Elenco®

Learn by doing®

American Printing House for the Blind

Snap Circuits® Junior Instructional Manual

Instructions and Labels for Project Builders who are blind or low vision.

Projects 1–130
Ages 8–108

Table of Contents

⚠ **WARNING FOR ALL PROJECTS WITH A ⚠ SYMBOL** - Moving parts. Do not touch the motor or fan during operation. Do not lean over the motor. Do not launch the fan at people, animals, or objects. Eye protection is recommended. ⚠

⚡ **WARNING: SHOCK HAZARD** - Never connect Snap Circuits to the electrical outlets in your home in any way!

⚠ **WARNING: CHOKING HAZARD** - Small parts. Not for children under 3 years.

WARNING: Always check your wiring before turning on a circuit. Never leave a circuit unattended while the batteries are installed. Never connect additional batteries or any other power sources to your circuits. Discard any cracked or broken parts.

Adult Supervision: Because children's abilities vary so much, even within age groups, adults should exercise discretion as to which experiments are suitable and safe (the instructions should enable supervising adults to establish the experiment's suitability for the child). Make sure your child reads and follows all of the relevant instructions and safety procedures and keeps them at hand for reference. This product is intended for use by adults and children who have attained sufficient maturity to read and follow directions and warnings. Never modify the parts, as doing so may disable important safety features in them and could put your child at risk of injury.

Basic Troubleshooting

1. Most circuit problems are due to incorrect assembly; always double-check that your circuit exactly matches the written instruction for it.
2. Be sure that parts with positive/negative markings are positioned as per the grid number listed in the instructions.
3. Be sure that all connections are securely snapped.
4. Try replacing the batteries.
5. If the motor spins but does not balance the fan, check the black plastic piece with three prongs on the motor shaft. Be sure that it is at the top of the shaft.

Elenco is not responsible for parts damaged due to incorrect wiring.

Note: If you suspect you have damaged parts, you can follow the Advanced Troubleshooting procedure to determine which ones need replacing.

Conforms to all applicable U.S. government requirements and CAN ICES-3 (B)/NMB-3 (B).

⚠ **Batteries:**

- Use only 1.5V AA type, alkaline batteries (not included).
- Insert batteries with correct polarity.
- Non-rechargeable batteries should not be recharged. Rechargeable batteries should only be charged under adult supervision and should not be recharged while in the product.
- Do not mix old and new batteries.
- Do not connect batteries or battery holders in parallel.
- Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- Remove batteries when they are used up.
- Do not short circuit the battery terminals.
- Never throw batteries in a fire or attempt to open its outer casing.
- Batteries are harmful if swallowed, so keep away from small children.

Parts List

Important: If any parts are missing or damaged, **DO NOT RETURN TO RETAILER**. Call toll-free (800) 533-2441 or email us at: help@elenco.com. Customer Service, 150 Carpenter Ave., Wheeling, IL, 60090, U.S.A.

You may order additional/replacement parts at our website: www.elenco.com/replacement-parts.

All parts have braille labels except those that are very distinctive and cannot be confused with other parts, such as the battery pack, speaker, or fan blade. Some parts have an additional label showing the positive terminal or, in the case of the integrated circuit parts (U1, U2, and U3), the location of terminal 1. Some pieces serve only to connect other parts and are referred to by the number of snaps on their top surface, such as "2-snap" or "5-snap".

Each step in the instructions below gives the name of a part followed by the coordinates where it is placed. For example, the instruction "Place S1 switch A5-C5" means to snap the switch labeled S1 onto the pegs at A5 and C5. When the orientation of a part matters, this is noted in the instructions; otherwise, you may assume that there is not a right or wrong direction for placing a part.

Qty.	ID	Name	Part #
3		2-Snap Wire	6SC01
5		2-Snap Wire	6SC02
3		3-Snap Wire	6SC03
1		4-Snap Wire	6SC04
1		5-Snap Wire	6SC05
2		Battery Holder - uses 2 1.5V type AA (not Included)	6SCB1
1		Base Grid Mini (11.0" x 7.7")	6SCBG
1	D8	Color LED	6SCD8
1		Jumper Wire (Black)	6SCJ1
1		Jumper Wire (Red)	6SCJ2
1	L1	3V Lamp	6SCL1
1	R4	Resistor 10kΩ	6SCR4
1	M1	Motor	6SCM1
1	M4	Motor	6SCM4
1	Wi	Horn	6SCMW1
1		Fan	6SCM1F
1		Wind Fan	65CM4B
1	RP	Photoresistor	6SCRP
1	S1	Slide Switch	6SCS1
1	S2	Press Switch	6SCS2
1	SP	Speaker	6SCSP
1	U1	Music Integrated Circuit	6SCU1
1	U2	Alarm Integrated Circuit	6SCU2
1	U3	Space War Integrated Circuit	6SCU3
1	WC	Whistle Chip	6SCWC

How to Use It

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

For Example:
The switch block is green and has the marking S1 on it.

A wire block is blue and comes in different wire lengths. A wire block has the number 2, 3, 4, or 5 printed on it depending on the length of the wire connection required. You can count the number of snap connectors to determine the number needed.

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

To build each circuit, you have a power source block number that needs two (2) "AA" batteries (not included with the Snap Circuits kit).

When installing a battery, be sure the spring is compressed straight back, and not bent up, down, or to one side. Battery installation should be supervised by an adult.

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

Next to each part in every circuit drawing is a small number in black. This tells you which level the component is placed at. Place all parts on level 1 first, then all of the parts on level 2, then all of the parts on level 3, etc. Within each project, there is a list of "Parts Needed," and below that, a description of which layer they are to be placed and the grid coordinates to place them. Place all parts on level 1 first, then all of the parts on level 2, then all of the parts on level 3, etc.

Some circuits use the jumper wires to make unusual connections. Just clip them to the metal snaps or as indicated. The colors are interchangeable, so it doesn't matter which color you use.

When the motor (M1) is used, the fan will usually be placed on it. On top of the motor shaft is a black plastic piece (the motor top) with three little tabs. Lay the fan on the black piece so the slots in its bottom "fall into place" around the three tabs in the motor top. If not placed properly, the fan will fall off when the motor starts to spin.

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

About Your Snap Circuits Parts

(Part designs are subject to change without notice).

Base Grid

The **base grid** is a platform for mounting parts and wires. It functions like the printed circuit boards used in most electronic products, or like how the walls are used for mounting the electrical wiring in your home. The Snap Circuits board has rows lettered from A to G (7 rows of pegs), and columns numbered 1 to 10 (10 columns of pegs). The rows are labeled with slightly embossed characters, from A at the top through G at the bottom (closest to you). The columns are labeled from 1 at the left through 10 at the right. Because the characters lack visual contrast, you may want to make small paper stickers with print lettering to mark the rows and columns or write directly on the board with a permanent marker. The instructions for each project will use these coordinates for parts placement.

If you take a few minutes to practice the exercises below, it will prove useful before you begin building projects. Knowing how to place parts in the right locations will ensure that your projects work properly and save you from the frustration that comes when they're misplaced!

Most of the projects involve separate "layers," that is, snapping parts on top of other parts. When the pegs you are looking for are already covered up, your skill in finding coordinates with confidence will pay off.

<u>Practice Exercise 1:</u>
Name a coordinate pair (such as F4, A3, or C6) and then point to the peg at that location. Hold your finger on the peg while you double-check your

answer. Repeat this numerous times using different coordinates all over the board.

Practice Exercise 2:
Reverse the previous exercise by first pointing to a peg anywhere on the board and then naming its coordinates.

Repeat both exercises with different locations until you are confident and accurate with your answers.

Snap Wires & Jumper Wires

The blue **snap wires** are plastic strips with wires embedded in them and are used to connect other components. They are used to transport electricity and do not affect circuit performance. They come in different lengths to allow orderly arrangement of connections on the base grid. Count the snaps to determine which snap wire corresponds to the instructions of the project you are building.

The red and black **jumper wires** make flexible connections for times when using the snap wires would be difficult. They also are used to make connections off the base grid. Although the instructions refer to wire colors, the wires all work the same way, and are interchangeable.

Wires transport electricity just like pipes are used to transport water. The colorful plastic coating protects them and prevents electricity from getting in or out.

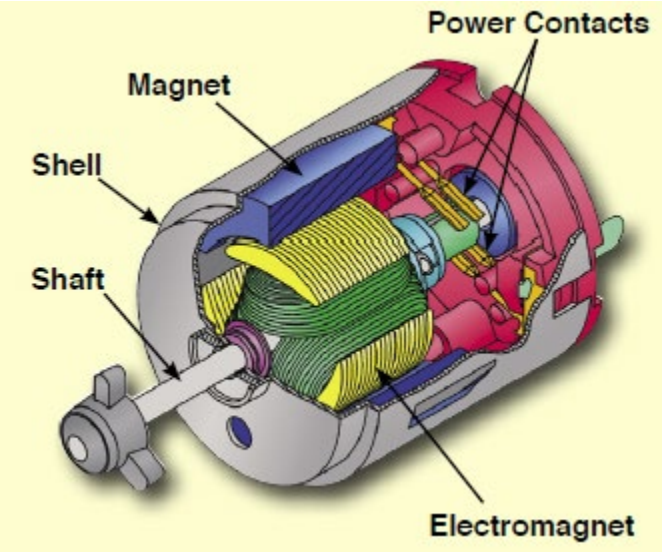
Battery Holder

The **batteries (B1)** produce an electrical voltage using a chemical reaction. This "voltage" can be thought of as electrical pressure, pushing electrical "current" through a circuit. This voltage is much lower and much safer than that used in your house wiring. Using more batteries increases the "pressure" and so more electricity flows. The negative, or flat bottom of the battery always faces the spring. To install the batteries, locate the spring in each cavity. The negative, or flat side of the battery goes on the spring, and the positive lug of the battery goes on the metal tab side of the cavity. Positive and negative poles alternate with each battery.

Motor

The **motor (M1 and M4)** converts electricity into mechanical motion. An electric current in the motor will turn the shaft and the motor blades, and the fan blade if it is on the motor.

How does electricity turn the shaft in the motor? The answer is magnetism. Electricity is closely related to magnetism, and an electric current flowing in a wire has a magnetic field similar to that of a very, very tiny magnet. Inside the motor is a coil of wire with many loops wrapped around metal plates. This is called an electromagnet. If a large electric current flows through the loops, it will turn ordinary metal into a magnet. The motor shell also has a magnet on it. When electricity flows through the electromagnet, it repels from the magnet on the motor shell and the shaft spins. If the fan is on the motor shaft, then its blades will create airflow.



Color LED

The **color LED (D8)** is a light emitting diode and may be thought of as a special one-way light bulb. In the "forward" direction (indicated by the "arrow" in the symbol), electricity flows if the voltage exceeds a turn-on threshold (about 1.5V for red, about 2.0V for green, and about 3.0V for blue); brightness then increases. The color LED contains red, green, and blue LEDs, with a micro-circuit controlling them. A high current will burn out an LED, so the color LED has an internal resistor to protect it. The unidirectional LED is labelled D8 with the braille label on the positive side. It faces forward when the braille label is on the right. It is very important to adhere to the instructions and place the positive snap on the exact coordinates specified by that project's instructions.

Slide & Press Switches

The **slide & press switches (S1 & S2)** connect (pressed or "ON") or disconnect (not pressed or "OFF") the wires in a circuit. When ON they have

no effect on circuit performance. Switches turn on electricity just like a faucet turns on water from a pipe. The switch has a braille S1 label and is in the open, or "ON" position, when moved to the side with the braille S1 label.

Photoresistor

Resistors "resist" the flow of electricity and are used to control or limit the current in a circuit. The **photoresistor (RP)** is a light-sensitive resistor; its value changes from nearly infinite in total darkness to about 1,000Ω when a bright light shines on it.

Speaker

The **speaker (SP)** converts electricity into sound by making mechanical vibrations. These vibrations create variations in air pressure, which travel across the room. You "hear" sound when your ears feel these air pressure variations.

Whistle Chip

The **whistle chip (WC)** contains two thin plates. When an electrical signal is applied across them, they will stretch slightly in an effort to separate (like two magnets opposing each other); when the signal is removed, they come back together. If the electrical signal applied across them is changing quickly, then the plates will vibrate. These vibrations create variations in air pressure that your ears feel just like sound from a speaker.

Horn

The **horn (W1)** converts electricity into sound by making mechanical vibrations. These vibrations create variations in air pressure which travel across the room. You "hear" sound when your ears feel these air pressure variations. The horn is labelled W1, is unidirectional, and has the braille W1 label on its positive side.

Electronic Modules

The **music, alarm, and space war ICs (U1, U2, and U3)** contain specialized sound-generation ICs and other supporting components (resistors, capacitors, and transistors) that are always needed with them. This was done to simplify the connections you need to make to use them. Schematics for them are available at www.elenco.com/FAQs.

Music IC (U1)
Both positive and negative sides will be indicated with a braille label. A description for this module is given here for those interested. With the positive braille label of the unit up, starting with the top-center snap at twelve o'clock and moving clockwise, each snap's function is listed below:

- (+) - power from batteries
- HLD - hold control input
- OUT - output connection
- (–) - power return to batteries
- TRG - trigger control input

Music should play for a few seconds on power-up, then hold HLD to (+) power or touch TRG to (+) power to resume music.

Alarm IC (U2)
The negative side is indicated with a braille label. A description for this module is given here for those interested. With the negative braille label of the unit down, starting with the bottom-left snap at ten o'clock and moving clockwise, each snap's function is listed below:

(–) - power return to batteries
IN1, IN2, IN3 - control inputs
OUT - output connection

Connect control inputs to (+) power to make five alarm sounds; see projects 21-24 for configurations.

Space War IC (U3)
Both positive and negative sides are indicated with a braille label. A description for this module is given here for those interested. With the positive braille label of the unit up, starting with the top left-hand snap at eleven o'clock and moving clockwise, each snap's function is listed below:

- (+) - power from batteries
- OUT - output connection
- IN2 - control input
- (–) - power return to batteries
- IN1 - control input

Connect each control input to (–) power to sequence through 8 sounds.

Lamp

A light bulb, such as in the **3V lamp (L1)**, contains a special thin high-resistance wire. When a lot of electricity flows through, this wire gets so hot it glows bright. Voltages above the bulb's rating can burn out the wire.

Introduction to Electricity

What is electricity? Nobody really knows. We only know how to produce it, understand its properties, and how to control it. Electricity is the movement of sub-atomic charged particles (called **electrons**) through a material due to electrical pressure across the material, such as from a battery.

Power sources, such as batteries, push electricity through a circuit, like a pump pushes water through pipes. Wires carry electricity, like pipes carry water. Devices like LEDs, motors, and speakers use the energy in electricity to do things. Switches and transistors control the flow of electricity like valves and faucets control water. Resistors limit the flow of electricity.

The electrical pressure exerted by a battery or other power source is called **voltage** and is measured in **volts** (V). Notice the "+" and "–" signs on the battery; these indicate which direction the battery will "pump" the electricity.

The **electric current** is a measure of how fast electricity is flowing in a wire, just as the water current describes how fast water is flowing in a pipe. It is expressed in **amperes** (A) or **milliamps** (mA, 1/1000 of an ampere).

The "**power**" of electricity is a measure of how fast energy is moving through a wire. It is a combination of the voltage and current (Power = Voltage x Current). It is expressed in **watts** (W).

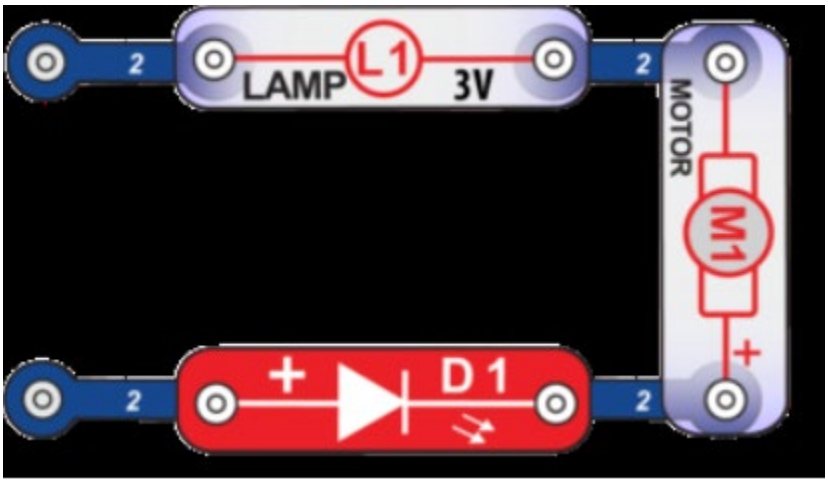
The **resistance** of a component or circuit represents how much it resists the electrical pressure (voltage) and limits the flow of electric current. The relationship is Voltage = Current x Resistance. When the resistance increases, less current flows. Resistance is measured in **ohms** (Ω), or **kilo ohms** (kΩ, 1000 ohms).

Nearly all of the electricity used in our world is produced at enormous generators driven by steam or water pressure. Wires are used to efficiently transport this energy to homes and businesses where it is used. Motors convert the electricity back into mechanical form to drive machinery and appliances. The most important aspect of electricity in our society is that it allows energy to be easily transported over distances.

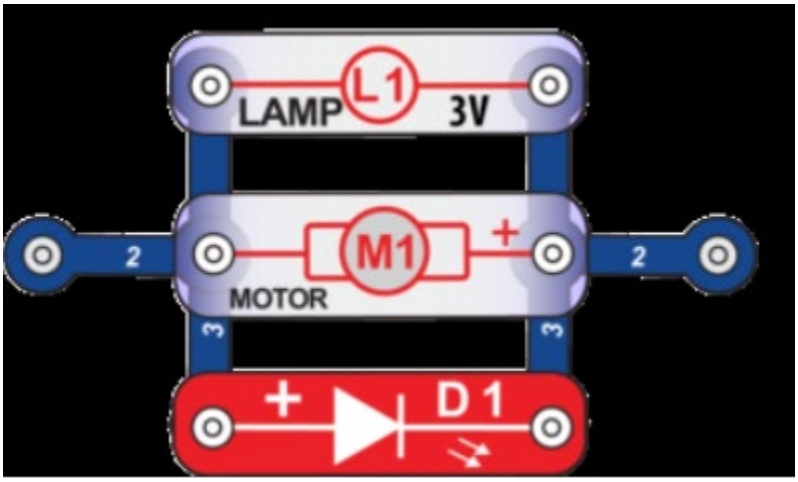
Note that “distances” includes not just large distances but also tiny distances. Try to imagine a plumbing structure of the same complexity as the circuitry inside a portable radio — it would have to be large because we can’t make water pipes so small. Electricity allows complex designs to be made very small.

There are two ways of arranging parts in a circuit, in series or in parallel. Here are examples:

Series Circuit



Parallel Circuit



Placing components in series increases the resistance; highest value dominates. Placing components in parallel decreases the resistance; lowest value dominates.

The parts within these series and parallel sub-circuits may be arranged in different ways without changing what the circuit does. Large circuits are made of combinations of smaller series and parallel circuits.

