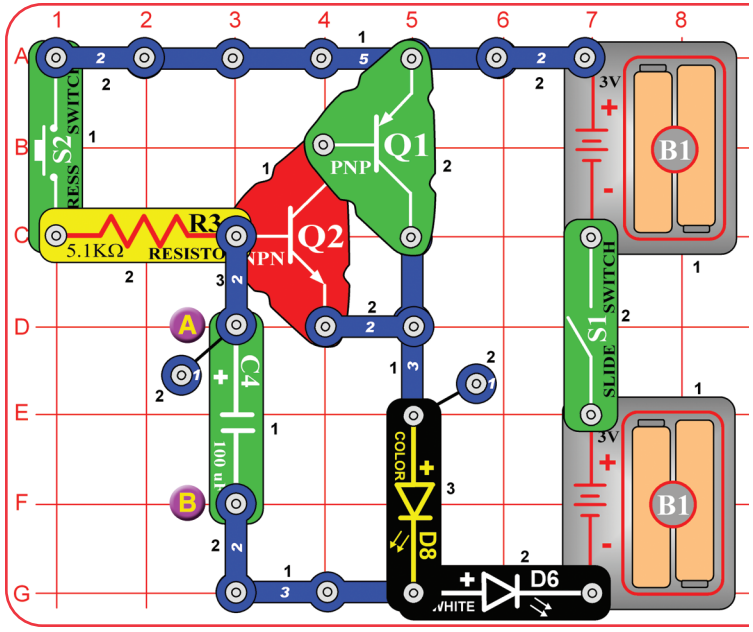


Light Buzz

Turn on the switch (S1). If there is enough light on the phototransistor (Q4), then nothing will happen. Cover the phototransistor with your finger, now the speaker (SP) makes noise and the color LED (D8) flashes. Wave your fingers over the phototransistor to vary the sound.

Replace the color LED with the red or white LEDs (D1 & D6). The light and sound will be a little different.

☐ Project 172



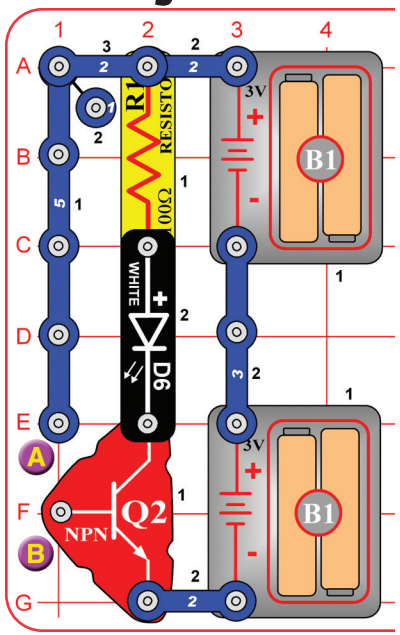
Delay Lights

Turn on the slide switch (S1), and push the press switch (S2). The color and white LEDs (D6 & D8) come on slowly but will stay bright for a long time after you release the press switch. Connect the red jumper wire across points A & B if you get tired of waiting for the LEDs to turn off.

Replace the 5.1kΩ resistor with the 100kΩ resistor. Now you have to push the press switch for much longer to make the LEDs bright.

Replace the 100μF capacitor (C4) with the smaller 0.1μF capacitor (C2). Now the LEDs turn on and off much faster, because C2 does not store as much electricity as C4.

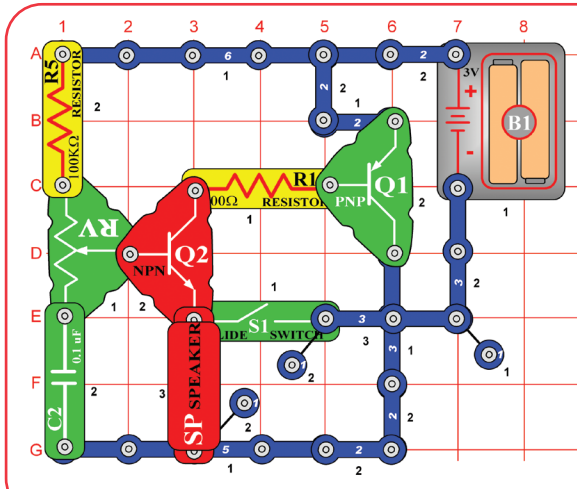
☐ Project 173 Touch Light



Build the circuit. It doesn't do anything, and may appear to be missing something. It is missing something, and that something is you.

Touch points A & B with your fingers. The white LED (D6) may be lit. If isn't bright, then you are not making a good enough electrical connection with the metal. Try pressing harder on the snaps, or wet your fingers with water or saliva. The LED should be bright now. You can replace the white LED with the red or color LEDs (D1 & D8).

