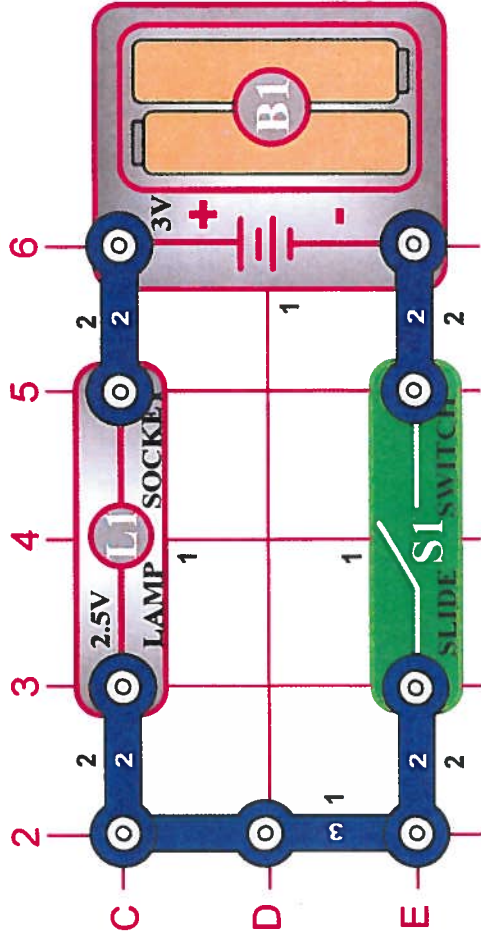


Project #1

Electric Light & Switch

OBJECTIVE: To show how electricity is turned "ON" or "OFF" with a switch.



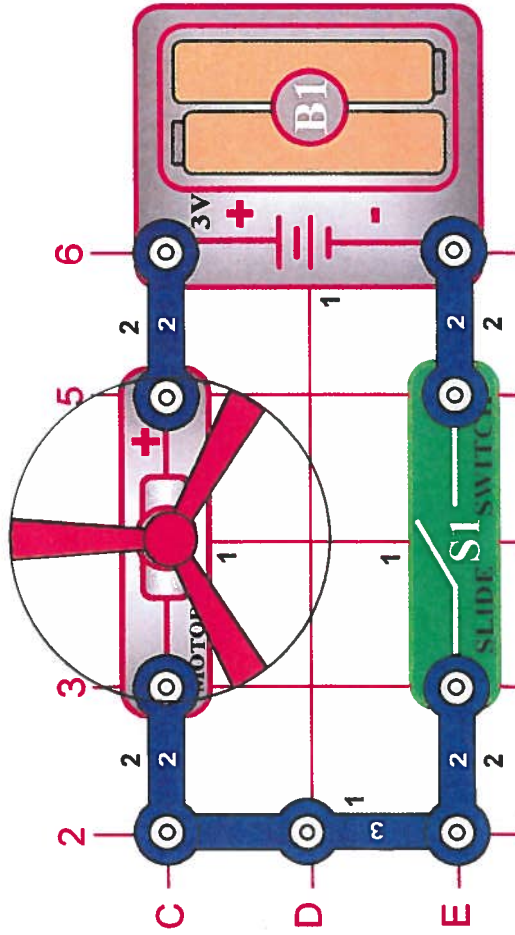
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the base grid first. Then, assemble parts marked with a 2. Install two (2) "AA" batteries (not included) into the battery holder (B1) and screw the bulb into the lamp socket (L1) if you have not done so already.

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

Project #2

DC Motor & Switch

OBJECTIVE: To show how electricity is used to run a Direct Current (DC) Motor.



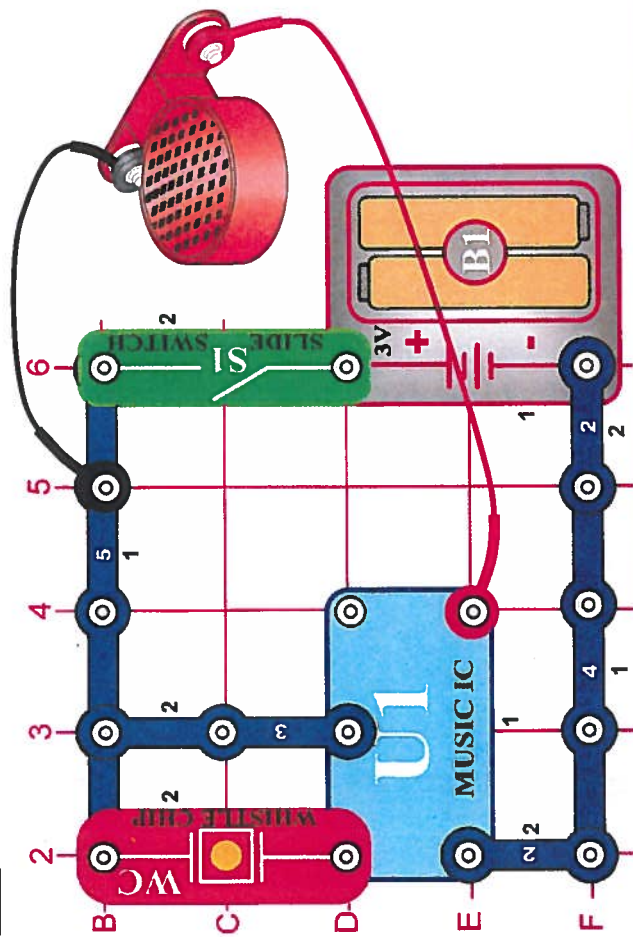
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the base grid first. Then, assemble parts marked with a 2.