Do's and Don'ts of Building Circuits

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

Here are some important guidelines:

- **ALWAYS** use eye protection when experimenting on your own.
- **ALWAYS** include at least one component that will limit the current through a circuit, such as the speaker, lamp, whistle chip, ICs (which must be connected properly), motor, photoresistor, or resistor.
- **ALWAYS** use the LED and switches in conjunction with other components that will limit the current through them. Failure to do so will create a short circuit and/or damage those parts.
- **ALWAYS** disconnect your batteries immediately and check your wiring if something appears to be getting hot.
- **ALWAYS** check your wiring before turning on a circuit.
- **ALWAYS** connect ICs using configurations given in the projects or as per the connection descriptions for the parts.
- **NEVER** connect to an electrical outlet in your home in any way.
- **NEVER** leave a circuit unattended when it is turned on.
- **NEVER** touch the motor when it is spinning at high speed.

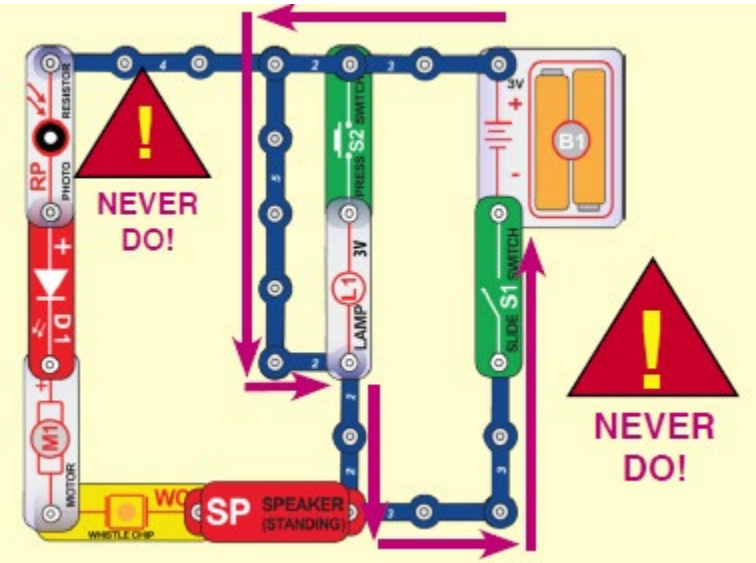
For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

Warning to Snap Circuits owners: Do not connect additional voltage sources from other sets, or you may damage your parts. Contact ELENCO if you have questions or need guidance.

Examples of SHORT CIRCUITS - **NEVER DO THESE!!!**

- Placing a 3-snap wire directly across the batteries is a SHORT CIRCUIT.
- Creating a path without resistance from positive to negative of the battery is a short circuit, no matter how long, and should not be done. An example of a longer short circuit is using the 5-snap connector from the positive with a jumper wire connected to the end. Then connecting that jumper wire to the negative is also a short circuit.

When the slide switch (S1) is turned on, this large circuit has a SHORT CIRCUIT path (as shown by the arrows). The short circuit prevents any other portions of the circuit from ever working.



You are encouraged to tell us about new circuits you create. If they are unique, we will post them with your name and state on our website at www.elenco.com/for-makers. Send your suggestions to Elenco: elenco@elenco.com.

Elenco provides a circuit designer so that you can make your own Snap Circuits drawings. This Microsoft® Word document can be downloaded from www.elenco.com/for-makers.

⚡WARNING: SHOCK HAZARD - Never connect Snap Circuits to the electrical outlets in your home in any way!

Advanced Troubleshooting (Adult supervision recommended)

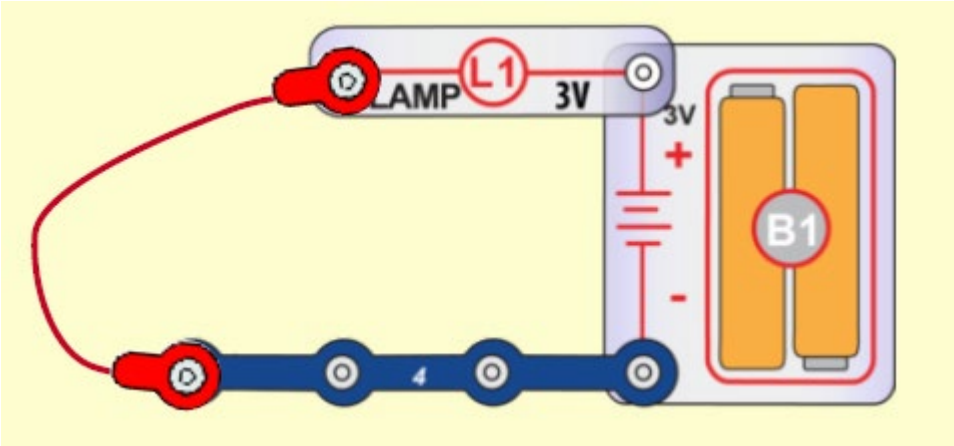
Elenco Electronics is not responsible for parts damaged due to incorrect wiring.

If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:

1. **3V lamp (L1), motor (M1), speaker (SP), color LED (D8), and battery holder (B1):** Place batteries in holder. Place the 3V lamp directly across the battery holder; it should light. Do the same with the motor (motor + to battery +); it should spin to the right at high speed. Next place the LED across the battery holder (LED + to battery +); the LED should light and change colors. Now "tap" the speaker across the battery holder contacts; you should hear static as it touches. If none work, then replace your batteries and repeat. If still bad, then the battery holder is damaged.

2. **Jumper wires:** Use this mini circuit to test each jumper wire; the lamp should light.

3. **Snap wires:** Use this mini circuit to test each of the snap wires, one at a time. The lamp should light.



4. **Slide switch (S1) and Press switch (S2):** Build project 1; if the lamp (L1) doesn't light then the slide switch is bad. Replace the slide switch with the press switch to test it.
5. **Alarm IC (U2):** Build project 21; you should hear a siren. Projects 22-24 should make different siren sounds.
6. **Whistle chip (WC):** Build project 29; you should hear sound from the whistle chip.

7. **Music IC (U1):** Build project 8, but initially leave out the whistle chip (WC). Turn on the slide switch (S1); music plays for a while and stops. Once the music stops push the press switch (S2); the music should play as long as you hold it down. Now add the whistle chip and tap it; the sound should resume for a while.
8. **Space war IC (U3) and photoresistor (RP):** Build project 6; both switches (S1 and S2) should change the sound. Then replace the slide switch with the photoresistor; waving your hand over it should change the sound.

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www.elenco.com/replacement-parts/

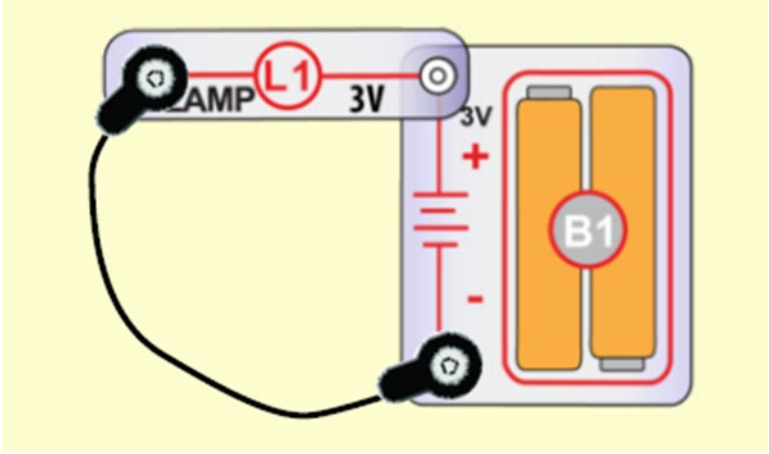
Project Instructions

Note: Each set of instructions starts with the battery pack on the first layer of instructions, because it is the source of power for each circuit. Since every project includes the battery pack, it may be worthwhile to practice placing it as instructed. The battery pack is square, but it has only two snaps, so it can be tricky to place properly until you are familiar with it. Make sure to place the positive terminal correctly!

Project 1: Electric Light

Snap Circuits uses electronic blocks that snap onto a clear plastic grid to build different circuits. These blocks have different colors and numbers on them so that you can easily identify them.

Build the circuit with the parts listed for each project. Follow the steps in each layer and snap the electronic blocks onto the clear plastic grid. Install two (2) "AA" batteries (not included) into the battery holder (B1). When installing a battery, be sure the spring is compressed straight back, and not bent up, down, or to one side. Battery installation should be supervised by an adult.



Turn on the slide switch (S1), and the lamp (L1) lights.
When you turn on the slide switch, electricity flows from the batteries through the lamp and back to the battery through the switch. If the switch is off, the flow of electricity is blocked, and the lamp won't light.

Accessibility Note - For those who are blind or low vision use (W1) Horn instead of (L1) Lamp piece; For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan instead of (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)

First Layer

1. 3-Snap Wire on A1 - C1
2. (B1) Battery holder on A3 and GND on C3

Second Layer

1. (S1) Slide Switch on C1 - C3
2. (L1) Lamp on A1 - A3

Project 2: Color Light

Project 2 is very similar to Project 1, except you are replacing the lamp (L1) with the color LED (D8). Turn on the slide switch (S1) and enjoy the light show from the color LED (D8). For best effects dim the room lights.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece. To activate the photoresistor, a very bright light, is needed like that of a cellphone's flashlight.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)

First Layer

1. 3-Snap Wire on A1 - C1
2. (B1) Battery holder on A3 and GND on C3

Second Layer

1. (S1) Slide Switch on C1 - C3
2. (D8) Color LED on A1 - A3 with positive on A3

Project 3: Light-Controlled Light

For this project use the same circuit as Project 2 but replace the 3-snap wire with the photoresistor (RP). Vary the amount of light shining on the photoresistor to change the brightness of the color LED.

The photoresistor (RP) uses light to control electric current. Parts like this are used in a number of ways that affect our lives. For example, you may have streetlights in your neighborhood that turn on when it starts getting dark and turn off in the morning.

The color LED actually contains separate red, green, and blue lights, with a microcircuit controlling them. LEDs have a "+" side because they only work in one direction. LEDs can be damaged by high current, so your color LED has an internal resistor to protect it. LEDs are increasingly replacing incandescent lamps for room lighting because they are more efficient, using less electricity to make light.

Accessibility Note - For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (D8) Color LED piece. To activate the photoresistor, a very bright light is needed like that of a cellphone's flashlight.

Parts Needed

- (B1) Battery holder
- (RP) Photoresistor (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)

First Layer

1. (RP) Photoresistor on A1 - C1
2. (B1) Battery holder on A3 and GND on C3

Second Layer

1. (S1) Slide Switch on C1 - C3
2. (D8) Color LED on A1 - A3 with positive on A3

Project 4: Flying Saucer

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

Build the circuit with the parts listed. Follow the steps in each layer and snap the electronic blocks onto the clear plastic grid. New alkaline batteries are recommended for this project.

Push the press switch (S2) until the motor reaches full speed, then release it. The fan blade should rise and float through the air like a flying saucer. Be careful not to look directly down on fan blade when it is spinning. If the fan doesn't fly off, then press the switch several times rapidly when it is at full speed.

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

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. 3-Snap Wire on B1 - D1
2. (B1) Battery holder on B3 and GND on D3

Second Layer

1. (S1) Slide Switch on D1 - D3
2. (M1) Motor on B1 - B3 with positive on B1

Third Layer

1. Fan on the motor

Project 5: Fan

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

Use the Project 4 circuit but reverse the position of the motor (M1). Push the press switch (S2) to spin the motor and fan.

With the Fan circuit, the blade is blowing air upward; place your hand a short distance above the motor and you should be able to feel it. In this project electrical power is changed into mechanical power. Motors like this are used in battery powered equipment requiring rotary motion, such as a cordless drill, electric toothbrush, and toys. An electric motor is much easier to control than gas or diesel engines.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. 3-Snap Wire on B1 - D1
2. (B1) Battery holder on B3 and GND on D3

Second Layer

1. (S1) Slide Switch on D1 - D3
2. (M1) Motor on B1 - B3 with positive on B3

Third Layer

1. Fan on the motor

Project 6: Space War

This circuit uses the space war integrated circuit (U3). Activate it by flipping the slide switch (S1) or pressing the press switch (S2); do both several times and in combination. You will hear an exciting range of sounds, as if a space war is raging!

The upper-right snap of the space war IC is like an electrical gate, opening and closing quickly to let small bursts of electric current flow in. The bursts of electric current also flow through the speaker (which produces sound). The space war IC produces the different sounds by adjusting the pattern of two separate current bursts through the speaker.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (1)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (SP) Speaker (1)
- (U3) Space War IC (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U3) Space War IC with 2-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C4 and GND on E4
4. 4-Snap Wire on F1 - F4

Second Layer

1. 3-Snap Wire on A1 - C1
2. (SP) Speaker on A3 - C3
3. 3-Snap Wire on A4 - C4
4. (S2) Press Switch on D1 - F1
5. 3-Snap Wire on D2 - F2
6. (S1) Slide Switch on D3 - F3
7. 2-Snap Wire on E5 - F5

Project 7: Photo Space War

Use the Project 6 circuit but replace the slide switch (S1) with the photoresistor (RP). Cover and uncover the photoresistor to change the sound.

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

In movie studios, technicians are paid to insert these sounds at the precise instant a gun is fired.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (1)
- (RP) Photoresistor (1)
- (S2) Press Switch (1)
- (SP) Speaker (1)
- (U3) Space War IC (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U3) Space War IC with 2-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C4 and GND on E4
4. 4-Snap Wire on F1 - F4

Second Layer

1. 3-Snap Wire on A1 - C1
2. (SP) Speaker on A3 - C3
3. 3-Snap Wire on A4 - C4
4. (S2) Press Switch on D1 - F1
5. 3-Snap Wire on D2 - F2
6. (RP) Photoresistor on D3 - F3
7. 2-Snap Wire on E5 - F5

Project 8: Meet the Music IC

Build the circuit on the grid, using the parts in the list and following the steps. Once completed, turn on the slide switch (S1). A tune plays for a short time and then stops. Push the press switch (S2) and music plays until you release S2. Tap on the whistle chip (WC) to re-start the music; the music may also start if you blow on the whistle chip or clap near it.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (SP) Speaker (1)

- (U1) Music IC (1)
- (WC) Whistle Chip (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B4 - D4

Second Layer

1. (WC) Whistle Chip on A1 - C1
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. (S2) Press Switch on A3 - C3
5. 2-Snap Wire on A4 - B4
6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on D3 - D4
8. 2-Snap Wire on E4 - E5

Project 9: Spin the Music

Use the Project 8 circuit but replace the whistle chip with the motor (M1, "+" side up or down, omit the fan). Spin the motor top with your finger to re-start the music.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (SP) Speaker (1)
- (U1) Music IC (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4

5. (SP) Speaker on B4 - D4

Second Layer

1. (M1) Motor on A1 - C1 with positive on A1
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. (S2) Press Switch on A3 - C3
5. 2-Snap Wire on A4 - B4
6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on D3 - D4
8. 2-Snap Wire on E4 - E5

Project 10: Light-Controlled Music

Use the Project 9 circuit but replace the press switch with the photoresistor (RP). After the start-up tune finishes, the music continues if there is light on the photoresistor.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (U1) Music IC (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B4 - D4

Second Layer

1. (M1) Motor on A1 - C1 with positive on A1
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. (RP) Photoresistor on A3 - C3
5. 2-Snap Wire on A4 - B4

6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on D3 - D4
8. 2-Snap Wire on E4 - E5

Project 11: Whistle Music

Build the circuit on the circuit grid and turn on the slide switch (S1). A tune plays for a short time and then stops. Push the press switch (S2) and music plays until you release S2. You can replace the press switch with a 3-snap wire to make the music play continuously.

Accessibility Note - For those who are blind or low vision, use (W1) Horn in place of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (U1) Music IC (1)
- (WC) Whistle Chip (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. 2-Snap Wire on C4 - D4

Second Layer

1. (WC) Whistle Chip on A4 - C4
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. (S2) Press Switch on A3 - C3
5. 2-Snap Wire on D3 - D4
6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on E4 - E5

Third Layer

1. (L1) Lamp on A4-C4

Project 12: Funky Whistle Music

Use the Project 11 circuit but replace the lamp (L1) with the color LED (D8 "+" on top). The circuit works the same way but the light and sound are different.

Accessibility Note - For those who are blind or low vision, use (M4) Motor and Wind Fan in place of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (U1) Music IC (1)
- (WC) Whistle Chip (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. 2-Snap Wire on C4 - D4

Second Layer

1. (WC) Whistle Chip on A4 - C4
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. (S2) Press Switch on A3 - C3
5. 2-Snap Wire on D3 - D4
6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on E4 - E5

Third Layer

1. (D8) Color LED on A4-C4 with positive on A4

Project 13: Light Whistle Music

Use the Project 12 circuit. You can replace either the press switch or the color LED with the photoresistor (RP). The suggested steps taken in this project are to replace the press switch (S2) with the photoresistor (RP). After the start-up tune finishes, the music continues if there is light on the photoresistor.

Accessibility Note - For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (D8) Color LED (1)
- (U1) Music IC (1)
- (WC) Whistle Chip (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. 2-Snap Wire on C4 - D4

Second Layer

1. (WC) Whistle Chip on A4 - C4
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. (RP) Photoresistor on A3 - C3
5. 2-Snap Wire on D3 - D4
6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on E4 - E5

Third Layer

1. (D8) Color LED on A4-C4 with positive on A4

Project 14: Spin Whistle Music

Use the Project 11 circuit but replace the lamp with the motor (M1, "+" on top) and fan, and replace the press switch with a 3-snap wire. The fan speed changes a little as the sound changes.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- Fan (1)
- (U1) Music IC (1)
- (WC) Whistle Chip (1)

First Layer

1. 5-Snap Wire on A1 - A5
2. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. 2-Snap Wire on C4 - D4

Second Layer

1. (WC) Whistle Chip on A4 - C4
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. 3-Snap Wire on A3 - C3
5. 2-Snap Wire on D3 - D4
6. (S1) Slide Switch on A5 - C5
7. 2-Snap Wire on E4 - E5

Third Layer

1. (M1) Motor on A4-C4

Fourth Layer

1. Fan on (M1) Motor

Project 15: Musical Doorbell

Build the circuit using the parts needed and the steps that are given. Turn on the slide switch (S1). A tune plays for a short time and then stops. When

there is no sound, push the press switch (S2) to play a tune. The press switch acts like a musical doorbell.