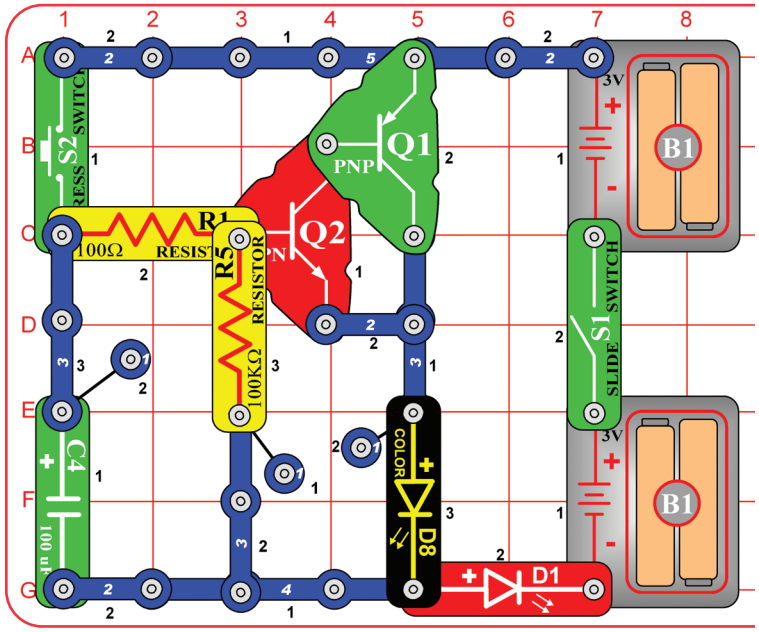
☐ Project 174 Narrow Range Tone



Turn on the switch (S1) and move the lever on the adjustable resistor (RV) around. The circuit makes a tone sound, but only over a small range of settings on RV.

Replace the 100kΩ resistor (R5) with the 5.1kΩ resistor (R3). The tone is a little different now.

☐ Project 175



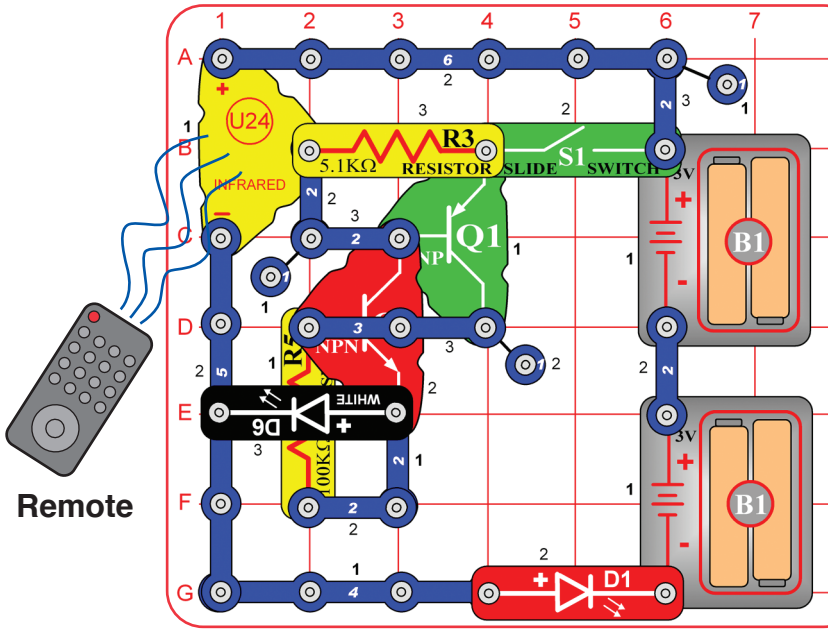
Slow Off Lights

Turn on the slide switch (S1), and push the press switch (S2). The red and color LEDs (D1 & D8) stay on for a few seconds after you release the press switch.

You can change how long the LEDs stay on for by replacing the 100μF capacitor with the 0.1μF capacitor, by replacing the 100kΩ resistor (R5) with the 5.1kΩ resistor (R3), or by removing the 100kΩ resistor.

For more fun, try swapping the locations of the LEDs, or replacing either with the white LED (D6).

☐ Project 176



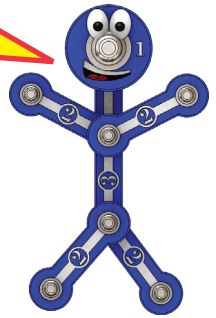
Super Infrared Detector

You need an infrared remote control for this project, such as any TV/stereo/DVD remote control in your home.

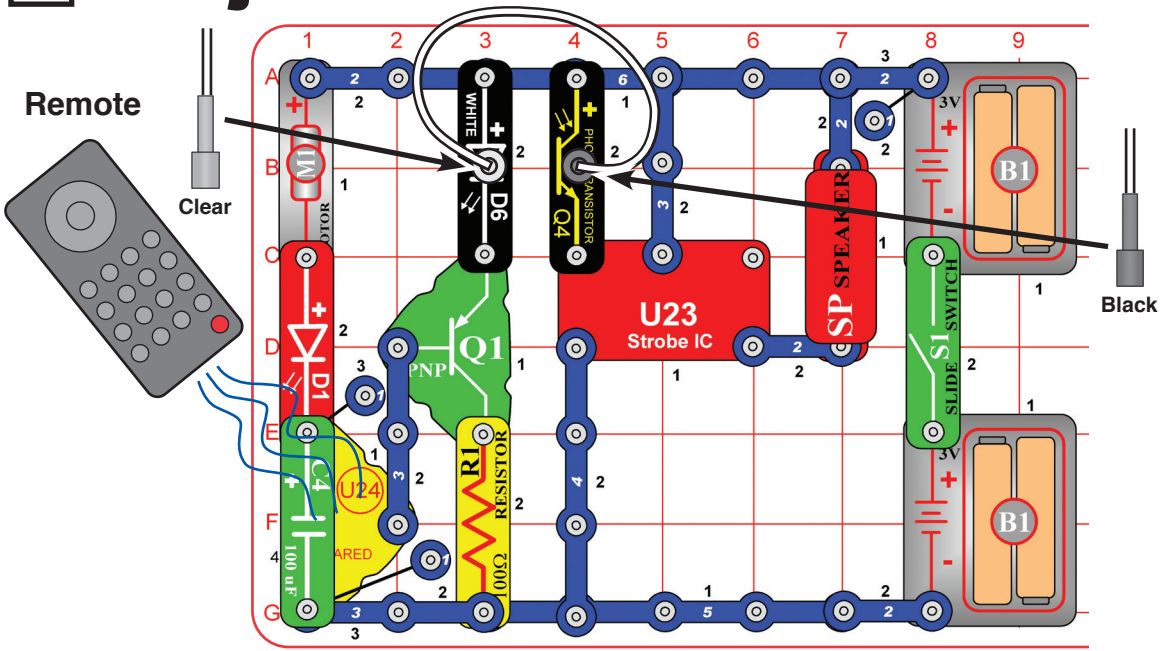
Build the circuit. The red LED (D1) will be dim. Turn on the switch (S1). Point your remote control toward the infrared module (U24) and press any button to activate the white LED (D6). Once activated, the white LED stays on until the switch is turned off.