When you close the slide switch (S1), current flows from the batteries (B1) through the motor (M1) making it rotate. Place the fan blade on the motor shaft and close the slide switch. The motor will rotate forcing the fan blade to move air past the motor.

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

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

Project #3



Sound Activated Switch

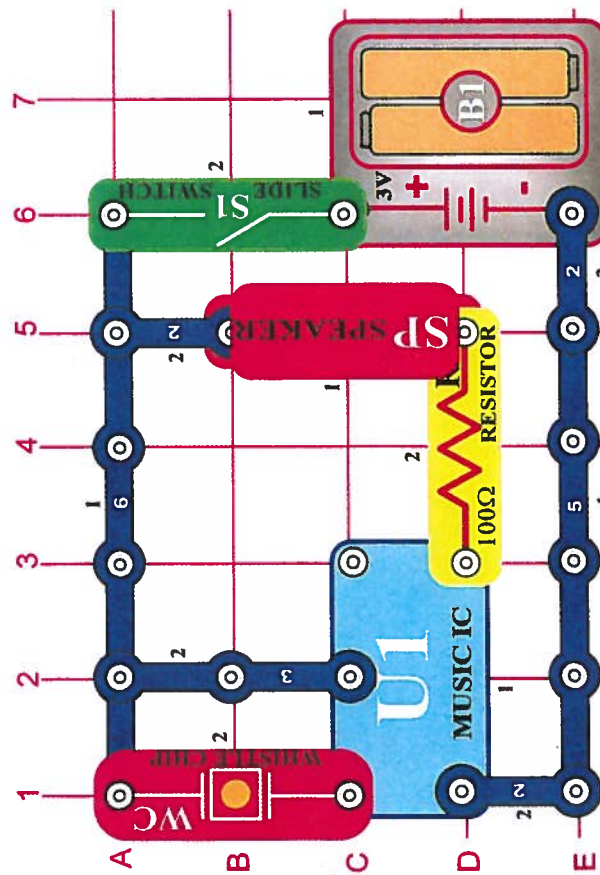
OBJECTIVE: To show how sound can turn "ON" an electronic device.

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

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

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

Project #4



Adjusting Sound Level

OBJECTIVE: To show how resistance can lower the sound from the speaker.

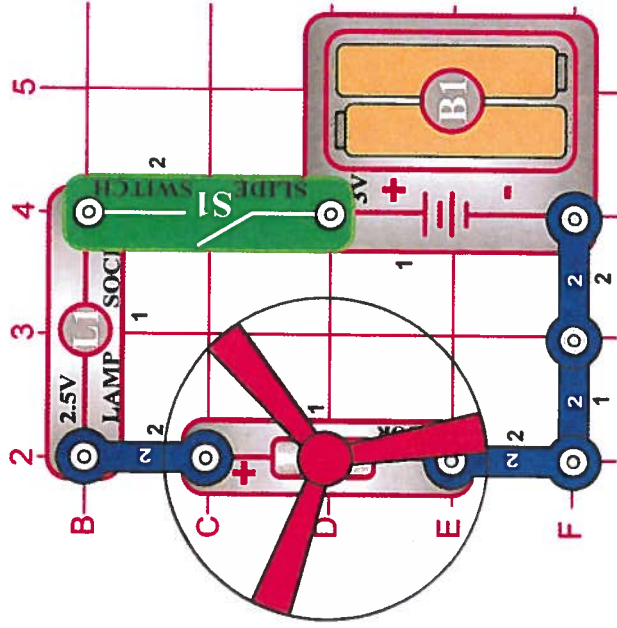
Build the circuit shown on the left. When you close the slide switch (S1), the music may play for a short time and then stop. After the music has stopped, clap your hands close to the whistle chip (WC) or tap the base with your finger. The music should play again for a short time, then stop.

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

Project #5

Lamp & Fan in Series

OBJECTIVE: To show how a lamp can indicate when a fan is running.



Build the circuit shown on the left by placing all the parts with a black 1 next to them on the base grid first. Then, assemble parts marked with a 2. Finally, place the fan blade on the motor (M1).

When you close the slide switch (S1), the fan will spin and the lamp (L1) should turn on. The fan will take a while to start turning due to inertia. Inertia is the property that tries to keep a body at rest from moving and tries to keep a moving object from stopping.