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

The lower-right snap of the music IC is like an electrical gate, opening and closing quickly to let small bursts of electric current flow in. The bursts of electric current also flow through the speaker (which produces sound). The music IC produces the tune by adjusting the pattern of current bursts through the speaker.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of the (D8) Color LED piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (SP) Speaker (1)
- (U1) Music IC (1)
- (D8) Color LED (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U1) Music IC with 3-snap on top, covering C2 - C4 and D2 - D4
3. (B1) Battery holder on C6 and GND on E6
4. (D8) Color LED on C1 - E1 with positive on C1
5. 3-Snap Wire on E2 - E4
6. (SP) Speaker on B5 - D5

Second Layer

1. 3-Snap Wire on A3 - C3
2. 3-Snap Wire E4 - E6
3. 2-Snap Wire on A5 - B5
4. (S2) Press Switch on A2 - C2

5. 1-Snap Wire on C1
6. 1-Snap Wire on E1
7. 2-Snap Wire on D2 - E2
8. (S1) Slide Switch on A6 - C6
9. 2-Snap Wire on D4 - D5

Third Layer
1. 2-Snap Wire on C1 - C2
2. 2-Snap Wire on E1 - E2

Project 16: Whistle Space War

Build Project 16 using the parts needed and the steps that are given. Turn on the slide switch (S1) or push the press switch (S2); do both several times and in combination. You will hear an exciting range of sounds, a little different from project 6 and not as loud.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (U3) Space War IC (1)
- (WC) Whistle Chip (1)

First Layer
1. 5-Snap Wire on A1 - E1
2. 4-Snap Wire on A2 - A5
3. (U3) Space War IC with 3-snap on the right, covering C3 - E3 and C4 - E4
4. (B1) Battery holder on A6 and GND on C6
5. 2-Snap Wire D6 - E6

Second Layer
1. 2-Snap Wire on A1 - A2
2. (WC) Whistle Chip A3 - C3
3. 2-Snap Wire on A5 - A6
4. (S1) Slide Switch on C4 - C6

5. 3-Snap Wire on D4 - D6
6. 3-Snap Wire on E1 - E3
7. (S2) Press Switch on E4 - E6

Third Layer
1. (L1) Lamp on A3 - C3
2. 2-Snap Wire on C6 - D6

Project 17: Funky Whistle Space War

Use the Project 16 circuit but replace the lamp (L1) with the color LED (D8 "+" on top). The sound is a little different now.

Accessibility Note - For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (D8) Color LED piece.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (U3) Space War IC (1)
- (WC) Whistle Chip (1)

First Layer
1. 5-Snap Wire on A1 - E1
2. 4-Snap Wire on A2 - A5
3. (U3) Space War IC with 3-snap on the right, covering C3 - E3 and C4 - E4
4. (B1) Battery holder on A6 and GND on C6
5. 2-Snap Wire D6 - E6

Second Layer
1. 2-Snap Wire on A1 - A2
2. (WC) Whistle Chip A3 - C3
3. 2-Snap Wire on A5 - A6
4. (S1) Slide Switch on C4 - C6
5. 3-Snap Wire on D4 - D6
6. 3-Snap Wire on E1 - E3

7. (S2) Press Switch on E4 - E6

Third Layer
1. (D8) Color LED on A3 - C3 with positive on A3
2. 2-Snap Wire on C6 - D6

Project 18: Spinning Whistle Space War

Use the Project 17 circuit but replace the color LED with the motor (M1, "+" on top) and fan. Use the switches to change the sound; the fan spins on some sounds.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (M1) Motor (1)
- Fan (1)
- (U3) Space War IC (1)
- (WC) Whistle Chip (1)

First Layer
1. 5-Snap Wire on A1 - E1
2. 4-Snap Wire on A2 - A5
3. (U3) Space War IC with 3-snap on the right, covering C3 - E3 and C4 - E4
4. (B1) Battery holder on A6 and GND on C6
5. 2-Snap Wire D6 - E6

Second Layer
1. 2-Snap Wire on A1 - A2
2. (WC) Whistle Chip A3 - C3
3. 2-Snap Wire on A5 - A6
4. (S1) Slide Switch on C4 - C6
5. 3-Snap Wire on D4 - D6
6. 3-Snap Wire on E1 - E3
7. (S2) Press Switch on E4 - E6

Third Layer
1. (M1) Motor on A3 - C3 with positive on A3

2. 2-Snap Wire on C6 - D6

Fourth Layer
1. Fan on (M1) Motor

Project 19: Light-Controlled Whistle Space War

Use the Project 18 circuit but replace the motor with the photoresistor (RP). Vary the amount of light shining on the photoresistor to change the sound volume.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (RP) Photoresistor (1)
- (U3) Space War IC (1)
- (WC) Whistle Chip (1)

First Layer
1. 5-Snap Wire on A1 - E1
2. 4-Snap Wire on A2 - A5
3. (U3) Space War IC with 3-snap on the right, covering C3 - E3 and C4 - E4
4. (B1) Battery holder on A6 and GND on C6
5. 2-Snap Wire D6 - E6

Second Layer
1. 2-Snap Wire on A1 - A2
2. (WC) Whistle Chip A3 - C3
3. 2-Snap Wire on A5 - A6
4. (S1) Slide Switch on C4 - C6
5. 3-Snap Wire on D4 - D6
6. 3-Snap Wire on E1 - E3
7. (S2) Press Switch on E4 - E6

Third Layer
1. (RP) Photoresistor on A3 - C3 with positive on A3
2. 2-Snap Wire on C6 - D6

Project 20: Light Whistle Space War

Projects 16-18 circuits can be used. It is suggested to use the parts list and steps for Project 18. Please replace the slide switch (S1) with the photoresistor (RP) to complete Project 20. Cover and uncover the photoresistor or press the press switch (S2) to change the sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (RP) Photoresistor (1)
- (S2) Press Switch (1)
- (M1) Motor (1)
- Fan (1)
- (U3) Space War IC (1)
- (WC) Whistle Chip (1)

First Layer

1. 5-Snap Wire on A1 - E1
2. 4-Snap Wire on A2 - A5
3. (U3) Space War IC with 3-snap on the right, covering C3 - E3 and C4 - E4
4. (B1) Battery holder on A6 and GND on C6
5. 2-Snap Wire D6 - E6

Second Layer

1. 2-Snap Wire on A1 - A2
2. (WC) Whistle Chip A3 - C3
3. 2-Snap Wire on A5 - A6
4. (RP) Photoresistor on C4 - C6
5. 3-Snap Wire on D4 - D6
6. 3-Snap Wire on E1 - E3
7. (S2) Press Switch on E4 - E6

Third Layer

1. (M1) Motor on A3 - C3 with positive on A3
2. 2-Snap Wire on C6 - D6

Fourth Layer

1. Fan on (M1) Motor

Project 21: Siren

Build Project 21 using the parts needed and steps that are given. Turn on the slide switch (S1) and a siren sounds.

The lower-right snap of the alarm IC (U2) is like an electrical gate, opening and closing quickly to let small bursts of electric current flow in. The bursts of electric current also flow through the speaker (which produces sound). The alarm IC produces different siren sounds by adjusting the pattern of current bursts through the speaker.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on D1 - E1
3. 3-Snap Wire on D3 - D5
4. 2-Snap Wire on A5 - B5
5. 3-Snap Wire on E4 - E6
6. (S1) Slide Switch on A6 - C6

Project 22: Machine Gun

Use Project 21 to build this circuit. Use C2 and C3 on the grid to make a connection using a 1-snap wire and a 2-snap wire. Now it sounds like a machine gun.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)

- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C3
3. 2-Snap Wire on D1 - E1
4. 3-Snap Wire on D3 - D5
5. 2-Snap Wire on A5 - B5
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer

1. 2-Snap Wire on C2 - C3

Project 23: Fire Engine

Use Project 22 to build this circuit. Remove the snap wires on C2 and C3, and follow the steps adding the snap wires on C1 and C2. Now it sounds like a fire engine.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C1
3. 2-Snap Wire on D1 - E1
4. 3-Snap Wire on D3 - D5
5. 2-Snap Wire on A5 - B5
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer

1. 2-Snap Wire on C1 - C2

Project 24: European Siren

Use Project 23 to build the circuit. Remove the snap wires from C1 and C2, and follow the steps adding the snap wires to C1 and D1. Now it sounds like a European siren.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C1
3. 2-Snap Wire on D1 - E1
4. 3-Snap Wire on D3 - D5
5. 2-Snap Wire on A5 - B5
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer

1. 2-Snap Wire on C1 - D1

Project 25: Light Siren Changer

Use Project 21 to build the circuit. Add the photoresistor (RP) to the grid points A3 - C3. Cover and uncover the photoresistor to change the sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. 3-Snap Wire on A2 - C2
2. (RP) Photoresistor on A3 - C3
3. 2-Snap Wire on D1 - E1
4. 3-Snap Wire on D3 - D5
5. 2-Snap Wire on A5 - B5
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Project 26: Light Siren

Use Project 21 to build the circuit. Remove the 3-snap wire at grid points A2 - C2 and replace it with the photoresistor (RP). A siren sounds when there is light on the photoresistor.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. (RP) Photoresistor on A2 - C2
2. 2-Snap Wire on D1 - E1
3. 3-Snap Wire on D3 - D5
4. 2-Snap Wire on A5 - B5
5. 3-Snap Wire on E4 - E6
6. (S1) Slide Switch on A6 - C6

Project 27: Softer Siren

Use Project 26 to build the circuit. Remove the 3-snap wire at grid points D3 - D5 and replace it with the color LED (D8, "+" on left). The sound is not as loud, but the LED does not light. If you flip the color LED so its "+" is on the right, the LED lights but you can barely hear the sound. A protection resistor inside D8 is causing most of the sound reduction.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (D8) Color LED piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (D8) Color LED (1)
- (RP) Photoresistor (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B5 - D5

Second Layer

1. (RP) Photoresistor on A2 - C2
2. 2-Snap Wire on D1 - E1
3. (D8) Color LED on D3 - D5 with positive on D5
4. 2-Snap Wire on A5 - B5
5. 3-Snap Wire on E4 - E6
6. (S1) Slide Switch on A6 - C6

Project 28: Conduction Detector

Build the circuit using the parts needed and the steps listed. When a metal paperclip is placed across the snaps on the ends of the red & black jumper wires, current flows from the batteries (B1) through the paperclip, through the lamp (L1), and back to the battery. The paper clip completes the circuit and current can flow through the lamp. Now replace the metal paperclip with other materials in your home and see if the lamp lights. This circuit can be used to see if a material like plastic is a good conductor of electricity, or a poor conductor of it. You may replace the lamp with the color LED (D8, "+" on left).

Materials that have low resistance to the flow of electricity are called conductors, and materials that have high electrical resistance are called insulators.

Accessibility Note - For those who are blind or low vision, use the (W1) Horn instead of the (L1) Lamp piece. For those who are blind or low vision and are deaf or hard of hearing, use the (M4) Motor and Wind Fan in place of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- 2-Snap Wire (2)
- (L1) Lamp (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- Paperclip

First Layer

1. 3-Snap Wire on A1 - A3
2. (B1) Battery holder on A4 and GND on C4
3. (L1) Lamp on C1 - C3

Second Layer

1. 2-Snap Wire on A3 - A4
2. 2-Snap Wire on C3 - A4
3. Jumper Wire (Red) on A1
4. Jumper Wire (Black) on C1

Third Layer

1. Connect the two ends of Jumper Wire (Red) and Jumper Wire (Black) that are not connected to the Base Grid with the Paperclip.

Project 29: Soft Siren

Turn on the slide switch (S1) and a siren sounds.

In the next five projects the resistance of the lamp, color LED, photoresistor, or motor is used to adjust the sound from the whistle chip.

Accessibility Note - For those who are blind or low vision, use the (W1) Horn instead of the (L1) Lamp piece. For those who are blind or low vision and are deaf or hard of hearing, use the (M4) Motor and Wind Fan in place of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)

- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (WC) Whistle Chip on B4 - D4

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on D1 - E1
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on A4 - B4
5. 3-Snap Wire on E4 - E6
6. (S1) Slide Switch on A6 - C6

Third Layer

1. (L1) Lamp on B4 - D4

Project 30: Soft Sirens

Use Project 29 to build this circuit. Use C1 and C2 on the grid to make a connection using a 1-snap wire and a 2-snap wire.

Accessibility Note - For those who are blind or low vision, use the (W1) Horn instead of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)

- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (WC) Whistle Chip on B4 - D4

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C1
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 2-Snap Wire on A4 - B4
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer

1. 2-Snap Wire on C1 - C2
2. (L1) Lamp on B4 - D4

Project 31: Funky Siren

Use Project 30 to build this circuit but replace the lamp (L1) with the color LED (D8 "+" on top). The sound changes a little as the color LED changes colors.

Accessibility Note - For those who are blind or low vision and are deaf or hard of hearing, use the (M4) Motor and the Wind Fan in place of the (D8) Color LED piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (WC) Whistle Chip on B4 - D4

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C1
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 2-Snap Wire on A4 - B4
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer

1. 2-Snap Wire on C1 - C2
2. (D8) Color LED on B4 - D4 with positive on B4

Project 32: Light Adjusted Siren

Use Project 30 to build this circuit but replace the lamp (L1) with the photoresistor (RP). Vary the amount of light shining on the photoresistor to change the sound volume.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (WC) Whistle Chip (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (WC) Whistle Chip on B4 - D4

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C1
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 2-Snap Wire on A4 - B4
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer

1. 2-Snap Wire on C1 - C2
2. (RP) Photoresistor on B4 - D4

Project 33: Siren & Fan

Use the Project 30 circuits but replace the lamp (L1) with the motor (M1, "+" on top) and fan. The fan speed changes as the sound changes, especially with the Machine Gun sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- Fan (1)
- (WC) Whistle Chip (1)
- (U2) Alarm IC (1)

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C6 and GND on E6
4. 4-Snap Wire on E1 - E4
5. (WC) Whistle Chip on B4 - D4

Second Layer

1. 3-Snap Wire on A2 - C2
2. 1-Snap Wire on C3
3. 2-Snap Wire on D1 - E1

4. 2-Snap Wire on D3 - D4
5. 2-Snap Wire on A4 - B4
6. 3-Snap Wire on E4 - E6
7. (S1) Slide Switch on A6 - C6

Third Layer
1. 2-Snap Wire on C2 - C3
2. (M1) Motor on B4 - D4 with the positive on B4

Fourth Layer
1. Fan on (M1) Motor

Project 34: Water Alarm

WARNING: Don't drink any water used here.

Build the circuit using the parts list and the steps that are provided. This project uses a cup of water. Initially leave the jumper wires outside the cup. Turn on the slide switch (S1); nothing happens. Place the jumper wires into a cup of water and an alarm sounds!

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

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U2) Alarm IC (1)
- Water in a Glass

First Layer
1. 5-Snap Wire on A1 - A5
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B4 - D4

Second Layer

1. 2-Snap Wire on A4 - B4
2. 2-Snap Wire on D1 - E1
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on E4 - E5
5. Jumper Wire (Red) on A2
6. Jumper Wire (Black) on C2
7. (S1) Slide Switch on A5 - C5

Third Layer

1. Connect the two ends of Jumper Wire (Red) and Jumper Wire (Black) that are not connected to the Base Grid by placing them in the glass of water.

Project 35: Salt Water Alarm

WARNING: Don't drink any water used here.

Add salt to the water and the tone of the alarm is louder and faster than in Project 34; this indicates you have detected salt in the water.

Normal tap water has some electrical resistance, but much less than air. Adding salt to water lowers its resistance.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U2) Alarm IC (1)
- Salt Water in a Glass

First Layer

1. 5-Snap Wire on A2 - A6
2. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
3. (B1) Battery holder on C5 and GND on E5
4. 4-Snap Wire on E1 - E4
5. (SP) Speaker on B4 - D4

Second Layer

1. 2-Snap Wire on A4 - B4
2. 2-Snap Wire on D1 - E1
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on E4 - E5
5. Jumper Wire (Red) on A2
6. Jumper Wire (Black) on C2
7. (S1) Slide Switch on A5 - C5

Third Layer

1. Connect the two ends of Jumper Wire (Red) and Jumper Wire (Black) that are not connected to the Base Grid by placing them in the glass of salt water.

Project 36: Symphony

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

Build the circuit using the parts list and steps that are provided. Note that the color LED (D8) does not snap on the battery holder (B1) but is secured by the 2-snap wire on level 3.

Turn on the slide switch (S1); you will hear sounds from the music & alarm ICs (U1 & U2), the color LED (D8) & lamp (L1) light up, and the motor spins the fan. Push the press switch (S2) several times to add sounds from the space war IC (U3).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (3)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)

- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. 4-Snap Wire A2 - A5
2. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
3. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
4. (B1) Battery holder on E5 and GND on G5
5. 1-Snap Wire F3
6. 3-Snap Wire on G1 - G3

Second Layer

1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on A3 - B3
3. 2-Snap Wire on C3 - D3
4. 5-Snap Wire on A5 - E5
5. Jumper Wire (Black) on C1
6. Jumper Wire (Red) on D1
7. (S2) Press Switch on E1 - G1
8. 3-Snap Wire on E2 - G2
9. (S1) Slide Switch on G3 - G5
10. (D8) Color LED on F3 - F5 in the middle of the Battery holder with the positive on the Battery holder module

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) other end on G1
3. (SP) Speaker on C3 - C5
4. 3-Snap Wire on D3 - F3
5. 1-Snap Wire on C1
6. 1-Snap Wire on D5
7. 2-Snap Wire on E5 - F5

Fourth Layer

1. (L1) Lamp on D3 - D5
2. (M1) Motor on E3 - E5
3. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Fifth Layer

1. Fan on (M1) Motor

Project 37: Photo Symphony

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

Use Project 36 to build this circuit but replace the press switch (S2) with the photoresistor (RP). Cover and uncover the photoresistor to change some of the sounds.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. 4-Snap Wire A2 - A5
2. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
3. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
4. (B1) Battery holder on E5 and GND on G5
5. 1-Snap Wire F3
6. 3-Snap Wire on G1 - G3

Second Layer

1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on A3 - B3
3. 2-Snap Wire on C3 - D3
4. 5-Snap Wire on A5 - E5
5. Jumper Wire (Black) on C1

6. Jumper Wire (Red) on D1
7. (RP) Photoresistor on E1 - G1
8. 3-Snap Wire on E2 - G2
9. (S1) Slide Switch on G3 - G5
10. (D8) Color LED on F3 - F5 in the middle of the Battery holder with the positive on the Battery holder.

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) other end on G1
3. (SP) Speaker on C3 - C5
4. 3-Snap Wire on D3 - F3
5. 1-Snap Wire on C1
6. 1-Snap Wire on D5
7. 2-Snap Wire on E5 - F5

Fourth Layer

1. (L1) Lamp on D3 - D5
2. (M1) Motor on E3 - E5 with the positive on E5
3. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Fifth Layer

1. Fan on (M1) Motor

Project 38: Whistle Symphony

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

Use Project 36 to build this circuit but replace the speaker (SP) with the whistle chip (WC).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (3)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)

- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. 4-Snap Wire A2 - A5
2. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
3. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
4. (B1) Battery holder on E5 and GND on G5
5. 1-Snap Wire F3
6. 3-Snap Wire on G1 - G3

Second Layer

1. 2-Snap Wire on A2 -B2
2. 2-Snap Wire on A3 - B3
3. 2-Snap Wire on C3 - D3
4. 5-Snap Wire on A5 - E5
5. Jumper Wire (Black) on C1
6. Jumper Wire (Red) on D1
7. (S2) Press Switch on E1 - G1
8. 3-Snap Wire on E2 - G2
9. (S1) Slide Switch on G3 - G5
10. (D8) Color LED on F3 - F5 in the middle of the Battery holder with the positive on the Battery holder.