Note: This circuit can activate without a remote control, due to infrared in sunlight or some room lights. If this happens, try moving to a dark room.

Infrared light can be given off by anything warm. Sunlight and room lights emit some infrared light, in addition to visible light. This circuit is very sensitive, and may often be activated without a remote control. TV remote control receivers look for a sequence of pulses that identify an infrared message directed to their TV set model, so will not be activated by sunlight or room lights.



☐ Project 177



Infrared Optical Audio

You need an infrared remote control for this project, such as any TV/stereo/DVD remote control in your home.

Build the circuit as shown. Place the clear cable holder on the white LED (D6) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.

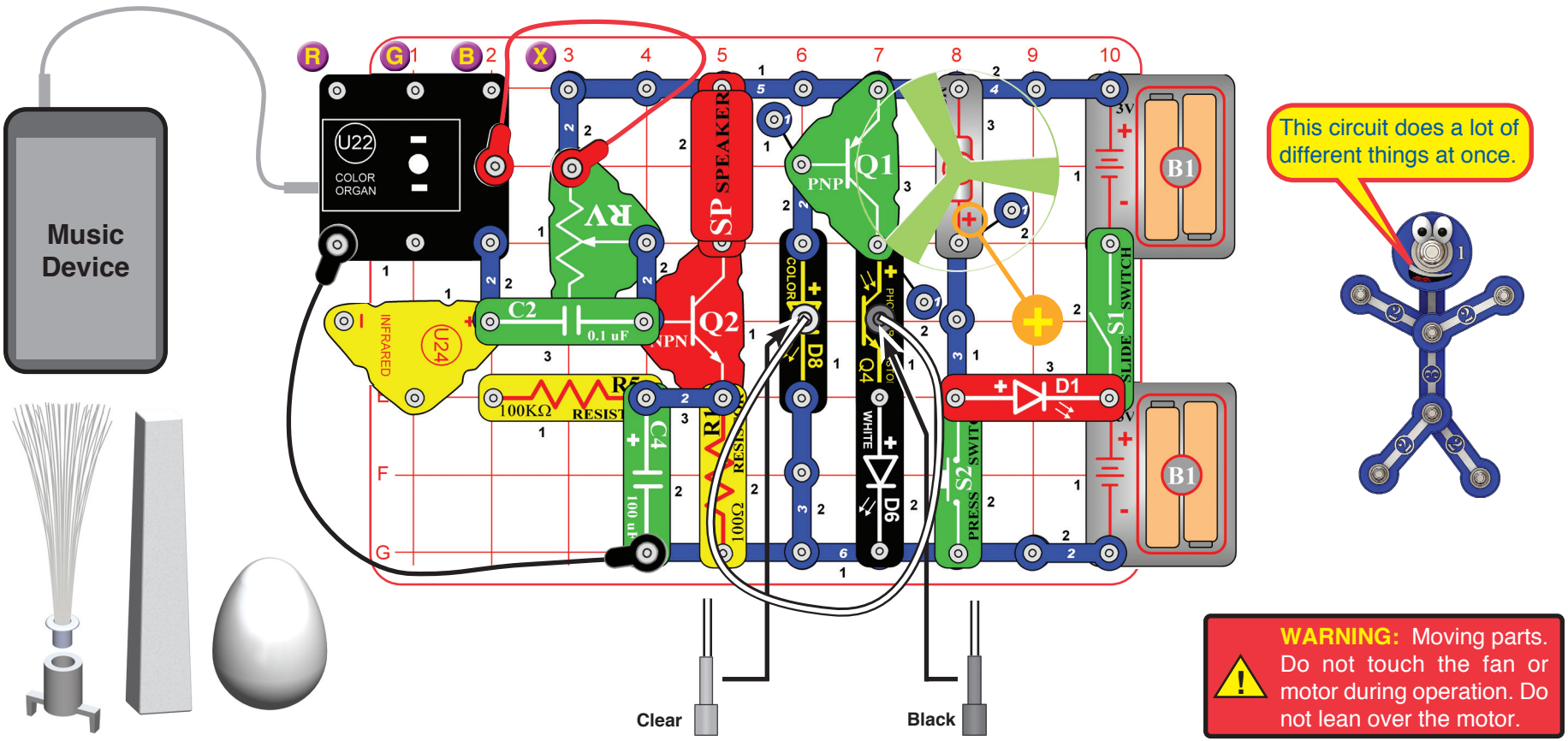
Turn on the switch (S1). Point your remote control toward the infrared module (U24) and press any button to activate the white LED (D6). Light is transmitted from the white LED, through the fiber optic cable, to control the strobe IC (U23) and speaker (SP).

The motor (M1) is used as a 3-snap here, and will not spin. Sometimes this circuit may activate without a remote control, due to infrared in sunlight or some room lights. You may get better results in a dark room.

Bonus Project 1

Requires connection to a music device (not included)

Big Circuit - Music



LED Attachments

This bonus project requires connection to a music device (not included).

Build the circuit as shown. Place either the glow fan or the light fan on the motor (M1) shaft, so that it is stable on the little black piece. Place the clear fiber optic holder on the color LED (D8) and the black fiber optic holder on the phototransistor (Q4), then insert the fiber optic cable between them, but don't let it lay close to the fan on the motor. For best performance the fiber optic cable should stand straight up in the holders, without bending them. Connect a music device to the color organ (U22) as shown, and start music on it. For best effects, place one of the LED attachments over the light on the color organ.

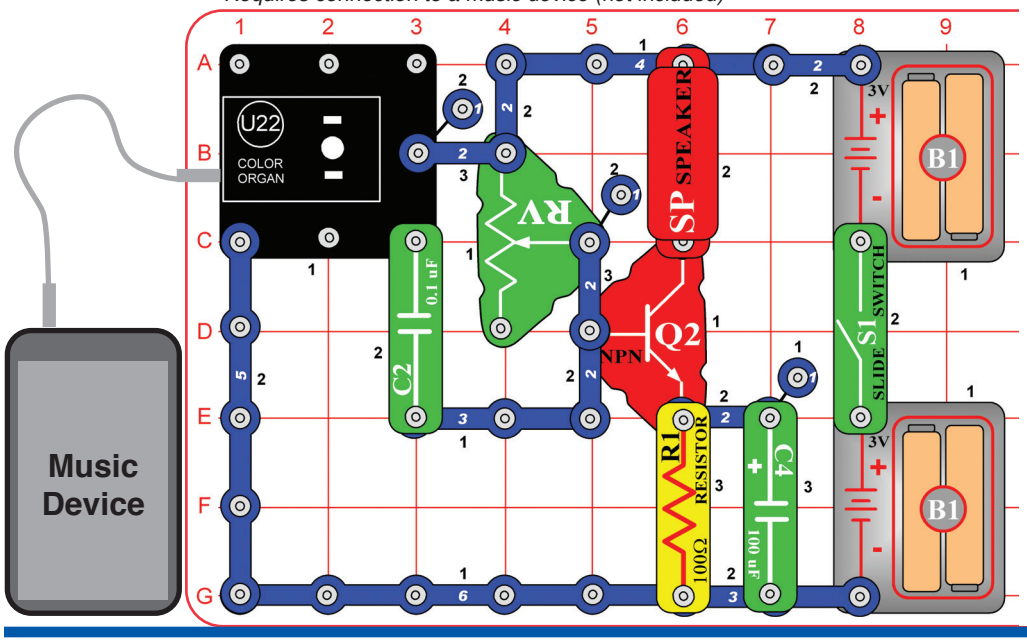
Turn on slide switch (S1). Adjust the lever on the adjustable resistor (RV) and the volume control on your music device for best sound and light effects. Push the press switch (S2) until the motor reaches full speed, then release it. The fan will rise into the air like a flying saucer.

"Playing the Color Organ": turn off or disconnect your music device. Wet your fingers, and touch them between the point marked "X", and "R", "G", or "B" in the drawing.

The infrared detector (U24) and 100kΩ resistor (R5) are only used to support the other components.

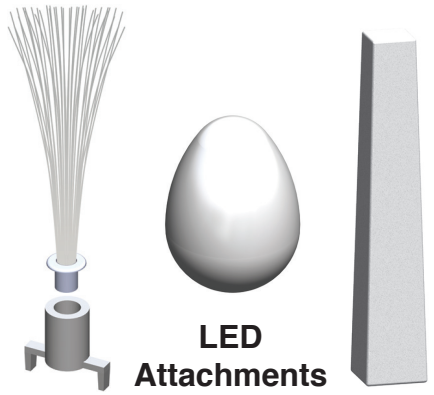
☐ Bonus Project 2

Requires connection to a music device (not included)



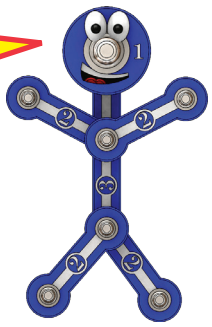
Dance to the Music

Build the circuit. Connect a music device (not included) to the color organ (U22) as shown, and start music on it. Place one of the LED attachments over the light on the color organ. Set the lever on the adjustable resistor (RV), and the volume control on your music device, for best sound quality and light effects. The color organ light will "dance" in synch with the music. Compare fast and slow songs, and different loudness levels.