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) other end on G1
3. (WC) Whistle Chip on C3 - C5
4. 3-Snap Wire on D3 - F3
5. 1-Snap Wire on C1
6. 1-Snap Wire on D5
7. 2-Snap Wire on E5 - F5

Fourth Layer

1. (L1) Lamp on D3 - D5
2. (M1) Motor on E3 - E5
3. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Fifth Layer

1. Fan on (M1) Motor

Project 39: Sirens Symphony

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

Use Project 38 to build the circuit. Add a 2-snap wire across grid points B1 - C1.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (3)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. 4-Snap Wire A2 - A5
2. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
3. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
4. (B1) Battery holder on E5 and GND on G5
5. 1-Snap Wire F3
6. 3-Snap Wire on G1 - G3

Second Layer

1. 1-Snap Wire on B1
2. 2-Snap Wire on A2 -B2
3. 2-Snap Wire on A3 - B3

4. 2-Snap Wire on C3 - D3
5. 5-Snap Wire on A5 - E5
6. Jumper Wire (Black) on C1
7. Jumper Wire (Red) on D1
8. (S2) Press Switch on E1 - G1
9. 3-Snap Wire on E2 - G2
10. (S1) Slide Switch on G3 - G5
11. (D8) Color LED on F3 - F5 in the middle of the Battery holder with the positive on the Battery holder.

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) other end on G1
3. (WC) Whistle Chip on C3 - C5
4. 3-Snap Wire on D3 - F3
5. 1-Snap Wire on C1
6. 1-Snap Wire on D5
7. 2-Snap Wire on E5 - F5

Fourth Layer

1. (L1) Lamp on D3 - D5
2. (M1) Motor on E3 - E5
3. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Fifth Layer

1. Fan on (M1) Motor
2. 2-Snap Wire on B1 - C1

Project 40: Using Parts as Conductors

Turn on the slide switch (S1). The color LED (D8) lights up and you will hear space war sounds. For a short time the sound is continuous but then you can stop the sound by covering the photoresistor (RP), or change the sound by covering and uncovering the photoresistor. You can also replace the photoresistor with the press switch (S2).

Note that the color LED (D8) lights up, but the lamp (L1) does not light up and the motor (M1) does not spin. Electricity is flowing through the lamp and motor, but not enough to turn them on. So in this circuit they are acting like 3-snap wires. You could replace L1 or M1 with a 3-snap wire and the circuit would work the same.

Parts Needed

- (B1) Battery holder

- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (RP) Photoresistor
- (L1) Lamp (1)
- (M1) Motor (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- (U1) Music IC (1)
- (U3) Space War IC (1)

First Layer

1. (L1) Lamp on A1 - A3
2. 5-Snap Wire on A5 - A9
3. (M1) Motor on B1 - D1
4. (U1) Music IC with 3-snap on top, covering C3 - C5 and D3 - D5
5. (U3) Space War IC with 3-snap on bottom, covering C6 - C8 and D6 - D8
6. (B1) Battery holder on C9 and GND on E9
7. 4-Snap Wire on E5 - E8

Second Layer

1. 2-Snap Wire on A1 - B1
2. 1-Snap Wire on A3
3. (D8) Color LED on D1 - D3
4. 1-Snap Wire on C4
5. (RP) Photoresistor on A5 - C5
6. Jumper Wire (Red) on E5
7. 3-Snap Wire on A6 - C6
8. 2-Snap Wire on D5 - D6
9. 2-Snap Wire on D7 - E7
10. 2-Snap Wire on E8 - E9
11. (SP) Speaker on A8 - C8
12. (S1) Slide Switch A9 - C9

Third Layer

1. 3-Snap Wire on A3 - A5
2. 1-Snap Wire on C4
3. Jumper Wire (Red) other end on D3

Fourth Layer

1. 3-Snap Wire on A4 - C4

Project 41: Lamp & Fan in Series

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

Turn on the slide switch (S1). The lamp (L1) lights up and the motor (M1) spins the fan. Notice how the lamp gets a little less bright as the motor speeds up.

The faster the motor is spinning, the less electricity it needs. The more electricity flows, the brighter the lamp gets. The motor needs the most electricity when it starts up, making the lamp brightest. Without the fan, the motor can spin fast and needs little electricity, making the lamp dim.

Parts Needed

- (B1) Battery holder
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. (B1) Battery holder on B3 and GND on D3
2. (L1) Lamp on B1 - D1

Second Layer

1. (M1) Motor on B1 - B3 with positive on B3
2. (S1) Slide Switch on D1 - D3

Third Layer

1. Fan on (M1) Motor

Project 41: Lamp & Fan in Series (Accessible)

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

Turn on the slide switch (S1). The lamp (L1) lights up and the motor (M1) spins the fan. Notice how the lamp gets a little less bright as the motor speeds up.

Accessibility Note - For those who are blind or low vision, use (W1) Horn and replace the Motor (M1) and Fan with Motor (M4) and Wind Fan. A second battery holder has been added to increase power for the added parts to operate.

Parts Needed

- (B1) Battery holder (2)
- (S1) Slide Switch (1)
- (W1) Horn (1)
- (M4) Motor (1)
- Wind Fan (1)

First Layer

1. (B1) Battery holder on C1 and GND on C3
2. (B1) Battery holder on E3 and GND on E1
3. (M4) Motor on C5 - E5 with positive on C5

Second Layer

1. (L1) Lamp on E3 - E5
2. (W1) Horn on C3 - C5 with positive on C5
3. (S1) Slide Switch on C1 - E1

Third Layer

1. Wind Fan on (M4) Motor

Project 42: Light Dimmer

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

Use Project 41 to build this circuit. Remove the fan from the motor (M1). Turn on the slide switch (S1) and watch how the lamp (L1) lights initially but gets dimmer as the motor speeds up. Next, turn off the circuit and hold the motor top with your fingers so it can't spin, then turn on the switch and see how bright the lamp is.

The faster the motor is spinning, the less electricity it needs. The more electricity flows, the brighter the lamp gets. The motor needs the most electricity when it starts up, making the lamp brightest. Without the fan, the motor can spin fast and needs little electricity, making the lamp dim.

Parts Needed

- (B1) Battery holder
- (S1) Slide Switch (1)

- (L1) Lamp (1)
- (M1) Motor (1)

First Layer

1. (B1) Battery holder on B3 and GND on D3
2. (L1) Lamp on B1 - D1

Second Layer

1. (M1) Motor on B1 - B3 with positive on B3
2. (S1) Slide Switch on D1 - D3

Project 42: Light Dimmer (Accessible)

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

Use Project 41 to build this circuit. Remove the fan from the motor (M1). Turn on the slide switch (S1) and watch how the lamp (L1) lights initially but gets dimmer as the motor speeds up. Next, turn off the circuit and hold the motor top with your fingers so it can't spin, then turn on the switch and see how bright the lamp is.

Accessibility Note - For those who are blind or low vision, use (W1) Horn and replace the Motor (M1) with Motor (M4). A second battery holder has been added to increase power for the added parts to operate.

Parts Needed

- (B1) Battery holder (2)
- (S1) Slide Switch (1)
- (W1) Horn (1)
- (L1) Lamp (1)
- (M4) Motor (1)

First Layer

1. (B1) Battery holder on C1 and GND on C3
2. (B1) Battery holder on E3 and GND on E1
3. (M4) Motor on C5 - E5 with positive on C5

Second Layer

1. (L1) Lamp on E3 - E5
2. (W1) Horn on C3 - C5 with positive on C5
3. (S1) Slide Switch on C1 - E1

Project 43: Lamp & Fan in Parallel

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

Turn on the slide switch (S1). The lamp (L1) lights up and the motor (M1) spins the fan.

Compare this circuit to the circuit in project 41, and also try removing the fan as done in project 42. Notice how the lamp brightness is not affected by the motor speed, and the motor starts a little faster.

Here the motor and lamp are connected in parallel. Each has its own path to the batteries, so they don't affect each other.

An advantage of connecting parts in parallel is that if one of them burns out, the other will still work. The switch is connected in series with both the lamp and motor, so if it breaks, nothing will work. Electricity flows out of the batteries, through either the motor or lamp, then back to the batteries through the switch.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece.

<u>Parts Needed</u>

- (B1) Battery holder
- 3-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)

<u>First Layer</u>

1. (B1) Battery holder on A6 and GND on C6
2. 3-Snap Wire on A2 - A4
3. 3-Snap Wire on C2 - C4

<u>Second Layer</u>

1. (M1) Motor on A2 - C2 with positive on C2
2. (L1) Lamp on A3 - C3
3. (S1) Slide Switch on C4 - C6
4. 3-Snap Wire on A4 - A6

Third Layer

1. Fan on (M1) Motor

Project 44: Motor Controlled Sound & Light

Turn on the slide switch (S1). You will hear a siren for a few seconds, and then it will stop. Spin the motor (M1) top with your fingers to re-start the sound. Push the press switch (S2) to make the sound louder. The color LED lights up if there is bright light on the photoresistor (RP).

When you spin the motor shaft the energy of the spinning shaft produces a small electrical voltage. This voltage is used to activate the music IC (U1), which controls the alarm IC (U2).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C9 and GND on E9
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on A6 - A9
4. 1-Snap Wire on B6
5. 2-Snap Wire on C8 - D8
6. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
7. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6
8. 3-Snap Wire on C7 - E7

Second Layer

1. (M1) Motor on A1 - C1 with positive on A1
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D3 - D4
4. 3-Snap Wire on A5 - C5
5. 2-Snap Wire on A6 - B6
6. (D8) Color LED on A7 - C7 with positive on A7
7. (SP) Speaker on A8 - C8
8. (S1) Slide Switch on A9 - C9
9. (S2) Press Switch on D6 - D8
10. (RP) Photoresistor on E7 - E9
11. Jumper Wire (Red) on D1
12. Jumper Wire (Black) on C4

Third Layer

1. Jumper Wire (Red) other end on E9
2. Jumper Wire (Black) other end on D4
3. 2-Snap Wire on A5 - A6
4. 1-Snap Wire on B6
5. 1-Snap Wire on D6

Fourth Layer

1. (WC) Whistle Chip on B6 - D6

Fifth Layer

1. (L1) Lamp on B6 - D6

Project 45: Motor Sounds & Light

Change the siren sound by adding the black jumper wire across grid points C4 - D4.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- (D8) Color LED (1)

- (WC) Whistle Chip (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C9 and GND on E9
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on A6 - A9
4. 1-Snap Wire on B6
5. 2-Snap Wire on C8 - D8
6. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
7. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6
8. 3-Snap Wire on C7 - E7

Second Layer

1. (M1) Motor on A1 - C1 with positive on A1
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D3 - D4
4. 3-Snap Wire on A5 - C5
5. 2-Snap Wire on A6 - B6
6. (D8) Color LED on A7 - C7 with positive on A7
7. (SP) Speaker on A8 - C8
8. (S1) Slide Switch on A9 - C9
9. (S2) Press Switch on D6 - D8
10. (RP) Photoresistor on E7 - E9
11. Jumper Wire (Red) on D1
12. Jumper Wire (Black) on C4

Third Layer

1. Jumper Wire (Red) other end on E9
2. Jumper Wire (Black) other end on D4
3. 2-Snap Wire on A5 - A6
4. 1-Snap Wire on B6
5. 1-Snap Wire on D6

Fourth Layer

1. (WC) Whistle Chip on B6 - D6

Fifth Layer

1. (L1) Lamp on B6 - D6

Project 46: Shine on Siren

Cover the photoresistor (RP) and turn on the switch (S1). A siren is heard for a while and then stops; then you can control it by covering or uncovering the photoresistor. The lamp (L1) is used here as a 3-snap wire and will not light.

This circuit demonstrates how sounds can be synchronized to light patterns through the photoresistor.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on E3 and GND on E1
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on A8 - D8
4. 1-Snap Wire on E8
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
6. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6
7. (L1) Lamp on E5 - E7

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on D1 - E1
3. (RP) Photoresistor on A3 - C3
4. 2-Snap Wire on D3 - D4
5. 3-Snap Wire on E3 - E5
6. 3-Snap Wire on A5 - C5
7. (S1) Slide Switch A6 - A8
8. (SP) Speaker on D6 - D8
9. 2-Snap Wire on E7 - E8

Third Layer

1. 2-Snap Wire on D8 - E8

Project 47: Shine on Siren

Use Project 46 to build this circuit. Use C4 and C5 on the grid to make a connection using a 1-snap wire and a 2-snap wire. Now it sounds like a machine gun.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on E3 and GND on E1
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on A8 - D8
4. 1-Snap Wire on E8
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
6. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6
7. (L1) Lamp on E5 - E7

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on D1 - E1
3. (RP) Photoresistor on A3 - C3
4. 1-Snap Wire on C4
5. 2-Snap Wire on D3 - D4
6. 3-Snap Wire on E3 - E5
7. 3-Snap Wire on A5 - C5
8. (S1) Slide Switch A6 - A8
9. (SP) Speaker on D6 - D8
10. 2-Snap Wire on E7 - E8

Third Layer

1. 2-Snap Wire on C4 - C5
2. 2-Snap Wire on D8 - E8

Project 48: Loud & Soft Tunes

Build the circuit using the parts list and the steps that are given. Turn on the slide switch (S1). The siren is louder than the music.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. (U1) Music IC with 3-snap on top, covering D1 - D3 and E1 - E3
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. 3-Snap Wire on G1 - G3

Second Layer

1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on D2 - D3
3. 1-Snap Wire on C1
4. 1-Snap Wire on C3
5. 1-Snap Wire on E3
6. 3-Snap Wire on E1 - G1
7. 5-Snap Wire on A5 - E5
8. (S1) Slide Switch on G3 - G5

Third Layer

1. 3-Snap Wire on C1 - E1

2. Jumper Wire (Black) on A2 - D2
3. (SP) Speaker on C3 - C5
4. (WC) Whistle Chip on E3 - E5

Fourth Layer
1. (L1) Lamp on E3 - E5

Project 49: Loud & Soft Tunes (II)

Use Project 48 to build the circuit. Use the red jumper wire to connect grid points B1 - B2 to produce a different sound.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. (U1) Music IC with 3-snap on top, covering D1 - D3 and E1 - E3
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. 3-Snap Wire on G1 - G3

Second Layer
1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on D2 - D3
3. 1-Snap Wire on C1
4. 1-Snap Wire on C3
5. 1-Snap Wire on E3
6. 3-Snap Wire on E1 - G1
7. 5-Snap Wire on A5 - E5
8. (S1) Slide Switch on G3 - G5

9. Jumper Wire (Red) on B1

Third Layer
1. Jumper Wire (Red) other end on B2
2. 3-Snap Wire on C1 - E1
3. Jumper Wire (Black) on A2 - D2
4. (SP) Speaker on C3 - C5
5. (WC) Whistle Chip on E3 - E5

Fourth Layer
1. (L1) Lamp on E3 - E5

Project 50: Loud & Soft Tunes (III)

Use Project 48 to build this circuit. Swap the locations of the speaker (SP) and whistle chip (WC)/lamp (L1) to produce a different sound.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. (U1) Music IC with 3-snap on top, covering D1 - D3 and E1 - E3
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. 3-Snap Wire on G1 - G3

Second Layer
1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on D2 - D3
3. 1-Snap Wire on C1
4. 1-Snap Wire on C3

5. 1-Snap Wire on E3
6. 3-Snap Wire on E1 - G1
7. 5-Snap Wire on A5 - E5
8. (S1) Slide Switch on G3 - G5

Third Layer
1. 3-Snap Wire on C1 - E1
2. Jumper Wire (Black) on A2 - D2
3. (SP) Speaker on E3 - E5
4. (WC) Whistle Chip on C3 - C5

Fourth Layer
1. (L1) Lamp on C3 - C5

Project 51: Loud & Soft Tunes (IV)

Use Project 48 to build this circuit but replace the lamp (L1) with the color LED (D8 "+" on right) for a different light effect.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. (U1) Music IC with 3-snap on top, covering D1 - D3 and E1 - E3
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. 3-Snap Wire on G1 - G3

Second Layer
1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on D2 - D3

3. 1-Snap Wire on C1
4. 1-Snap Wire on C3
5. 1-Snap Wire on E3
6. 3-Snap Wire on E1 - G1
7. 5-Snap Wire on A5 - E5
8. (S1) Slide Switch on G3 - G5

Third Layer
1. 3-Snap Wire on C1 - E1
2. Jumper Wire (Black) on A2 - D2
3. (SP) Speaker on C3 - C5
4. (WC) Whistle Chip on E3 - E5

Fourth Layer
1. (D8) Color LED on E3 - E5

Project 52: Loud & Soft Sounds

Build the circuit using the parts list and the steps that are given. Turn on the slide switch (S1), and cover and uncover the photoresistor (RP) several times. The siren is louder than the space war sounds.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

4. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
5. 2-Snap Wire on G1 - G2
6. (S1) Slide Switch G3 - G5

Second Layer
1. Jumper Wire (Red) on A1 - D1
2. Jumper Wire (Black) on C1 - G3
3. 2-Snap Wire on A2 - B2
4. 1-Snap Wire on C3
5. 1-Snap Wire on D3
6. (RP) Photoresistor on E1 - G1
7. 3-Snap Wire on E2 - G2
8. 4-Snap Wire on A5 - D5
9. 2-Snap Wire on F5 - G5

Third Layer
1. (SP) Speaker on C3 - C5
2. (WC) Whistle Chip on D3 - D5
3. 2-Snap Wire on G2 - G3

Fourth Layer
1. (L1) Lamp on D3 - D5

Project 53: More Loud & Soft Sounds

Use Project 52 to build this circuit. Use B1 - B2 on the grid to make a connection using a 2-snap wire and a 1-snap wire.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U3) Space War IC (1)

- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
4. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
5. 2-Snap Wire on G1 - G2
6. (S1) Slide Switch G3 - G5

Second Layer

1. Jumper Wire (Red) on A1 - D1
2. Jumper Wire (Black) on C1 - G3
3. 2-Snap Wire on A2 - B2
4. 1-Snap Wire on C3
5. 1-Snap Wire on D3
6. 1-Snap Wire on B1
7. (RP) Photoresistor on E1 - G1
8. 3-Snap Wire on E2 - G2
9. 4-Snap Wire on A5 - D5
10. 2-Snap Wire on F5 - G5

Third Layer

1. (SP) Speaker on C3 - C5
2. (WC) Whistle Chip on D3 - D5
3. 2-Snap Wire on G2 - G3
4. 2-Snap Wire on B1 - B2

Fourth Layer

1. (L1) Lamp on D3 - D5

Project 54: Spin Draw

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

Drawing: To make a ring drawing obtain some thin and thick marking pens as drawing tools. Spin the paper by pressing and holding the press switch (S2) down. Press the marker on the paper to form rings. To make spiral

drawings, release the press switch (S2) and as the motor approaches a slow speed move the marker from the inside outward quickly.

Change the colors often and avoid using too much black to get hypnotic effects. Another method is to make colorful shapes on the disc and then spin the disc and watch them blend into each other. When certain speeds are reached under fluorescent lights without electronic ballasts, the strobe principle shown in another project will produce strange effects and backward movement. Make a wheel with different colored spokes to see this strange effect. Adding more spokes and removing spokes will give different effects at different motor speeds.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- Fan (1)
- Circular Piece of Paper
- Circular Piece of Cardboard
- Tape

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on A2 - A4
3. (M1) Motor on B2 - D2 with positive on B2
4. (S1) Slide Switch on D3 - D5

Second Layer

1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on A4 - A5
3. 2-Snap Wire on D2 - D3
4. 2-Snap Wire on C5 - D5
5. Fan on (M1) Motor

Third Layer

1. Cut out a piece of cardboard and a piece of paper the size of the fan and tape the pieces together and tape it onto the Fan piece with the paper up.