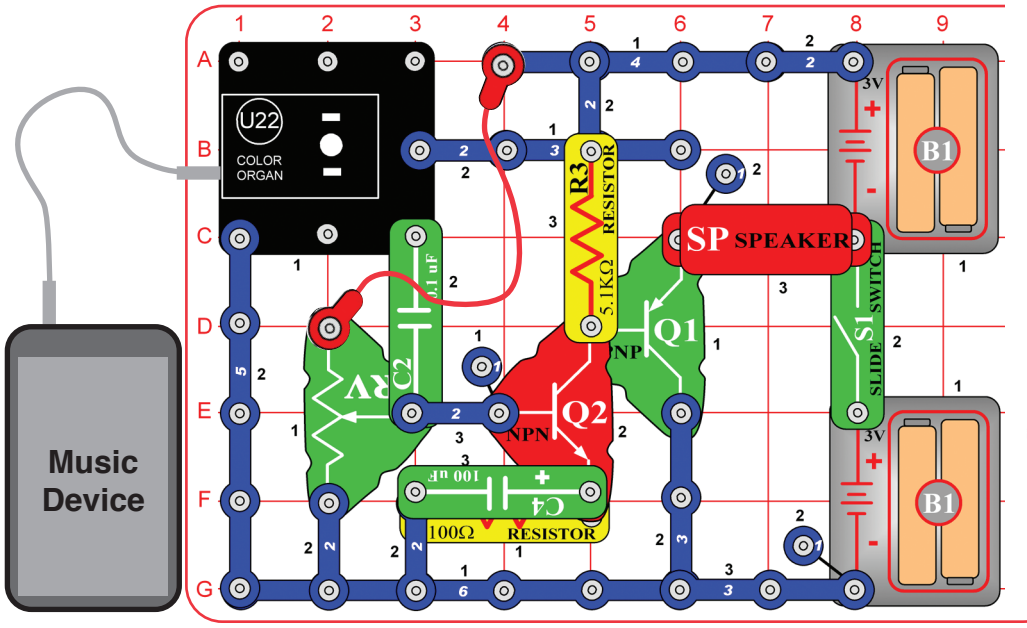
LED Attachments

This circuit amplifies the music so it can be heard on the speaker. This is a simple circuit, so sound quality may not be as good as your other music players.



☐ Bonus Project 3

Requires connection to a music device (not included)

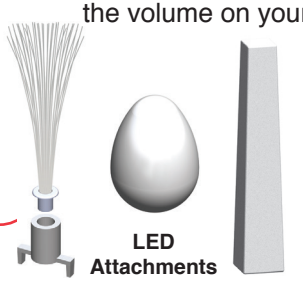


Super Dance to the Music

This circuit is similar to the preceding one, but louder and more sensitive. Build the circuit as shown. Connect a music device (not included) to the color organ (U22) as shown, and start music on it, set the volume to mid-range. Place one of the LED attachments over the light on the color organ. Turn on the switch (S1) and SLOWLY ADJUST the lever on the adjustable resistor (RV) for best sound; there will only be a narrow range where the sound is clear. Adjust the volume on your music device for best sound quality.

☐ Bonus Project 4 Super Dance to the Music (II)

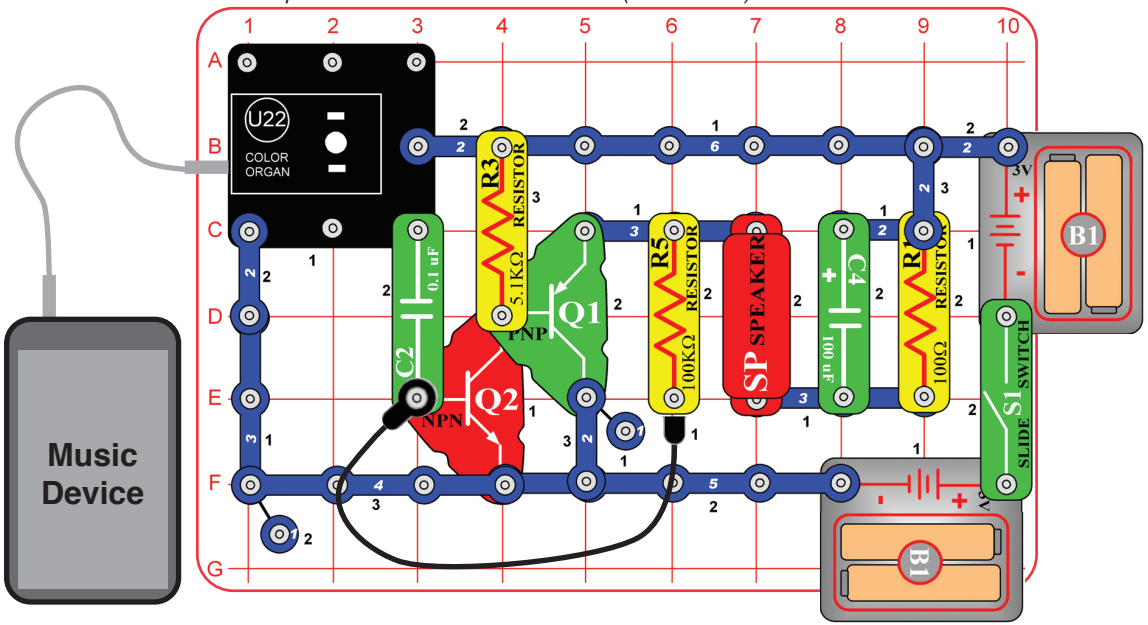
Use the preceding circuit, but remove the 100μF capacitor (C4). The sound will not be as loud, but will be less distorted. Adjust RV and the volume on your music device for best sound.



LED Attachments

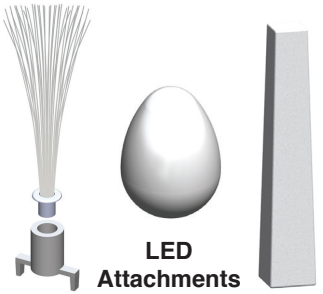
Bonus Project 5

Requires connection to a music device (not included)



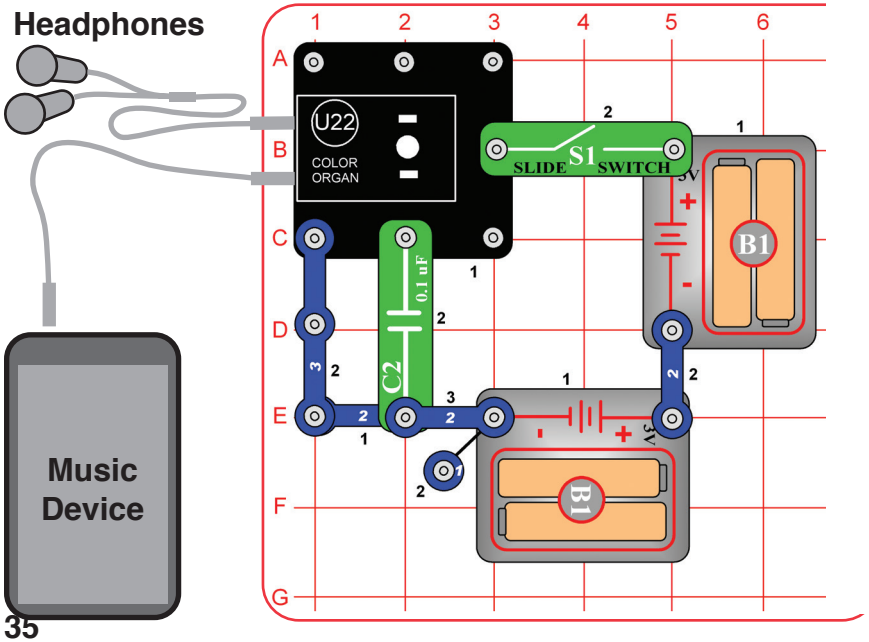
Follow the Music

Build the circuit. Connect a music device (not included) to the color organ (U22) as shown, and start music on it. For best effects, place one of the LED attachments over the light on the color organ. Set the volume control on your music device for best sound quality and light effects. The color organ light will “dance” in synch with the music. Compare fast and slow songs, and different loudness levels.



Bonus Project 6

Requires connection to a music device (not included) and headphones (not included).

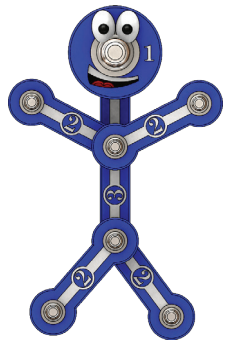


Color Organ - Headphones

Build the circuit. Connect a music device (not included) and your own headphones (not included) to the color organ (U22) as shown, and start music on it. For best effects, place one of the LED attachments over the light on the color organ. Set the volume control on your music device for best sound quality and light effects. The color organ light will “dance” in synch with the music.

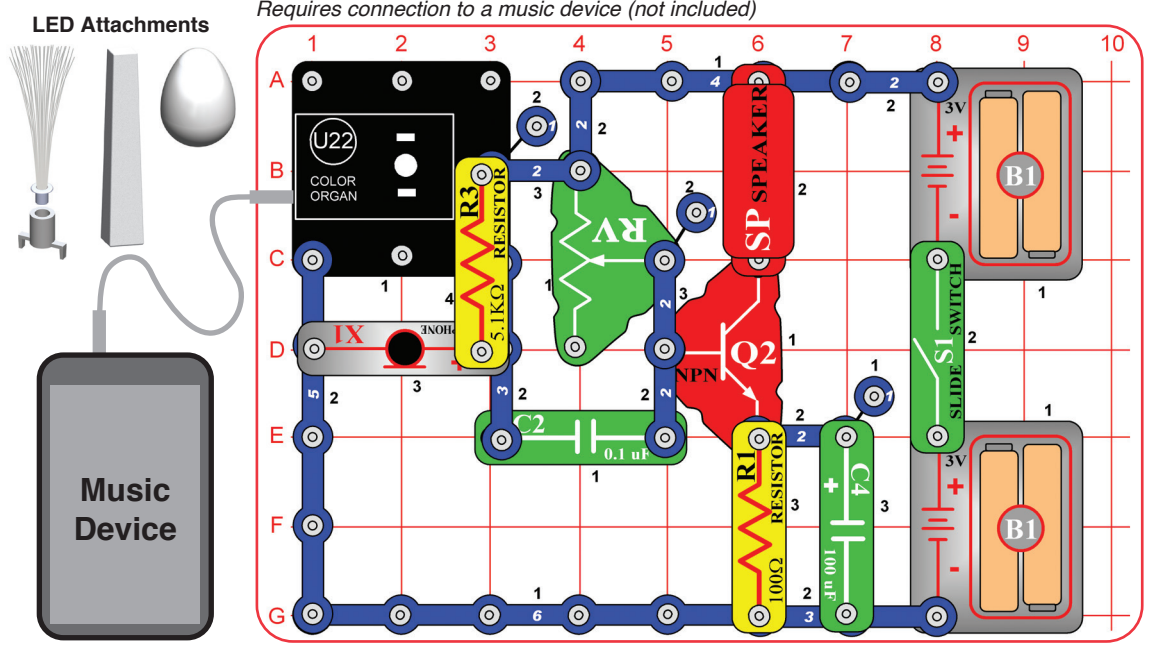
Output signal to headphones is mono, so you will not hear stereo effects.