Project 55: Crazy Combo

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

Build the circuit using the parts list and the steps that are given. Turn it on, press the press switch (S2) several times or cover and uncover the photoresistor (RP) to hear all the sound combinations. The press switch (S2) may only work when photoresistor (RP) is covered.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on G2 - G6
3. 4-Snap Wire on A3 - A6
4. 3-Snap Wire on C5 - E5
5. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
6. (U3) Space War IC with 3-snap on bottom, covering D2 - D4 and E2 - E4

Second Layer

1. 3-Snap Wire on A6 - C6
2. 3-Snap Wire on E3 - G3
3. 2-Snap Wire on A3 - B3
4. 2-Snap Wire on D4 - D5
5. 1-Snap Wire on C3
6. (SP) Speaker on A5 - C5

7. (S2) Press Switch on E2 - G2
8. (S1) Slide Switch on E6 - G6
9. (RP) Photoresistor on E4 - G4
10. (D8) Color LED on E5 - G5 with positive on E5
11. Jumper Wire (Red) on B2 - D2
12. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Black) other end on G2
2. 2-Snap Wire on B2 - B3
3. (L1) Lamp on C3 - C5

Project 56: Whistle Crazy Combo

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

Use Project 55 to build the circuit but replace the speaker (SP) with the whistle chip (WC), a 1-snap wire, and the motor (M1) and fan, as indicated in the steps.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (RP) Photoresistor (1)
- (M1) Motor (1)
- Fan (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on G2 - G6

3. 4-Snap Wire on A3 - A6
4. 3-Snap Wire on C5 - E5
5. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
6. (U3) Space War IC with 3-snap on bottom, covering D2 - D4 and E2 - E4

Second Layer

1. 3-Snap Wire on A6 - C6
2. 3-Snap Wire on E3 - G3
3. 2-Snap Wire on A3 - B3
4. 2-Snap Wire on D4 - D5
5. 1-Snap Wire on C3
6. (WC) Whistle Chip on A5 - C5
7. (S2) Press Switch on E2 - G2
8. (S1) Slide Switch on E6 - G6
9. (RP) Photoresistor on E4 - G4
10. (D8) Color LED on E5 - G5 with positive on E5
11. Jumper Wire (Red) on B2 - D2
12. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Black) other end on G2
2. 1-Snap Wire on A5
3. 2-Snap Wire on B2 - B3
4. (L1) Lamp on C3 - C5

Fourth Layer

1. (M1) Motor on A5 - C5 with positive on A5

Fifth Layer

1. Fan on (M1) Motor

Project 57: Fun with the Alarm IC

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

Place the fan on the motor (M1) and turn on the slide switch (S1). The lamp (L1) lights up, the motor spins, and you will hear a machine gun sound (with very faint music in background). Cover the photoresistor (RP) with your hand and the sound becomes a siren. After a while the sound will stop; if you hold down the press switch (S2), the sound resumes.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- Fan (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C10 and GND on E10
2. 5-Snap Wire on A6 - A10
3. 2-Snap Wire on A3 - A4
4. (U1) Music IC with 3-snap on top, covering C2 - C4 and D2 - D4
5. (U2) Alarm IC with 3-snap on top, covering C5 - C7 and D5 - D7
6. (L1) Lamp on B1 - D1
7. (SP) Speaker on B8 - D8

Second Layer

1. 3-Snap Wire on A3 - C3
2. 3-Snap Wire on A6 - C6
3. 2-Snap Wire on D1 - D2
4. 2-Snap Wire on D4 - D5
5. 2-Snap Wire on D7 - D8
6. 2-Snap Wire on A8 - B8
7. 1-Snap Wire on B1
8. (S1) Slide Switch on A10 - C10
9. (S2) Press Switch on A4 - C4
10. (RP) Photoresistor on A7 - C7
11. Jumper Wire (Black) on E10

Third Layer

1. Jumper Wire (Black) other end on D2
2. 3-Snap Wire on A4 - A6
3. (M1) Motor on B1 - B3 with positive on B3

Fourth Layer

1. Fan on (M1) Motor

Project 58: Whistle Fun

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

Use Project 57 to build the circuit but replace the speaker (SP) with the whistle chip (WC) and color LED (D8), as indicated in the steps.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (M1) Motor (1)
- Fan (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C10 and GND on E10
2. 5-Snap Wire on A6 - A10
3. 2-Snap Wire on A3 - A4
4. (U1) Music IC with 3-snap on top, covering C2 - C4 and D2 - D4
5. (U2) Alarm IC with 3-snap on top, covering C5 - C7 and D5 - D7
6. (L1) Lamp on B1 - D1
7. (WC) Whistle Chip on B8 - D8

Second Layer

1. 3-Snap Wire on A3 - C3
2. 3-Snap Wire on A6 - C6
3. 2-Snap Wire on D1 - D2
4. 2-Snap Wire on D4 - D5
5. 2-Snap Wire on D7 - D8

6. 2-Snap Wire on A8 - B8
7. 1-Snap Wire on B1
8. (S1) Slide Switch on A10 - C10
9. (S2) Press Switch on A4 - C4
10. (RP) Photoresistor on A7 - C7
11. Jumper Wire (Black) on E10

Third Layer

1. Jumper Wire (Black) other end on D2
2. 3-Snap Wire on A4 - A6
3. (M1) Motor on B1 - B3 with positive on B3
4. (D8) Color LED on B8 - D8 with positive on B8

Fourth Layer

1. Fan on (M1) Motor

Project 59: Nifty Noises

Build the circuit using the parts list and the steps that are given. Turn on the slide switch (S1), press the press switch (S2) several times, and cover and uncover the photoresistor (RP) to hear all the sound combinations. The press switch (S2) may only work when photoresistor (RP) is covered.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on G2 - G6
3. 2-Snap Wire on A2 - A3

4. 2-Snap Wire on C5 - D5
5. 1-Snap Wire on A6
6. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
7. (U3) Space War IC with 3-snap on bottom, covering D2 - D4 and E2 - E4

Second Layer

1. 4-Snap Wire on A3 - A6
2. 3-Snap Wire on C3 - C5
3. 3-Snap Wire on E3 - G3
4. 2-Snap Wire on A2 - B2
5. 2-Snap Wire on D4 - D5
6. 1-Snap Wire on C6
7. (S1) Slide Switch on E6 - G6
8. (S2) Press Switch on E2 - G2
9. (RP) Photoresistor on E4 - G4
10. Jumper Wire (Red) on D2
11. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Red) other end on A2
2. Jumper Wire (Black) other end on G2
3. 3-Snap Wire on A6 - C6
4. (L1) Lamp on A4 - C4
5. (SP) Speaker on A5 - C5

Project 60: Nifty Noises (II)

Use Project 59 to build the circuit. Use the grid points B1 - B2 to make a connection using a 1-snap wire and a 2-snap wire. The sound will be different.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)

- Jumper Wire (Red)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on G2 - G6
3. 2-Snap Wire on A2 - A3
4. 2-Snap Wire on C5 - D5
5. 1-Snap Wire on A6
6. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
7. (U3) Space War IC with 3-snap on bottom, covering D2 - D4 and E2 - E4

Second Layer

1. 4-Snap Wire on A3 - A6
2. 3-Snap Wire on C3 - C5
3. 3-Snap Wire on E3 - G3
4. 2-Snap Wire on A2 - B2
5. 2-Snap Wire on D4 - D5
6. 1-Snap Wire on C6
7. 1-Snap Wire on B1
8. (S1) Slide Switch on E6 - G6
9. (S2) Press Switch on E2 - G2
10. (RP) Photoresistor on E4 - G4
11. Jumper Wire (Red) on D2
12. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Red) other end on A2
2. Jumper Wire (Black) other end on G2
3. 3-Snap Wire on A6 - C6
4. 2-Snap Wire on B1 - B2
5. (L1) Lamp on A4 - C4
6. (SP) Speaker on A5 - C5

Project 61: Nifty Noises (III)

Use Project 59 to build this circuit, but replace the lamp (L1) with the color LED (D8, "+" on right). The LED lights up and the sound will be different.

Parts Needed

- (B1) Battery holder

- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on G2 - G6
3. 2-Snap Wire on A2 - A3
4. 2-Snap Wire on C5 - D5
5. 1-Snap Wire on A6
6. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
7. (U3) Space War IC with 3-snap on bottom, covering D2 - D4 and E2 - E4

Second Layer

1. 4-Snap Wire on A3 - A6
2. 3-Snap Wire on C3 - C5
3. 3-Snap Wire on E3 - G3
4. 2-Snap Wire on A2 - B2
5. 2-Snap Wire on D4 - D5
6. 1-Snap Wire on C6
7. (S1) Slide Switch on E6 - G6
8. (S2) Press Switch on E2 - G2
9. (RP) Photoresistor on E4 - G4
10. Jumper Wire (Red) on D2
11. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Red) other end on A2
2. Jumper Wire (Black) other end on G2
3. 3-Snap Wire on A6 - C6
4. (D8) Color LED on A4 - C4 with positive on A4
5. (SP) Speaker on A5 - C5

Project 62: Nifty Noises (IV)

Use Project 61 to build the circuit but replace the speaker (SP) with the whistle chip (WC). The sound is not as loud now.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on G2 - G6
3. 2-Snap Wire on A2 - A3
4. 2-Snap Wire on C5 - D5
5. 1-Snap Wire on A6
6. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
7. (U3) Space War IC with 3-snap on bottom, covering D2 - D4 and E2 - E4

Second Layer

1. 4-Snap Wire on A3 - A6
2. 3-Snap Wire on C3 - C5
3. 3-Snap Wire on E3 - G3
4. 2-Snap Wire on A2 - B2
5. 2-Snap Wire on D4 - D5
6. 1-Snap Wire on C6
7. (S1) Slide Switch on E6 - G6
8. (S2) Press Switch on E2 - G2
9. (RP) Photoresistor on E4 - G4
10. Jumper Wire (Red) on D2

11. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Red) other end on A2
2. Jumper Wire (Black) other end on G2
3. 3-Snap Wire on A6 - C6
4. (D8) Color LED on A4 - C4
5. (WC) Whistle Chip on A5 - C5

Project 63: Singing Motor

Do not place the fan on the motor (M1). Turn on the switch and the motor spins (you may need to give it a push with your finger to get it started). The sounds from the IC are used to drive the motor. Because the motor uses magnets and a coil of wire similar to a speaker, you may even hear the space war sounds coming faintly from the motor.

The motor has a coil and a magnet similar to the speaker. An electrical signal in the coil creates a magnetic field, which makes the shaft spin. Normally the motor is used with a stable electrical signal, but in this project it is used with a changing signal from the space war IC. This creates mechanical vibrations, which create air pressure variations that sound like the speaker does, though not as efficiently.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on A4 - A8
3. (S1) Slide Switch on E5 - E7
4. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
5. (U3) Space War IC with 3-snap on bottom, covering C4 - C6 and D4 - D6

Second Layer

1. 3-Snap Wire on A4 - C4
2. 2-Snap Wire on C2 - C3
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on D5 - E5
5. 2-Snap Wire on E7 - E8
6. 1-Snap Wire on A8
7. (M1) Motor on C6 - C8 with positive on C8
8. Jumper Wire (Black) on D1

Third Layer

1. Jumper Wire (Black) other end on E5
2. 3-Snap Wire on A8 - C8
3. 2-Snap Wire on C3 - C4

Project 64: Singing Motor (II)

Use Project 63 to build the circuit. Add the color LED (D8, "+" on top) across grid points A6 - C6 using a 1-snap wire.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- (D8) Color LED (1)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on A4 - A8
3. (S1) Slide Switch on E5 - E7
4. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
5. (U3) Space War IC with 3-snap on bottom, covering C4 - C6 and D4 - D6

Second Layer

1. 3-Snap Wire on A4 - C4
2. 2-Snap Wire on C2 - C3

3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on D5 - E5
5. 2-Snap Wire on E7 - E8
6. 1-Snap Wire on A6
7. 1-Snap Wire on A8
8. (M1) Motor on C6 - C8 with positive on C8
9. Jumper Wire (Black) on D1

Third Layer

1. Jumper Wire (Black) other end on E5
2. 3-Snap Wire on A8 - C8
3. 2-Snap Wire on C3 - C4
4. (D8) Color LED on A6 - C6 with positive on A6

Project 65: Singing Motor (III)

Use Project 64 to build the circuit but replace the color LED with the lamp (L1) across grid points A6 - C6 using a 1-snap wire.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- (L1) Lamp (1)
- Jumper Wire (Black)
- (U3) Space War IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on A4 - A8
3. (S1) Slide Switch on E5 - E7
4. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3
5. (U3) Space War IC with 3-snap on bottom, covering C4 - C6 and D4 - D6

Second Layer

1. 3-Snap Wire on A4 - C4
2. 2-Snap Wire on C2 - C3
3. 2-Snap Wire on D3 - D4

4. 2-Snap Wire on D5 - E5
5. 2-Snap Wire on E7 - E8
6. 1-Snap Wire on A6
7. 1-Snap Wire on A8
8. (M1) Motor on C6 - C8 with positive on C8
9. Jumper Wire (Black) on D1

Third Layer

1. Jumper Wire (Black) other end on E5
2. 3-Snap Wire on A8 - C8
3. 2-Snap Wire on C3 - C4
4. (L1) Lamp on A6 - C6 with positive on A6

Project 66: Periodic Sounds

Build the circuit using the parts list and steps that are given. The lamp (L1) alternates between being on and off, the color LED (D8) flashes at intervals, while the speaker (SP) alternates between two musical tones. It is as if someone is flipping a switch, but at a very consistent rate. Periodic signals like this are very important in electronics.

Periodic electrical signals are used for things like flashing lights or to indicate batteries are low.

Parts Needed

- (B1) Battery holder
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 4-Snap Wire on A2 - A5
3. 2-Snap Wire on A7 - A8
4. (U1) Music IC with 3-snap on left, covering C4 - E4 and C5 - E5
5. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer

1. 3-Snap Wire on A7 - C7
2. 2-Snap Wire on A2 - B2
3. 2-Snap Wire on A3 - B3
4. 1-Snap Wire on C3
5. 1-Snap Wire on D4
6. (S1) Slide Switch on E5 - E7
7. (D8) Color LED on A5 - C5
8. (L1) Lamp on A4 - C4
9. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Black) other end on E5
2. 3-Snap Wire on A5 - A7
3. 2-Snap Wire on C4 - D4
4. 1-Snap Wire on C3
5. (SP) Speaker on C5 - C7

Fourth Layer

1. 2-Snap Wire on C3 - C4

Project 67: Double Blinking Flashlight

Use Project 66 to build the circuit but remove the speaker.

Parts Needed

- (B1) Battery holder
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 4-Snap Wire on A2 - A5
3. 2-Snap Wire on A7 - A8
4. (U1) Music IC with 3-snap on left, covering C4 - E4 and C5 - E5
5. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer

1. 3-Snap Wire on A7 - C7
2. 2-Snap Wire on A2 - B2
3. 2-Snap Wire on A3 - B3
4. 1-Snap Wire on C3
5. 1-Snap Wire on D4
6. (S1) Slide Switch on E5 - E7
7. (D8) Color LED on A5 - C5
8. (L1) Lamp on A4 - C4
9. Jumper Wire (Black) on C1

Third Layer

1. Jumper Wire (Black) other end on E5
2. 3-Snap Wire on A5 - A7
3. 2-Snap Wire on C4 - D4
4. 1-Snap Wire on C3

Fourth Layer

1. 2-Snap Wire on C3 - C4

Project 68: Periodic Sounds (II)

Use Project 66 to build the circuit but swap the locations of the speaker and the lamp. The sound and light patterns are different now.

Parts Needed

- (B1) Battery holder
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 4-Snap Wire on A2 - A5
3. 2-Snap Wire on A7 - A8
4. (U1) Music IC with 3-snap on left, covering C4 - E4 and C5 - E5

5. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer
1. 3-Snap Wire on A7 - C7
2. 2-Snap Wire on A2 - B2
3. 2-Snap Wire on A3 - B3
4. 1-Snap Wire on C3
5. 1-Snap Wire on D4
6. (S1) Slide Switch on E5 - E7
7. (D8) Color LED on A5 - C5 with positive on A5
8. (SP) Speaker on A4 - C4
9. Jumper Wire (Black) on C1

Third Layer
1. Jumper Wire (Black) other end on E5
2. 3-Snap Wire on A5 - A7
3. 2-Snap Wire on C4 - D4
4. 1-Snap Wire on C3
5. (L1) Lamp on C5 - C7

Fourth Layer
1. 2-Snap Wire on C3 - C4

Project 69: Super Circuit

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

Turn on the slide switch (S1) to make sound and lights. Some of the sound may stop after a few seconds unless there is light on the photoresistor (RP).

Push the press switch (S2) until the motor reaches full speed, then release it. The fan blade should rise and float through the air like a flying saucer. Be careful not to look directly down on fan blade when it is spinning.

If the fan doesn't fly off, then press the switch several times rapidly when it is at full speed. The motor spins faster when the batteries are new. If you don't want the fan to fly off then reverse the orientation of the motor.

This circuit is shown on the front of the Snap Circuits Select box; use that picture to help build it.

Parts Needed
- (B1) Battery holder

- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- Fan (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C9 and GND on E9
2. 5-Snap Wire on A5 - A9
3. 4-Snap Wire on E2 - E5
4. 2-Snap Wire on C2 - C3
5. 1-Snap Wire on C4
6. (WC) Whistle Chip on A1 - A3
7. (SP) Speaker on B8 - D8
8. (U1) Music IC with 3-snap on top, covering C5 - C7 and D5 - D7

Second Layer

1. 3-Snap Wire on A3 - A5
2. 3-Snap Wire on A6 - C6
3. 2-Snap Wire on A8 - B8
4. 2-Snap Wire on D5 - E5
5. 2-Snap Wire on D7 - D8
6. (D8) Color LED on C2 - E2 with positive on C2
7. (L1) Lamp on C3 - E3
8. (S2) Press Switch on C4 - E4
9. (RP) Photoresistor on A7 - C7
10. (S1) Slide Switch on A9 - C9
11. Jumper Wire (Black) on E9

Third Layer

1. Jumper Wire (Black) other end on D5
2. 3-Snap Wire on A3 - C3

3. 1-Snap Wire on C6
4. 1-Snap Wire on D7
5. (M1) Motor on A4 - C4 with positive on C4

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering C5 - C7 and D5 - D7
2. Fan on (M1) Motor

Project 70: Sirens Super Circuit

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

Use Project 69 to build the circuit. Add a 2-snap wire across grid points C5 - C6 to create a different sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (WC) Whistle Chip (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- Fan (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C9 and GND on E9
2. 5-Snap Wire on A5 - A9
3. 4-Snap Wire on E2 - E5
4. 2-Snap Wire on C2 - C3
5. 1-Snap Wire on C4
6. (WC) Whistle Chip on A1 - A3
7. (SP) Speaker on B8 - D8

8. (U1) Music IC with 3-snap on top, covering C5 - C7 and D5 - D7

Second Layer
1. 3-Snap Wire on A3 - A5
2. 3-Snap Wire on A6 - C6
3. 2-Snap Wire on A8 - B8
4. 2-Snap Wire on D5 - E5
5. 2-Snap Wire on D7 - D8
6. (D8) Color LED on C2 - E2 with positive on C2
7. (L1) Lamp on C3 - E3
8. (S2) Press Switch on C4 - E4
9. (RP) Photoresistor on A7 - C7
10. (S1) Slide Switch on A9 - C9
11. Jumper Wire (Black) on E9

Third Layer
1. Jumper Wire (Black) other end on D5
2. 3-Snap Wire on A3 - C3
3. 1-Snap Wire on C6
4. 1-Snap Wire on D7
5. (M1) Motor on A4 - C4 with positive on C4

Fourth Layer
1. (U2) Alarm IC with 3-snap on top, covering C5 - C7 and D5 - D7
2. Fan on (M1) Motor

Fifth Layer
1. 2-Snap Wire on C5 - C6

Project 71: Light Spots

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

Turn on the slide switch (S1); the lamp (L1) and color LED (D8) are on. Notice how the color LED is changing colors.

Now push the press switch (S2) to spin the motor and glow fan. Notice how the color LED color pattern has changed. You can try this with or without the glow fan on the motor.

The motor produces electrical “noise” as it spins, which can confuse the color-changing circuit in the color LED. The lamp is just a simple light bulb and is not affected by the motor.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on C1 - E1
4. 3-Snap Wire on C3 - E3
5. (S2) Press Switch on C2 - E2

Second Layer

1. 3-Snap Wire on E3 - E5
2. 2-Snap Wire on E1 - E2
3. (D8) Color LED on A1 - C1 with positive on A1
4. (M1) Motor on A2 - C2 with positive on A2
5. (L1) Lamp on A3 - C3
6. (S1) Slide Switch on A5 - C5

Third Layer

1. 2-Snap Wire on E2 - E3
2. Fan on (M1) Motor

Project 72: Symphony of Sounds

Turn on the slide switch (S1); you hear sounds from the music & alarm ICs (U1 & U2), and the lamp (L1) lights. Push the press switch (S2) several times to add sounds from the space war IC (U3).

This circuit has a lot happening at once.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)

- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (1)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. 3-Snap Wire on G1 - G3
4. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3

Second Layer

1. 5-Snap Wire on A5 - E5
2. 3-Snap Wire on E2 - G2
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 2-Snap Wire on C3 - D3
6. 1-Snap Wire on C1
7. (S1) Slide Switch on G3 - G5
8. (S2) Press Switch on E1 - G1
9. Jumper Wire (Red) on D1

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) on C1 - G1
3. (SP) Speaker on C3 - C5
4. (L1) Lamp on D3 - D5

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 73: Photo Symphony of Sounds

Use Project 72 to build the circuit. Add the photoresistor (RP) across grid points E3 - G3 using a 1-snap wire. Cover and uncover the photoresistor to change some of the sounds.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. 3-Snap Wire on G1 - G3
4. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3

Second Layer

1. 5-Snap Wire on A5 - E5
2. 3-Snap Wire on E2 - G2
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 2-Snap Wire on C3 - D3
6. 1-Snap Wire on C1
7. 1-Snap Wire on E3
8. (S1) Slide Switch on G3 - G5
9. (S2) Press Switch on E1 - G1
10. Jumper Wire (Red) on D1

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) on C1 - G1
3. (SP) Speaker on C3 - C5
4. (L1) Lamp on D3 - D5
5. (RP) Photoresistor on E3 - G3

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 74: LED Symphony of Sounds

Use Project 73 to build the circuit but replace the lamp (L1) with the color LED (D8, "+" on right).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. 3-Snap Wire on G1 - G3
4. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3

Second Layer

1. 5-Snap Wire on A5 - E5
2. 3-Snap Wire on E2 - G2

3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 2-Snap Wire on C3 - D3
6. 1-Snap Wire on C1
7. 1-Snap Wire on E3
8. (S1) Slide Switch on G3 - G5
9. (S2) Press Switch on E1 - G1
10. Jumper Wire (Red) on D1

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) on C1 - G1
3. (SP) Speaker on C3 - C5
4. (D8) Color LED on D3 - D5
5. (RP) Photoresistor on E3 - G3

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 75: Whistle Symphony of Sounds

Use Project 74 to build this circuit but replace the speaker (SP) with the whistle chip (WC).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on E5 and GND on G5

2. 4-Snap Wire on A2 - A5
3. 3-Snap Wire on G1 - G3
4. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3

Second Layer

1. 5-Snap Wire on A5 - E5
2. 3-Snap Wire on E2 - G2
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 2-Snap Wire on C3 - D3
6. 1-Snap Wire on C1
7. 1-Snap Wire on E3
8. (S1) Slide Switch on G3 - G5
9. (S2) Press Switch on E1 - G1
10. Jumper Wire (Red) on D1

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) on C1 - G1
3. (WC) Whistle Chip on C3 - C5
4. (D8) Color LED on D3 - D5
5. (RP) Photoresistor on E3 - G3

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 76: Sirens Symphony of Sounds

Use Project 75 to build this circuit. Add a 2-snap wire across grid points B1 - B2 to hear a different sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (2)
- (S2) Press Switch (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)

- (RP) Photoresistor (1)
- Jumper Wire (Red)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on E5 and GND on G5
2. 4-Snap Wire on A2 - A5
3. 3-Snap Wire on G1 - G3
4. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3

Second Layer

1. 5-Snap Wire on A5 - E5
2. 3-Snap Wire on E2 - G2
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 2-Snap Wire on C3 - D3
6. 1-Snap Wire on C1
7. 1-Snap Wire on E3
8. (S1) Slide Switch on G3 - G5
9. (S2) Press Switch on E1 - G1
10. Jumper Wire (Red) on D1

Third Layer

1. Jumper Wire (Red) other end on B2
2. Jumper Wire (Black) on C1 - G1
3. (WC) Whistle Chip on C3 - C5
4. (D8) Color LED on D3 - D5
5. (RP) Photoresistor on E3 - G3

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Fifth Layer

1. 2-Snap Wire on B1 - B2

Project 77: Power Shifter

When you turn on the slide switch (S1), the color LED (D8) is on and the lamp (L1) is off. Push the press switch (S2) to bypass the LED. The lamp

turns on and the LED turns off. This shows how switches can be used to shift power between different devices.

The color LED has an internal resistor to protect it from overload. This resistor does not prevent the LED from lighting, but it limits the circuit current too much to allow the lamp to light.

If you swap the locations of the lamp and color LED (put LED "+" on top), then the LED will always be on, the lamp will always be off, and the press switch will have no effect.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece and replace the (L1) Lamp with the (M4) Motor and Wind Fan.

Parts Needed

- (B1) Battery holder
- 4-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (L1) Lamp (1)

First Layer

1. (B1) Battery holder on B6 and GND on D6
2. 4-Snap Wire on D2 - D5
3. (S2) Press Switch on A2 - A4
4. (L1) Lamp on B1 - D1
5. (D8) Color LED on B2 - B4 with positive on B4

Second Layer

1. 2-Snap Wire on B1 - B2
2. 2-Snap Wire on D1 - D2
3. 2-Snap Wire on D5 - D6
4. 1-Snap Wire on A2
5. 1-Snap Wire on A4
6. (S1) Slide Switch on B4 - B6

Third Layer

1. 2-Snap Wire on A2 - B2
2. 2-Snap Wire on A4 - B4

Project 78: Sing & Fling

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

In the circuit, the outputs from the alarm (U2) and music ICs are connected together. Build the circuit using the parts list and the steps that are given and then place the alarm IC (U2) directly over the music IC (U1), resting on two 1-snap wires and a 2-snap wire. Turn on the slide switch (S1) and you will hear a siren and music together. Push the press switch (S2) and the fan spins, while the sound may not be as loud. The fan may rise into the air when you release the switch. Some of the sounds may stop after a while unless there is light on the photoresistor (RP).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- Fan (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on A3 - A7
3. 4-Snap Wire on E2 - E5
4. 2-Snap Wire on A1 - B1
5. 2-Snap Wire on C6 - D6
6. 1-Snap Wire on D1
7. (U1) Music IC with 3-snap on top, covering C2 - C4 and D2 - D4

Second Layer

1. 3-Snap Wire on A3 - C3
2. 3-Snap Wire on E5 - E7
3. 2-Snap Wire on D2 - E2

4. (S1) Slide Switch on A7 - C7
5. (S2) Press Switch on B1 - D1
6. (RP) Photoresistor on A4 - C4
7. (L1) Lamp on D4 - D6
8. (SP) Speaker on A6 - C6

Third Layer
1. 2-Snap Wire on D1 - D2
2. 1-Snap Wire on C3
3. 1-Snap Wire on D4
4. (M1) Motor on B1 - B3 with positive on B1

Fourth Layer
1. (U2) Alarm IC with 3-snap on top, covering C2 - C4 and D2 - D4
2. Fan on (M1) Motor

Project 79: Sing & Fling (II)

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

Use Project 78 to build the circuit. Add a 2-snap wire across grid points C2 - C3 to hear a different sound.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- Fan (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on A3 - A7

3. 4-Snap Wire on E2 - E5
4. 2-Snap Wire on A1 - B1
5. 2-Snap Wire on C6 - D6
6. 1-Snap Wire on D1
7. (U1) Music IC with 3-snap on top, covering C2 - C4 and D2 - D4

Second Layer
1. 3-Snap Wire on A3 - C3
2. 3-Snap Wire on E5 - E7
3. 2-Snap Wire on D2 - E2
4. (S1) Slide Switch on A7 - C7
5. (S2) Press Switch on B1 - D1
6. (RP) Photoresistor on A4 - C4
7. (L1) Lamp on D4 - D6
8. (SP) Speaker on A6 - C6

Third Layer
1. 2-Snap Wire on D1 - D2
2. 1-Snap Wire on C3
3. 1-Snap Wire on D4
4. (M1) Motor on B1 - B3 with positive on B1

Fourth Layer
1. (U2) Alarm IC with 3-snap on top, covering C2 - C4 and D2 - D4
2. Fan on (M1) Motor

Fifth Layer
1. 2-Snap Wire on C2 - C3

Project 80: Mixed Up Music

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

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (3)

- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on E1 - E4
4. 2-Snap Wire on C4 - C5
5. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer

1. 3-Snap Wire on A6 - C6
2. 3-Snap Wire on C1 - E1
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 1-Snap Wire on C3
6. (S1) Slide Switch on E4 - E6
7. (SP) Speaker on A4 - C4
8. (L1) Lamp on A5 - C5

Third Layer

1. 2-Snap Wire on C3 - C4
2. 1-Snap Wire on B2
3. 1-Snap Wire on C1

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 81: Whistle Mixed Up Music

Use Project 80 to build this circuit but replace the speaker (SP) with the whistle chip (WC).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)

- (L1) Lamp (1)
- (WC) Whistle Chip (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on E1 - E4
4. 2-Snap Wire on C4 - C5
5. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer

1. 3-Snap Wire on A6 - C6
2. 3-Snap Wire on C1 - E1
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 1-Snap Wire on C3
6. (S1) Slide Switch on E4 - E6
7. (WC) Whistle Chip on A4 - C4
8. (L1) Lamp on A5 - C5

Third Layer

1. 2-Snap Wire on C3 - C4
2. 1-Snap Wire on B2
3. 1-Snap Wire on C1

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 82: Color Mixed Up Music

Use Project 81 to build this circuit but replace the lamp (L1) with the color LED (D8).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (4)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (D8) Color LED (1)

- (WC) Whistle Chip (1)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on E1 - E4
4. 2-Snap Wire on C4 - C5
5. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer

1. 3-Snap Wire on A6 - C6
2. 3-Snap Wire on C1 - E1
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 1-Snap Wire on C3
6. (S1) Slide Switch on E4 - E6
7. (WC) Whistle Chip on A4 - C4
8. (D8) Color LED on A5 - C5

Third Layer

1. 2-Snap Wire on C3 - C4
2. 1-Snap Wire on B2
3. 1-Snap Wire on C1

Fourth Layer

1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Project 83: Sirens Mixed Up Music

Use Project 82 to build this circuit. Add a 2-snap wire across grid points B1 - B2 to make a different sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)

- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on C6 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on E1 - E4
4. 2-Snap Wire on C4 - C5
5. (U1) Music IC with 3-snap on top, covering B1 - B3 and C1 - C3

Second Layer
1. 3-Snap Wire on A6 - C6
2. 3-Snap Wire on C1 - E1
3. 2-Snap Wire on A2 - B2
4. 2-Snap Wire on A3 - B3
5. 1-Snap Wire on C3
6. (S1) Slide Switch on E4 - E6
7. (WC) Whistle Chip on A4 - C4
8. (D8) Color LED on A5 - C5

Third Layer
1. 2-Snap Wire on C3 - C4
2. 1-Snap Wire on B2
3. 1-Snap Wire on C1

Fourth Layer
1. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3

Fifth Layer
1. 2-Snap Wire on B1 - B2

Project 84: Space War Controlled Siren

Turn on the slide switch (S1), then cover and uncover the photoresistor (RP) several times to change the sound. If there is no sound, then shine more light on the photoresistor (RP).

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (3)

- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on A3 - A7
3. 2-Snap Wire on A1 - A2
4. (U2) Alarm IC with 3-snap on top, covering B3 - B5 and C3 - C5
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
6. Jumper Wire (Black) on E5

Second Layer

1. Jumper Wire (Black) other end on E2
2. 4-Snap Wire on A1 - D1
3. 3-Snap Wire on A7 - C7
4. 2-Snap Wire on A2 - A3
5. 2-Snap Wire on A4 - B4
6. 2-Snap Wire on C3 - D3
7. 1-Snap Wire on B3
8. 1-Snap Wire on C5
9. 1-Snap Wire on E3
10. (S1) Slide Switch on E5 - E7

Third Layer

1. 2-Snap Wire on B3 - B4
2. (SP) Speaker on C5 - C7
3. (RP) Photoresistor on E3 - E5

Project 85: Space War Controlled Sirens

Use Project 84 to build this circuit but move the 2-snap wire and 1-snap wire connecting grid points B3 - B4 and instead connect them across grid points B4 - B5. Cover and uncover the photoresistor (RP) several times. The sounds are different now.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)

- 3-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on A3 - A7
3. 2-Snap Wire on A1 - A2
4. (U2) Alarm IC with 3-snap on top, covering B3 - B5 and C3 - C5
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
6. Jumper Wire (Black) on E5

Second Layer

1. Jumper Wire (Black) other end on E2
2. 4-Snap Wire on A1 - D1
3. 3-Snap Wire on A7 - C7
4. 2-Snap Wire on A2 - A3
5. 2-Snap Wire on A4 - B4
6. 2-Snap Wire on C3 - D3
7. 1-Snap Wire on B5
8. 1-Snap Wire on C5
9. 1-Snap Wire on E3
10. (S1) Slide Switch on E5 - E7

Third Layer

1. 2-Snap Wire on B4 - B5
2. (SP) Speaker on C5 - C7
3. (RP) Photoresistor on E3 - E5

Project 86: Space War Controlled Sirens

Use Project 85 to build this circuit but replace the speaker (SP) with the whistle chip (WC) and color LED (D8, "+" on right), stacked together.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)

- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (3)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- Jumper Wire (Black)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on A3 - A7
3. 2-Snap Wire on A1 - A2
4. (U2) Alarm IC with 3-snap on top, covering B3 - B5 and C3 - C5
5. (U3) Space War IC with 3-snap on bottom, covering D1 - D3 and E1 - E3
6. Jumper Wire (Black) on E5

Second Layer

1. Jumper Wire (Black) other end on E2
2. 4-Snap Wire on A1 - D1
3. 3-Snap Wire on A7 - C7
4. 2-Snap Wire on A2 - A3
5. 2-Snap Wire on A4 - B4
6. 2-Snap Wire on C3 - D3
7. 1-Snap Wire on B5
8. 1-Snap Wire on C5
9. 1-Snap Wire on E3
10. (S1) Slide Switch on E5 - E7

Third Layer

1. 2-Snap Wire on B4 - B5
2. (WC) Whistle Chip on C5 - C7
3. (RP) Photoresistor on E3 - E5

Fourth Layer

1. (D8) Color LED on C5 - C7 with positive on C7

Project 87: Two-Speed Fan

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

Turn on the slide switch (S1); the motor (M1) spins the fan and the lamp (L1) lights. Push the press switch (S2) to bypass the lamp and increase the fan speed. Swap the locations of the lamp and motor (motor "+" on top). Now pushing the press switch bypasses the motor and makes the lamp brighter.

When the lamp is on, the fan spins slower because the battery power is divided between the motor and lamp. Pushing S2 allows electricity to bypass the lamp, so all the battery power is available to the motor, so the fan spins faster.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. (B1) Battery holder on B5 and GND on D5
2. 3-Snap Wire on B1 - B3
3. 3-Snap Wire on D1 - D3

Second Layer

1. (S1) Slide Switch on D3 - D5
2. (S2) Press Switch on B1 - D1
3. (L1) Lamp on B2 - D2
4. (M1) Motor on B3 - B5 with positive on B5

Third Layer

1. Fan on (M1) Motor

Project 88: Reflection Detector

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

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

For more fun, remove the lamp, replace the photoresistor with the whistle chip (WC), and tap on the whistle chip to hear sound. You can also replace the speaker (SP) with the color LED (D8, "+" on top); tapping on the whistle chip makes the LED flicker.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (L1) Lamp (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on F2 - F5
4. 3-Snap Wire on B4 - D4
5. (U3) Space War IC with 3-snap on bottom, covering C1 - C3 and D1 - D3

Second Layer

1. 3-Snap Wire on A1 - C1
2. 3-Snap Wire on D2 - F2
3. 2-Snap Wire on A4 - B4
4. 2-Snap Wire on E5 - F5
5. (S1) Slide Switch on A5 - C5
6. (SP) Speaker on A3 - C3
7. (L1) Lamp on D4 - F4
8. (RP) Photoresistor on D3 - F3

Project 89: Whistle Reflection Detector

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

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

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- (L1) Lamp (1)
- (U1) Music IC (1)

First Layer

1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on C4 - E4
4. 2-Snap Wire on E3 - F3
5. 1-Snap Wire on E1
6. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer

1. 4-Snap Wire on A5 - D5
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on E3 - E4
5. 1-Snap Wire on D3
6. (S1) Slide Switch on F3 - F5
7. (L1) Lamp on A4 - C4
8. (RP) Photoresistor on A3 - C3

Third Layer

1. 3-Snap Wire on E1 - E3

2. (WP) Whistle Chip on D3 - D5

Fourth Layer
1. (D8) Color LED on D3 - D5 with positive on D5

Project 90: Music Reflection Detector

Use Project 89 to build this circuit but replace the whistle chip (WC) and color LED (D8) with the speaker (SP).