Compare the sound quality of using headphones in this circuit, to using the speaker in the preceding circuit.



Bonus Project 7 Light Dance Audio Override

Requires connection to a music device (not included)



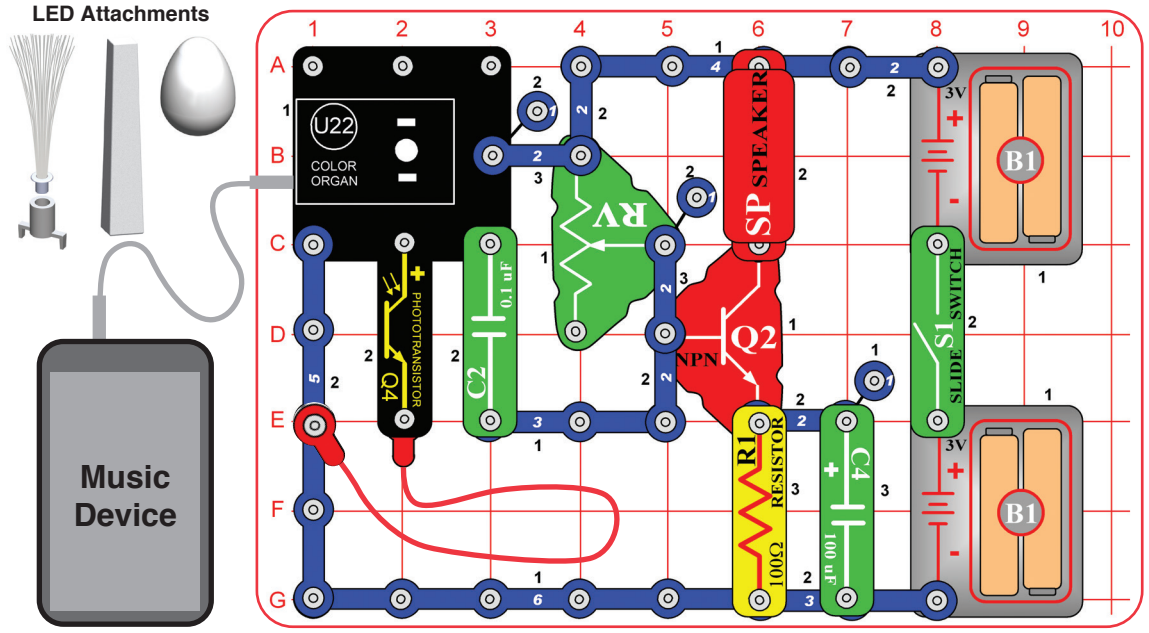
Build the circuit, which is similar to project 34 (Dance to the Music). Connect a music device (not included) to the color organ (U22) as shown, and start music on it. Place one of the LED attachments over the light on the color organ. Set the lever on the adjustable resistor (RV), and the volume control on your music device, for best sound quality and light effects. The color organ light will “dance” in synch with the music.

For the next part, you need the color organ light to be changing slowly. Set your music device to play a song with a slow beat, and set the volume control on it so the sound is not very loud.

Now blow on the microphone (X1) or talk loud directly into it. The dancing light pattern should be interrupted by your blowing/talking. If you don’t notice any difference then lower the volume control on your music device. Songs with a slower beat work best for this.

Bonus Project 8 Light Dance Light Override

Requires connection to a music device (not included)