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (SP) Speaker (1)
- (L1) Lamp (1)
- (U1) Music IC (1)

First Layer
1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on C4 - E4
4. 2-Snap Wire on E3 - F3
5. 1-Snap Wire on E1
6. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer
1. 4-Snap Wire on A5 - D5
2. 3-Snap Wire on A2 - C2
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on E3 - E4
5. 1-Snap Wire on D3
6. (S1) Slide Switch on F3 - F5
7. (L1) Lamp on A4 - C4
8. (RP) Photoresistor on A3 - C3

Third Layer
1. 3-Snap Wire on E1 - E3
2. (SP) Speaker on D3 - D5

Project 91: Space Battle

Build the circuit using the parts list and the steps that are given. Turn on the switch (S1) and you will hear exciting sounds, as if a space battle is raging!

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- Jumper Wire (Red)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on E1 - E5
3. 1-Snap Wire on E6
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering B4 - B6 and C4 - C6
6. Jumper Wire (Red) on A8

Second Layer

1. Jumper Wire (Red) other end on B4
2. 3-Snap Wire on A8 - C8
3. 3-Snap Wire on C1 - E1
4. 3-Snap Wire on C5 - E5
5. 2-Snap Wire on B2 - B3
6. 2-Snap Wire on C3 - C4
7. 1-Snap Wire on B6
8. (S1) Slide Switch on E6 - E8

Third Layer

1. 2-Snap Wire on B3 - B4
2. 2-Snap Wire on E5 - E6
3. (SP) Speaker on B6 - B8

Project 92: Space Battle (II)

Use Project 91 to build this circuit but replace the speaker (SP) with the whistle chip (WC) and color LED (D8, "+" on right), stacked together.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- Jumper Wire (Red)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on E1 - E5
3. 1-Snap Wire on E6
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering B4 - B6 and C4 - C6
6. Jumper Wire (Red) on A8

Second Layer

1. Jumper Wire (Red) other end on B4
2. 3-Snap Wire on A8 - C8
3. 3-Snap Wire on C1 - E1
4. 3-Snap Wire on C5 - E5
5. 2-Snap Wire on B2 - B3
6. 2-Snap Wire on C3 - C4
7. 1-Snap Wire on B6
8. (S1) Slide Switch on E6 - E8

Third Layer

1. 2-Snap Wire on B3 - B4
2. 2-Snap Wire on E5 - E6
3. (WC) Whistle Chip on B6 - B8

Fourth Layer

1. (D8) Color LED on B6 - B8 with the positive on B8

Project 93: Space Battle (III)

Use Project 92 to build this circuit but replace the color LED with the lamp (L1).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (WC) Whistle Chip (1)
- (L1) Lamp (1)
- Jumper Wire (Red)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on E1 - E5
3. 1-Snap Wire on E6
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering B4 - B6 and C4 - C6
6. Jumper Wire (Red) on A8

Second Layer

1. Jumper Wire (Red) other end on B4
2. 3-Snap Wire on A8 - C8
3. 3-Snap Wire on C1 - E1
4. 3-Snap Wire on C5 - E5
5. 2-Snap Wire on B2 - B3
6. 2-Snap Wire on C3 - C4
7. 1-Snap Wire on B6
8. (S1) Slide Switch on E6 - E8

Third Layer

1. 2-Snap Wire on B3 - B4
2. 2-Snap Wire on E5 - E6
3. (WC) Whistle Chip on B6 - B8

Fourth Layer

1. (L1) Lamp on B6 - B8

Project 94: Space Battle (IV)

Use Project 93 to build this circuit, but replace the lamp with the motor (M1, "+" on right) and fan.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (WC) Whistle Chip (1)
- (M1) Motor (1)
- Fan (1)
- Jumper Wire (Red)
- (U2) Alarm IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C8 and GND on E8
2. 5-Snap Wire on E1 - E5
3. 1-Snap Wire on E6
4. (U2) Alarm IC with 3-snap on top, covering B1 - B3 and C1 - C3
5. (U3) Space War IC with 3-snap on bottom, covering B4 - B6 and C4 - C6
6. Jumper Wire (Red) on A8

Second Layer

1. Jumper Wire (Red) other end on B4
2. 3-Snap Wire on A8 - C8
3. 3-Snap Wire on C1 - E1
4. 3-Snap Wire on C5 - E5
5. 2-Snap Wire on B2 - B3
6. 2-Snap Wire on C3 - C4
7. 1-Snap Wire on B6
8. (S1) Slide Switch on E6 - E8

Third Layer

1. 2-Snap Wire on B3 - B4
2. 2-Snap Wire on E5 - E6
3. (WC) Whistle Chip on B6 - B8

Fourth Layer

1. (M1) Motor on B6 - B8 with positive on B8

Fifth Layer

1. Fan on (M1) Motor

Project 95: Fan Flash Energy

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

Place the fan on the motor (M1). Hold down the press switch (S2) for a few seconds and then watch the color LED (D8) as you release the switch. The LED flashes briefly but only after the batteries (B1) are disconnected from the circuit.

Do you know why the LED flashes? It flashes because the motor uses a magnetic field to spin the shaft. When the switch is released energy creates a brief current through the LED.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece. In order for the circuit to work, a (B2) Battery holder with three AA batteries will be needed in place of the (B1) Battery Holder.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 2-Snap Wire (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. (B1) Battery holder on A6 and GND on C6
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on C1 - C4

Second Layer

1. 2-Snap Wire on A5 - A6
2. (S2) Press Switch on C4 - C6

3. (D8) Color LED on A1 - C1 with positive on C1
4. (M1) Motor on A3 - C3 with positive on A3

Third Layer
1. Fan on (M1) Motor

Project 96: Wave & Watch

Turn on the slide switch (S1), the color LED (D8) flickers. Wait a few seconds, and then cover the photoresistor (RP), and the flicker stops. The flicker is controlled by the photoresistor; uncover it and the flicker resumes. People who are deaf need lights to tell them when a doorbell is ringing. They also use circuits like this to tell them if an alarm has been triggered or an oven is ready. Can you think of other uses?

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (RP) Photoresistor (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on E8 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on A8 - D8
4. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
5. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6

Second Layer
1. 3-Snap Wire on A2 - C2
2. 3-Snap Wire on A5 - C5
3. 2-Snap Wire on D3 - D4
4. 1-Snap Wire on C6
5. 1-Snap Wire on E8
6. (S1) Slide Switch on A6 - A8
7. (RP) Photoresistor on A3 - C3

8. (D8) Color LED on D6 - D8 with positive on D8
9. Jumper Wire (Black) on D1 - E6

Third Layer
1. 2-Snap Wire on C5 - C6
2. 2-Snap Wire on D8 - E8

Project 97: Wave & Watch (II)

Use Project 96 to build this circuit but move the 2-snap wire and 1-snap wire connecting grid points C5 - C6 and instead connect them across grid points C4 - C5. Cover and uncover the photoresistor several times. The color LED light pattern is different.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (RP) Photoresistor (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on E8 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on A8 - D8
4. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
5. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6

Second Layer
1. 3-Snap Wire on A2 - C2
2. 3-Snap Wire on A5 - C5
3. 2-Snap Wire on D3 - D4
4. 1-Snap Wire on C4
5. 1-Snap Wire on E8
6. (S1) Slide Switch on A6 - A8
7. (RP) Photoresistor on A3 - C3
8. (D8) Color LED on D6 - D8 with positive on D8

9. Jumper Wire (Black) on D1 - E6

Third Layer
1. 2-Snap Wire on C4 - C5
2. 2-Snap Wire on D8 - E8

Project 98: Wave & Watch (III)

Use Project 97 to build this circuit but replace the color LED with the lamp (L1).

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (3)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- Jumper Wire (Black)
- (U1) Music IC (1)
- (U2) Alarm IC (1)

First Layer
1. (B1) Battery holder on E8 and GND on E6
2. 5-Snap Wire on A2 - A6
3. 4-Snap Wire on A8 - D8
4. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
5. (U2) Alarm IC with 3-snap on top, covering C4 - C6 and D4 - D6

Second Layer
1. 3-Snap Wire on A2 - C2
2. 3-Snap Wire on A5 - C5
3. 2-Snap Wire on D3 - D4
4. 1-Snap Wire on C4
5. 1-Snap Wire on E8
6. (S1) Slide Switch on A6 - A8
7. (RP) Photoresistor on A3 - C3
8. (L1) Lamp on D6 - D8 with positive on D8
9. Jumper Wire (Black) on D1 - E6

Third Layer

1. 2-Snap Wire on C4 - C5
2. 2-Snap Wire on D8 - E8

Project 99: Singing Spinner

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

Turn on the slide switch (S1). Push the press switch and cover/uncover the photoresistor (RP) to light the color LED (D8) and make the motor (M1) spin the fan at different speeds. The motor also produces sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (1)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (RP) Photoresistor (1)
- (M1) Motor (1)
- Fan (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on F1 - F3
4. 1-Snap Wire on B3
5. (U3) Space War IC with 3-snap on bottom, covering C1 - C3 and D1 - D3

Second Layer

1. 4-Snap Wire on A5 - D5
2. 3-Snap Wire on A1 - C1
3. 3-Snap Wire on D2 - F2
4. 2-Snap Wire on B3 - C3
5. 1-Snap Wire on F5
6. (S2) Press Switch on D1 - F1
7. (RP) Photoresistor on D3 - F3

Third Layer

1. (D8) Color LED on B3 - B5 with positive on B5
2. (M1) Motor on C3 - C5 with positive on C5
3. (S1) Slide Switch on F3 - F5

Fourth Layer

1. Fan on (M1) Motor

Project 100: Whistling Spinner

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

Use Project 99 to build this circuit but add the whistle chip (WC) directly under the motor. The sound is louder now. The press switch (S2) may only work when the photoresistor (RP) is covered.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (1)
- 1-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (RP) Photoresistor (1)
- (M1) Motor (1)
- (WC) Whistle Chip (1)
- Fan (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on F1 - F3
4. 1-Snap Wire on B3
5. (U3) Space War IC with 3-snap on bottom, covering C1 - C3 and D1 - D3

Second Layer

1. 4-Snap Wire on A5 - D5

2. 3-Snap Wire on A1 - C1
3. 3-Snap Wire on D2 - F2
4. 2-Snap Wire on B3 - C3
5. 1-Snap Wire on F5
6. (S2) Press Switch on D1 - F1
7. (RP) Photoresistor on D3 - F3

Third Layer
1. (D8) Color LED on B3 - B5 with positive on B5
2. (WC) Whistle Chip on C3 - C5
3. (S1) Slide Switch on F3 - F5

Fourth Layer
1. (M1) Motor on C3 - C5 with positive on C5

Fifth Layer
1. Fan on (M1) Motor

Project 101: Light Makes Light

Build the circuit with the parts list and the steps that are given. Cover the photoresistor (RP), turn the switch on, and notice that the color LED (D8) is on for several seconds and then goes off. Uncover the photoresistor and place the unit near a light and the LED will light. Cover the photoresistor (RP) again and the LED (D8) will turn off.

The resistance of the photoresistor (RP) decreases as the light increases. If the photoresistor's resistance is low enough it activates the music IC (U1), which controls the voltage to the color LED, making it light up.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (RP) Photoresistor (1)
- (D8) Color LED (1)
- (U1) Music IC (1)

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on E1 - E4
4. (D8) Color LED on B4 - D4 with positive on B4
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on A4 - B4
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on D1 - E1
5. 2-Snap Wire on E4 - E5
6. (S1) Slide Switch on A5 - C5
7. (RP) Photoresistor on A3 - C3

Project 102: Go & Glow

Use Project 101 to build this circuit, but connect the motor (M1, without the fan) across grid points A1 - C1 and remove the photoresistor (RP). Turn the switch on and the color LED (D8) lights up for several seconds then goes out. Now spin the shaft of the motor and the LED will light up again.

Inside the motor is a magnet and a coil. When the motor shaft turns, the magnetic field will change and generate a small voltage across the coil. This voltage then activates the music IC.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (M1) Motor (1)
- (D8) Color LED (1)
- (U1) Music IC (1)

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5

3. 4-Snap Wire on E1 - E4
4. (D8) Color LED on B4 - D4 with positive on B4
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on A4 - B4
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on D1 - E1
5. 2-Snap Wire on E4 - E5
6. (S1) Slide Switch on A5 - C5
7. (M1) Motor on A1 - C1 with positive on A1

Project 103: Not Circuit

Build the circuit using the parts list and the steps that are given. Notice that when the press switch (S2) is pressed, the color LED (D8) goes off. This is an example of an inverter circuit, or NOT gate. Whenever the input is high (switch is on), the output is low (LED is off) and whenever the input is low (switch is off) the output is high (LED is on). Ignore any sound coming from the speaker (SP). Disassemble the circuit when finished to avoid draining your batteries.

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

The speaker is used here to load the batteries, so there will not be a short circuit when S2 is pressed. The speaker will make a little noise as the color LED changes the circuit current as it changes colors.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (D8) Color LED piece.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (3)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5

2. 3-Snap Wire on A1 - A3
3. 3-Snap Wire on C1 - C3

Second Layer

1. 3-Snap Wire on C3 - C5
2. (S2) Press Switch on A1 - C1
3. (D8) Color LED on A2 - C2 with positive on A2
4. (SP) Speaker on A3 - A5

Project 104: This OR That

Build the circuit using the parts list and the steps that are given. Notice that if you turn on the slide switch (S1) OR press the press switch (S2) the lamp (L1) lights up. There is no partially lit state here, the lamp is either totally on or totally off. While this may seem very simple and boring, it represents an important concept in electronics. Two switches like this may be used to turn on a light in your house, or they might be two sensors at a railroad crossing used to start the ding-ding sound and lower the gate. You could also have more than two switches and the circuit would function the same way.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece with the positive on C3. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on A1 - A3
3. 3-Snap Wire on C1 - C3

Second Layer

1. 3-Snap Wire on A3 - A5

2. (S1) Slide Switch on A1 - C1
3. (S2) Press Switch on A2 - C2
4. (L1) Lamp on C3 - C5

Project 105: This AND That

Build the circuit using the parts list and the steps that are given. Notice that if you turn on the slide switch (S1) AND press the press switch (S2) the lamp (L1) lights up. Once again, there is no partially lit state here, the lamp is either totally on or totally off. Two switches like this may be used to turn on the same light in your house: the room switch and the master switch in the electrical box. You could also have more than two switches and the circuit would function the same way.

This circuit is commonly called an AND gate. AND gates are used in digital logic circuits to perform logical multiplies. When one of the inputs is low (one of the switches is off) the output is low (lamp off). The output will only be high (lamp on) if both inputs are high (both switches are on). Combinations of AND and OR circuits are used to add and multiply numbers together in modern computers. These circuits are made of tiny transistors in massive integrated circuits.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece with positive on A1. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (L1) Lamp piece.

<u>Parts Needed</u>

- (B1) Battery holder
- 3-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)

<u>First Layer</u>

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on A1 - A3
3. (S1) Slide Switch on C1 - C3

<u>Second Layer</u>

1. 3-Snap Wire on A3 - A5
2. (S2) Press Switch on C3 - C5
3. (L1) Lamp on A1 - C1

Project 106: Neither This NOR That

Build the circuit using the parts list and the steps that are given. Test the combinations of the slide switch (S1) and press switch (S2). If you compare it to the OR circuit in Project 104, you can see the color LED (D8) lights in the opposite combinations of when the lamp lit in that circuit. Hence, we refer to it as a NOR circuit (short for "NOT this OR that"). Like the OR and AND, it is an important building block in computers. Disassemble the circuit when finished to avoid draining your batteries.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece with positive on A3.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (3)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on A1 - A3
3. 3-Snap Wire on C1 - C3

Second Layer

1. 3-Snap Wire on C3 - C5
2. (SP) Speaker on A3 - A5
3. (S1) Slide Switch on A1 - C1
4. (S2) Press Switch on A2 - C2

Third Layer

1. (D8) Color LED on A3 - C3 with positive on A3

Project 107: Neither This AND That

Build the circuit using the parts list and the steps that are given. Test the combinations of the slide switch (S1) and press switch (S2). If you compare it to the AND circuit in Project 105, you can see the color LED (D8) lights in

the opposite combinations of when the lamp lit in that circuit. Hence, we refer to it as a NAND circuit (short for "NOT this AND that"). This circuit can also have more or less than two inputs, though when it only has one input it is referred to as a NOT circuit. Like the OR, AND, and NOR, NAND and NOT are important building blocks in computers. Disassemble the circuit when finished to avoid draining your batteries.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (D8) Color LED piece with positive on A3.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on C1 - C3
3. (S2) Press Switch on A1 - A3

Second Layer

1. 3-Snap Wire on C3 - C5
2. (SP) Speaker on A3 - A5
3. (S1) Slide Switch on A1 - C1

Third Layer

1. (D8) Color LED on A3 - C3 with positive on A3

Project 108: Morse Code

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

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

Years ago Native Americans would send messages to other tribes using smoke signals and a special code.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece with positive on A3. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (L1) Lamp piece.

Parts Needed

- (B1) Battery holder

- 3-Snap Wire (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)

First Layer

1. (B1) Battery holder on A3 and GND on C3
2. 3-Snap Wire on A1 - C1

Second Layer

1. (S2) Press Switch on C1 - C3
2. (L1) Lamp on A1 - A3

Project 109: Spinning Rings

Setup: Cut out the disc on the last page that is indicated for Project 109. Using tape, attach the disc with the printed side up on the top of the fan blade. Place the blade on the motor. When the press switch (S2) is pressed, the arcs will turn into colored rings with a black background. Notice how the color drops in brightness when it is stretched to make a complete circle.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S2) Press Switch (1)
- (M1) Motor (1)
- Fan (1)
- Cut Out Disk

First Layer

1. (B1) Battery holder on A10 and GND on C10
2. 3-Snap Wire on A7 - A9
3. (S2) Press Switch on D8 - D10
4. (M1) Motor on B7 - D7 with positive on B7

Second Layer

1. 2-Snap Wire on A7 - B7
2. 2-Snap Wire on A9 - A10
3. 2-Snap Wire on D7 - D8
4. 2-Snap Wire on C10 - D10
5. Fan on (M1) Motor with the Printed Disk on top of the Fan

Project 110: Strobe the House Lights

Project 110 requires a fluorescent light with a T12 bulb (1.5” diameter) that runs on normal house current. Place the Spinning Rings circuit (Project 109) under the fluorescent light. Start the disc spinning and release the press switch (S2). As the speed changes you will notice the white lines first seem to move in one direction then they start moving in another direction.

This effect is because the lights are blinking 120 times a second and the changing speed of the motor is acting like a strobe light to catch the motion at certain speeds. To prove this, try the same test with a flashlight. The light from a flashlight is constant and if all other lights are out, you will not see the effect that looks like a helicopter blade in a movie. This does not work with newer fluorescent lights because they use an electronic ballast and produce a constant light.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S2) Press Switch (1)
- (M1) Motor (1)
- Fan (1)
- Cut Out Disk
- T12 Bulb

First Layer

1. (B1) Battery holder on A10 and GND on C10
2. 3-Snap Wire on A7 - A9
3. (S2) Press Switch on D8 - D10
4. (M1) Motor on B7 - D7 with positive on B7

Second Layer

1. 2-Snap Wire on A7 - B7
2. 2-Snap Wire on A9 - A10
3. 2-Snap Wire on D7 - D8
4. 2-Snap Wire on C10 - D10
5. Fan on (M1) Motor with the Printed Disk on top of the Fan

Project 111: Race Game

Modify Project 110 by adding the pointer. The paper should be cut from the last page and taped high enough on the speaker so the pointer will stick over the fan with paper. Bend the pointer at a right angle.