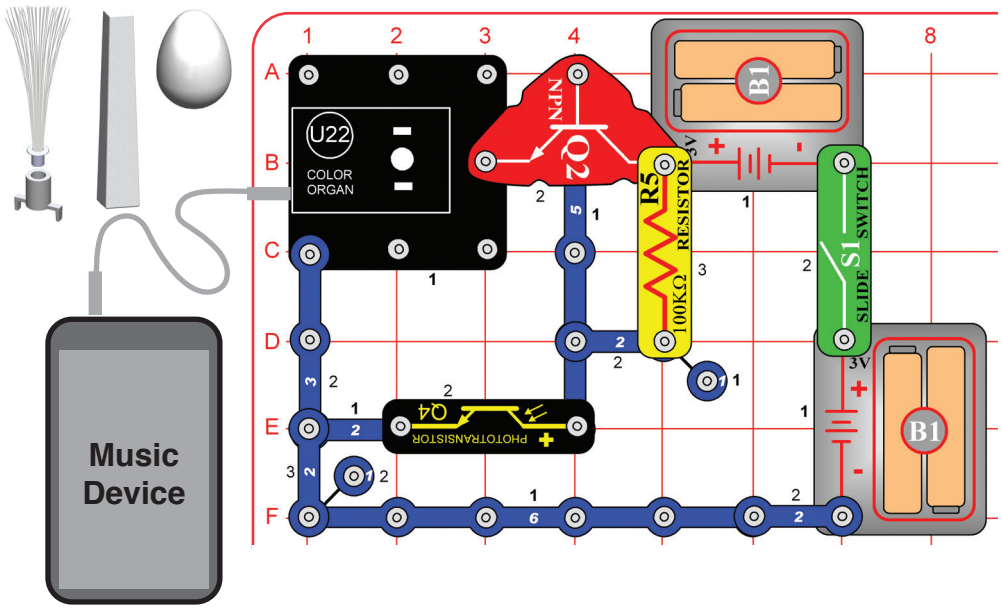
Build the circuit, which is similar to Bonus project 2 (Dance to the Music). Connect a music device (not included) to the color organ (U22) as shown, and start music on it. Place one of the LED attachments over the light on the color organ. Cover the phototransistor (Q4) with your hand and set the lever on the adjustable resistor (RV), and the volume control on your music device, for best sound quality and light effects. The color organ light will “dance” in synch with the music.

Uncover the phototransistor and shine a bright light on it. The color organ light will stop changing until you re-cover the phototransistor. The music will not be affected.

☐ Bonus Project 9

LED Attachments

Requires connection to a music device (not included)



Night Light Show

Build the circuit as shown. Connect a music device (not included) to the color organ (U22) as shown, and start music on it. Place one of the LED attachments over the light on the color organ. Turn on the switch (S1), then cover the phototransistor (Q4) to see a light show. Adjust the volume on your music device for best light effects.

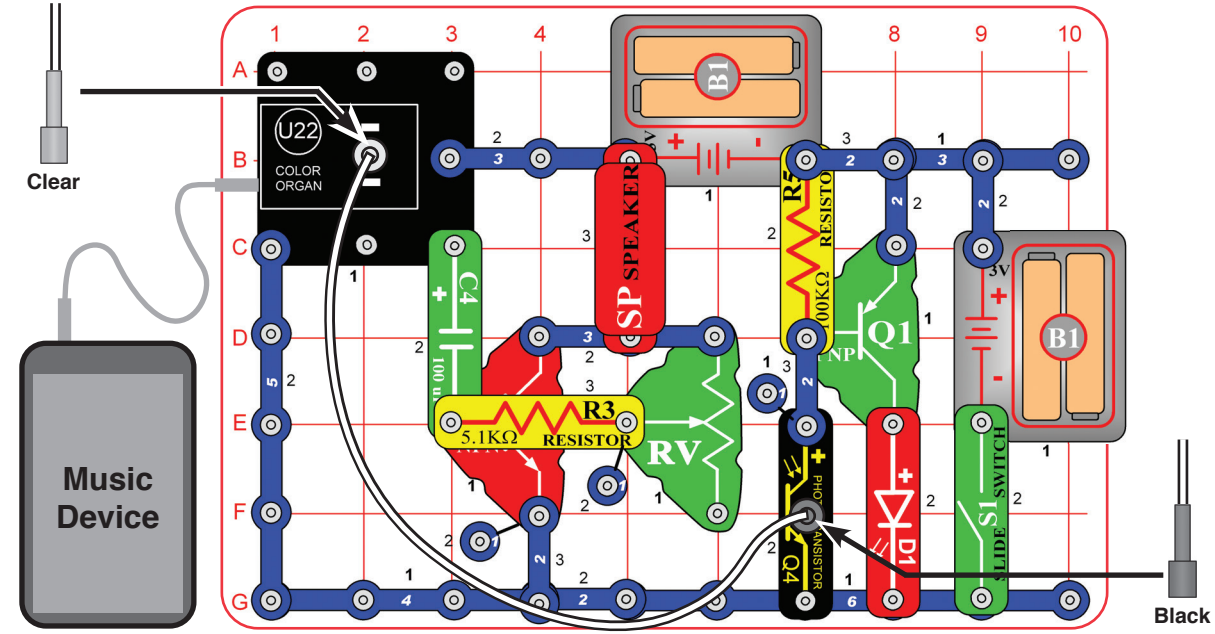
Replace the 100kΩ resistor (R5) with the 5.1kΩ resistor (R3) to make the light brighter.

☐ Bonus Project 10 Daylight Light Show

Use the preceding circuit, but swap the locations of the phototransistor (Q4) and the 100kΩ resistor (R5), put the "+" side of Q4 towards the NPN transistor (Q2). Now covering the phototransistor turns off the light show.

☐ Bonus Project 11

Requires connection to a music device (not included)



Fiber Music

Build the circuit as shown. Place the clear cable holder on the color organ (U22) and the black cable holder on the phototransistor (Q4), then place the fiber optic cable into the holders as far as it will go. For best performance the fiber optic cable should stand straight up in the holders, without bending them.The clear holder will be a loose fit.

Connect a music device (not included) to the color organ as shown, and start the music on it. The music plays on the speaker (SP) while the LED on the color organ controls the red LED (D1) through the fiber optic cable. Set the volume control on your music device for best light & sound effects.

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