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

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

Parts Needed

- (B1) Battery holder
- 1-Snap Wire (3)
- 2-Snap Wire (4)
- 3-Snap Wire (1)
- (S2) Press Switch (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- Fan (1)
- Cut Out Disk
- T12 Bulb
- Cut Out Grid
- Cut Out Pointer

First Layer

1. Cut Out Grid pressed onto the Base Grid
2. (B1) Battery holder on A10 and GND on C10
3. 3-Snap Wire on A7 - A9
4. 1-Snap Wire on G1
5. 1-Snap Wire on G2
6. 1-Snap Wire on G3
7. (S2) Press Switch on D8 - D10
8. (M1) Motor on B7 - D7 with positive on B7
9. (SP) Speaker on E5 - G5

Second Layer

1. 2-Snap Wire on A7 - B7

2. 2-Snap Wire on A9 - A10
3. 2-Snap Wire on D7 - D8
4. 2-Snap Wire on C10 - D10
5. Fan on (M1) Motor with the Printed Disk on top of the Fan
6. Cut Out Pointer on (SP) Speaker

Project 112: Two-way Light Switch

Build the circuit using the parts list and the steps that are given. Note that two of the 2-snaps are left unconnected on one end because they will be used as switches in this project. If you connect the free ends of each of these 2-snaps both to the "high bar" or positions B in the figure or both to the "low bar" or positions A in the figure, the lamp (L1) lights. But if you connect the free end of one of the 2-snaps to the "high bar" and the free end of the other 2-snap to the "low bar", then the lamp does not light.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece with positive on A1. For those who are blind or low vision and are deaf or hard of hearing, use (M4) Motor and Wind Fan in place of (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 2-Snap Wire (4)
- 3-Snap Wire (2)
- 5-Snap Wire (1)
- (L1) Lamp (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on D1 - D3
3. 3-Snap Wire on C2 - C4
4. 2-Snap Wire on D4 - D5
5. (L1) Lamp on A1 - C1

Second Layer

1. 5-Snap Wire on A1 - A5
2. 2-Snap Wire on C1
3. 2-Snap Wire on D4
4. 2-Snap Wire on C5 - D5

Project 113: Machine Gun Buzz

Build the circuit using the parts list and the steps that are given. Turn on the switch (S1) and you will hear a machine gun and a buzzing sound, while the color LED (D8) is changing colors.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 5-Snap Wire on E1 - E5
3. 1-Snap Wire on C3
4. (SP) Speaker on A4 - C4
5. (U2) Alarm IC with 3-snap on top, covering A1 - A3 and B1 - B3

Second Layer

1. 4-Snap Wire on B1 - E1
2. 2-Snap Wire on A2 - A3
3. 2-Snap Wire on A4 - A5
4. 2-Snap Wire on B3 - C3
5. (S1) Slide Switch on C5 - E5
6. (D8) Color LED on C4 - E4

Third Layer

1. 2-Snap Wire on A3 - A4
2. 2-Snap Wire on C3 - C4

Project 114: Double Flash Machine Gun

Use Project 113 to build this circuit but add the lamp (L1) across the grid points A3 - C3, on Layer 4.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)

- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- (L1) Lamp (1)
- (U2) Alarm IC (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 5-Snap Wire on E1 - E5
3. 1-Snap Wire on C3
4. (SP) Speaker on A4 - C4
5. (U2) Alarm IC with 3-snap on top, covering A1 - A3 and B1 - B3

Second Layer

1. 4-Snap Wire on B1 - E1
2. 2-Snap Wire on A2 - A3
3. 2-Snap Wire on A4 - A5
4. 2-Snap Wire on B3 - C3
5. (S1) Slide Switch on C5 - E5
6. (D8) Color LED on C4 - E4

Third Layer

1. 2-Snap Wire on A3 - A4
2. 2-Snap Wire on C3 - C4

Fourth Layer

1. (L1) Lamp on A3 - C3

Project 115: Mind Reader Game

Build the circuit using the parts list and the steps that are given. It uses the red jumper wire and a 3-Snap Wire as "shorting bars".

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

The object is for Player 2 to guess the location by placing the loose end of the red jumper wire on the 5-snap wire at positions A, B, or C and then pressing the press switch (S2). If Player 2 places the red jumper wire at the correct position, the sounds played indicate a "hit". They keep guessing until they get a hit. After each hit, remove the 3-snap shorting bar and slide

the switch off and on to reset the sound. Player 2 then sets the 2, 3, 4 side and player 1 tries their luck.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece with positive on A5.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- Jumper Wire (Red)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on G1 - G5
3. 4-Snap Wire on B4 - B7
4. 2-Snap Wire on D1 - E1
5. 2-Snap Wire on D2 - E2
6. 2-Snap Wire on D3 - E3
7. 1-Snap Wire on G7
8. (L1) Lamp on A3 - A5
9. (U3) Space War with 3-snap on Bottom, covering D4 - D6 and E4 - E6

Second Layer

1. 3-Snap Wire on B4 - D4
2. 3-Snap Wire on E5 - G5
3. 2-Snap Wire on A5 - B5
4. 2-Snap Wire on B7 - C7
5. (SP) Speaker on B6 - D6
6. (S1) Slide Switch on E7 - G7
7. Jumper Wire (Red) on A3
8. Jumper Wire (Black) on E4

Third Layer

1. Jumper Wire (Black) other end on A3
2. (S2) Press Switch on G5 - G7

Project 116: Fuse

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

Pretend the 3-snap wire marked as fuse is a device that will open the circuit if too much current is taken from the battery. When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), the lamp (L1), motor (M1), and back to the battery (B1). When press switch (S2) is closed, the light is shorted and motor speed increases due to an increase in current to the motor. While still holding press switch (S2) down, remove the 3-snap wire marked fuse and notice how everything stops. Until the fuse is replaced, the open circuit path protects the electronic parts. If fuses did not exist, many parts could get hot and even start fires. Replace the 3-snap wire and the circuit should return to normal.

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

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece with positive on D4.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (2)
- 2-Snap Wire (2)
- (S1) Slide Switch (1)
- (S2) Press Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- Fan (1)

First Layer

1. (B1) Battery holder on B5 and GND on D5
2. 2-Snap Wire on D1 - E1
3. 2-Snap Wire on D3 - E3
4. (M1) Motor on B1 - B3 with positive on B3

Second Layer

1. 3-Snap Wire on B1 - D1
2. 3-Snap Wire on B3 - B5 marked as fuse
3. (S1) Slide Switch on D3 - D5
4. (S2) Press Switch on E1 - E3
5. Fan on (M1) Motor

Third Layer

1. (L1) Lamp on D1 - D3

Project 117: Water Activated Space War

WARNING: Don't drink any water used here.

Build the circuit using the parts list and the steps that are given. This includes the red and black jumper wires going between the circuit and the cup of water shown. There will be sound when you push the press switch (S2) or when the jumper wires are in the water. Pushing the press switch or placing the jumper wires out and then back into the water will change the sound played. Next, wet your fingers and touch them to the metal snaps on the ends of the jumper wires to activate the sound.

Normal tap water can conduct electricity due to the impurities in it. Your body can also conduct electricity because your body is mostly water.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (2)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- Jumper Wire (Red)
- (U3) Space War IC (1)
- Cup of Water

First Layer

1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on F2 - F4
4. (U3) Space War with 3-snap on Bottom, covering C1 - C3 and D1 - D3

Second Layer

1. 4-Snap Wire on A5 - D5
2. 3-Snap Wire on A1 - C1
3. 3-Snap Wire on D2 - F2
4. 2-Snap Wire on F4 - F5
5. (S2) Press Switch on D3 - F3
6. (D8) Color LED on A3 - C3 with positive on A3
7. Jumper Wire (Red) on D1 and in the Cup of Water

Third Layer

1. Jumper Wire (Black) on F2 and in the Cup of Water
2. (SP) Speaker on C3 - C5

Project 118: Water Activated Whistle War

WARNING: Don't drink any water used here.

Use Project 117 to build the circuit. Replace the speaker (SP) with the whistle chip (WC). If desired, place the lamp (L1) or the motor (M1, "+" on right, with the fan) on top of the whistle chip for more effects.

Normal tap water can conduct electricity due to the impurities in it. Your body can also conduct electricity because your body is mostly water.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (2)
- 2-Snap Wire (2)
- (S2) Press Switch (1)
- (D8) Color LED (1)
- (WC) Whistle Chip (1)
- Jumper Wire (Black)
- Jumper Wire (Red)
- (U3) Space War IC (1)
- Cup of Water

First Layer

1. (B1) Battery holder on D5 and GND on F5
2. 5-Snap Wire on A1 - A5
3. 3-Snap Wire on F2 - F4
4. (U3) Space War with 3-snap on Bottom, covering C1 - C3 and D1 - D3

Second Layer

1. 4-Snap Wire on A5 - D5
2. 3-Snap Wire on A1 - C1
3. 3-Snap Wire on D2 - F2
4. 2-Snap Wire on F4 - F5
5. (S2) Press Switch on D3 - F3
6. (D8) Color LED on A3 - C3 with positive on A3
7. Jumper Wire (Red) on D1 and in the Cup of Water

Third Layer

1. Jumper Wire (Black) on F2 and in the Cup of Water
2. (WC) Whistle Chip on C3 - C5

Project 119: Space War Sensor

Turn on the slide switch (S1). Sound plays for a while and stops. Spin the motor (M1) top with your fingers to re-start the sound. The lamp (L1) in this circuit is used as a 3-snap wire and will not light.

Think of this as having motion or sound sensors that activate space defense weapons.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- (M1) Motor (1)
- (U1) Music IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on E1 - E5
3. 4-Snap Wire on A1 - A4
4. 2-Snap Wire on A6 - A7
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
6. (U3) Space War with 3-snap on Bottom, covering C4 - C6 and D4 - D6

Second Layer

1. 3-Snap Wire on A2 - C2
2. 3-Snap Wire on A4 - C4
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 1-Snap Wire on D5
6. (S1) Slide Switch E5 - E7
7. (M1) Motor on A1 - C1 with positive on A1
8. (SP) Speaker on A6 - C6
9. (L1) Lamp on A7 - C7

Third Layer

1. 3-Snap Wire on A4 - A6
2. 2-Snap Wire on D5 - E5

Project 120: Space War Sensor (II)

Use Project 119 to build the circuit. Replace the motor with the whistle chip (WC). When the sound stops, re-start the sound by clapping loudly next to the whistle chip, or blowing on it, or tapping on it.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (SP) Speaker (1)
- (WC) Whistle Chip (1)
- (U1) Music IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on E1 - E5
3. 4-Snap Wire on A1 - A4
4. 2-Snap Wire on A6 - A7
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
6. (U3) Space War with 3-snap on Bottom, covering C4 - C6 and D4 - D6

Second Layer

1. 3-Snap Wire on A2 - C2
2. 3-Snap Wire on A4 - C4
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 1-Snap Wire on D5
6. (S1) Slide Switch E5 - E7
7. (WC) Whistle Chip on A1 - C1
8. (SP) Speaker on A6 - C6
9. (L1) Lamp on A7 - C7

Third Layer

1. 3-Snap Wire on A4 - A6
2. 2-Snap Wire on D5 - E5

Project 121: Space War Sensor (III)

Use Project 119 to build this circuit. Replace the speaker (SP) with the color LED (D8, "+" on top).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (3)
- 2-Snap Wire (4)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (D8) Color LED (1)
- (M1) Motor (1)
- (U1) Music IC (1)
- (U3) Space War IC (1)

First Layer

1. (B1) Battery holder on C7 and GND on E7
2. 5-Snap Wire on E1 - E5
3. 4-Snap Wire on A1 - A4
4. 2-Snap Wire on A6 - A7
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3
6. (U3) Space War with 3-snap on Bottom, covering C4 - C6 and D4 - D6

Second Layer

1. 3-Snap Wire on A2 - C2

2. 3-Snap Wire on A4 - C4
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 1-Snap Wire on D5
6. (S1) Slide Switch E5 - E7
7. (M1) Motor on A1 - C1 with positive on A1
8. (D8) Color LED on A6 - C6 with positive on A6
9. (L1) Lamp on A7 - C7

Third Layer
1. 3-Snap Wire on A4 - A6
2. 2-Snap Wire on D5 - E5

Project 122: Motion Activated Light

Turn on the slide switch (S1). The lamp (L1) flickers for a while and then stops. Spin the motor (M1) with your fingers to resume the flickering. You can replace the lamp with the color LED (D8).

Accessibility Note - For those who are blind or low vision use (W1) Horn instead of the (L1) Lamp piece.

Parts Needed
- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (M1) Motor (1)
- (U1) Music IC (1)

First Layer
1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on E1 - E4
4. (L1) Lamp on B4 - D4
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer
1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on A4 - B4
3. 2-Snap Wire on D1 - E1

4. 2-Snap Wire on D3 - D4
5. 2-Snap Wire on E4 - E5
6. (S1) Slide Switch A5 - C5
7. (M1) Motor on A1 - C1 with positive on A1

Project 123: Lighty Light

Use Project 122 to build the circuit. Remove the motor and add the photoresistor (RP) across grid points A3 - C3. If there is light on the photoresistor (RP) then the lamp flickers. Cover the photoresistor with your finger to turn off the light.

The upper-left snap on the music IC (U1) is triggered by an electrical pulse. The upper-right snap is controlled by a continuous voltage.

Accessibility Note - For those who are blind or low vision, use (W1) Horn instead of the (L1) Lamp piece.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 3-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (L1) Lamp (1)
- (RP) Photoresistor (1)
- (U1) Music IC (1)

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on E1 - E4
4. (L1) Lamp on B4 - D4
5. (U1) Music IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer

1. 3-Snap Wire on A2 - C2
2. 2-Snap Wire on A4 - B4
3. 2-Snap Wire on D1 - E1
4. 2-Snap Wire on D3 - D4
5. 2-Snap Wire on E4 - E5
6. (S1) Slide Switch A5 - C5
7. (RP) Photoresistor on A3 - C3

Project 124: Pencil Alarm

Build the circuit using the parts list and steps that are given. Connect the two jumper wires to the circuit as instructed, leaving the loose ends of the jumpers unconnected for now. There is one more part you need, and you are going to draw it. Take a pencil (No. 2 is best but other types will also work). SHARPEN IT and on a piece of paper draw a rectangle and fill it in. You will get better results if you place a hard, flat surface directly beneath this page while you are drawing. Press hard (but don't rip the paper) and fill in the shape several times to be sure you have a thick, even layer.

Turn on the slide switch (S1) and take the loose ends of the jumpers, press them to the shape and move them around over the drawing. If you don't hear any sound then move the ends closer together and move over the drawing, add another layer with the pencil, or put a drop of water on the jumper ends to get better contact.

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

The black core of pencils is graphite, the same material used in resistors (components that resist and control the flow of current).

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 2-Snap Wire (4)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- Jumper Wire (Red)
- (U2) Alarm IC (1)
- Graphite Covered Paper

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on E1 - E4
4. (SP) Speaker on B4 - D4
5. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer

1. 2-Snap Wire on A4 - B4
2. 2-Snap Wire on D1 - E1
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on E4 - E5
5. (S1) Slide Switch on A5 - C5
6. Jumper Wire (Black) on C2 and on the Graphite Covered Paper
7. Jumper Wire (Red) on A2 and on the Graphite Covered Paper

Project 125: Pencil Sirens

Use Project 124 to build the circuit. This includes the piece of paper with the pencil filled rectangle. Connect grid points C2 - C3 using a 2-snap wire and a 1-snap wire. This connection will make a new sound.

Parts Needed

- (B1) Battery holder
- 5-Snap Wire (1)
- 4-Snap Wire (1)
- 2-Snap Wire (5)
- 1-Snap Wire (1)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- Jumper Wire (Black)
- Jumper Wire (Red)
- (U2) Alarm IC (1)
- Graphite Covered Paper

First Layer

1. (B1) Battery holder on C5 and GND on E5
2. 5-Snap Wire on A1 - A5
3. 4-Snap Wire on E1 - E4
4. (SP) Speaker on B4 - D4
5. (U2) Alarm IC with 3-snap on top, covering C1 - C3 and D1 - D3

Second Layer

1. 2-Snap Wire on A4 - B4
2. 2-Snap Wire on D1 - E1
3. 2-Snap Wire on D3 - D4
4. 2-Snap Wire on E4 - E5
5. 1-Snap Wire on C3
6. (S1) Slide Switch on A5 - C5
7. Jumper Wire (Black) on C2 and on the Graphite Covered Paper
8. Jumper Wire (Red) on A2 and on the Graphite Covered Paper

Third Layer

1. 2-Snap Wire on C2 - C3

Project 126: Hear the Motor

Turn on the slide switch (S1). If the shaft on the motor (M1) isn't spinning, then give it a push to get started. Listen to the motor. You can also try this circuit with the fan on the motor.

Why does the motor make sound? A motor uses magnetism to convert electrical energy into mechanical spinning motion. As the motor shaft spins around it connects/disconnects several sets of electrical contacts to give the best magnetic properties. As these contacts are switched, an electrical disturbance is created, which the speaker converts into sound.

Parts Needed

- (B1) Battery holder
- 3-Snap Wire (2)
- (S1) Slide Switch (1)
- (SP) Speaker (1)
- (M1) Motor (1)

First Layer

1. (B1) Battery holder on A5 and GND on C5
2. 3-Snap Wire on A1 - A3
3. 3-Snap Wire on C1 - C3

Second Layer

1. (M1) Motor on A1 - C1
2. (SP) Speaker on A3 - A5
3. (S1) Slide Switch on C3 - C5

Project 127: Electricity You Can Wear

Did you ever wonder why clothes cling together when they come out of the dryer? Did you ever hear a crackling sound when you take off a sweater? (If the room is dark, you might even see sparks.) Did you ever feel a "zap" when you touch someone wearing a sweater on a dry day? These effects are caused by electricity. We call this static electricity because the electrical charges are not moving, although pulling clothes apart sounds like static on a radio. When electricity is moving (usually through wires) to do something in another place, we call it an electric current.

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

Example 1: Find some clothes that cling together in the dryer and try to uncling them.

Example 2: The crackling noise you hear when taking off a sweater is static electricity. You may see sparks when taking one off in a dark room.

Example 3: Rub a sweater (wool is best) and see how it clings to other clothes.

Clothes can cling together because electricity is all around us.

Project 128: Electricity In Your Hair

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

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

Rubbing the comb through your hair pulls extremely tiny, charged particles from your hair onto the comb. These give the comb a static electrical charge, which attracts the paper pieces. Notice how your hair can "stand up" or be attracted to the comb when the air is dry. Wetting your hair dissipates the static charge.

Project 129: Bending Water

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

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

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

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

Project 130: Static Tricks

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

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

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

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

Example 1: Take a piece of newspaper or other thin paper and rub it vigorously with a sweater or pencil. It will stick to a wall.

Example 2: Cut the paper into two long strips, rub them, then hang them next to each other. See if they attract or repel each other.

Example 3: If you have two balloons, rub them on a sweater and then try to touch the rubbed sides to each other. They repel away. You could also use the balloons to pick up tiny pieces of paper.