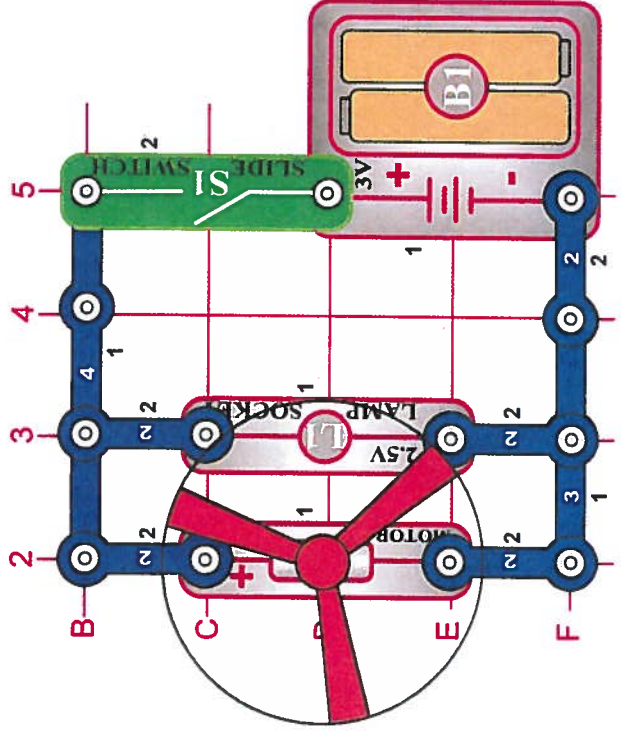
The light helps protect the motor from getting the full voltage when the slide switch is closed. Part of the voltage goes across the lamp and the rest goes across the motor. Remove the fan and notice how the lamp gets dimmer when the motor does not have to spin the fan blade.

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

Project #6

Lamp & Fan in Parallel

OBJECTIVE: To show how an indicator light can be connected without affecting the current in the motor.



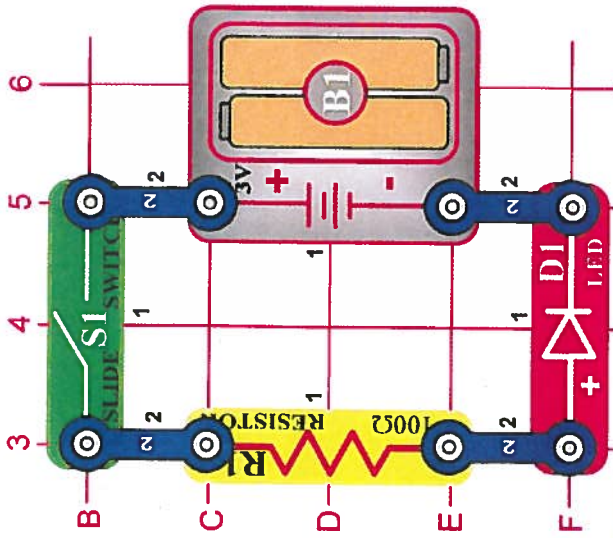
Build the circuit shown on the left.

When you close the slide switch (S1), both the fan and the lamp (L1) should turn on. The fan will take a while to start turning due to inertia. In this connection, the lamp does not change the current to the motor (M1). The motor should start a little faster than in Project #5.

Remove the fan and notice how the lamp does not change in brightness as the motor picks up speed. It has its own path to the battery (B1).

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

Project #7



Light Emitting Diode

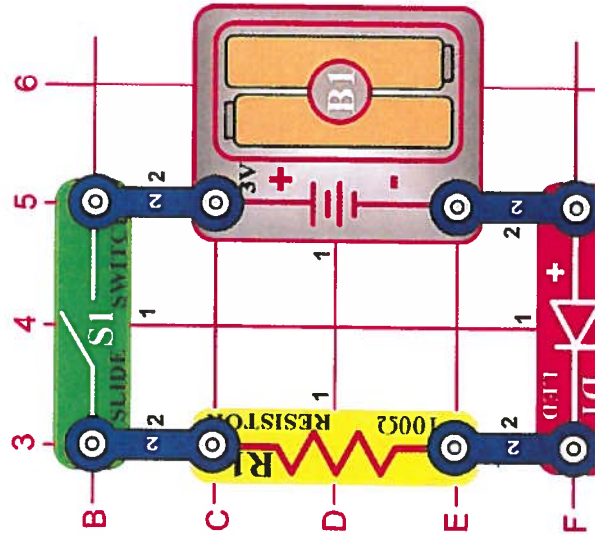
OBJECTIVE: To show how a resistor and LED are wired to emit light.

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

When you close the slide switch (S1), current flows from the batteries (B1) through the slide switch, through the resistor (R1), through the LED (light emitting diode, D1) and back to the battery. The closed slide switch completes the circuit. The resistor limits the current and prevents damage to the LED. NEVER PLACE AN LED DIRECTLY ACROSS THE BATTERY! If no resistor is in the circuit, the battery may push enough current through the LED to damage the semiconductor that is used to produce the light. LEDs are used in all types of electronic equipment to indicate conditions and pass information to the user of that equipment.

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

Project #8



One Direction for LED

OBJECTIVE: To show how electricity can only pass in one direction through an LED.

Rebuild the circuit used in Project #7 but put the LED (D1) in as shown on the left.

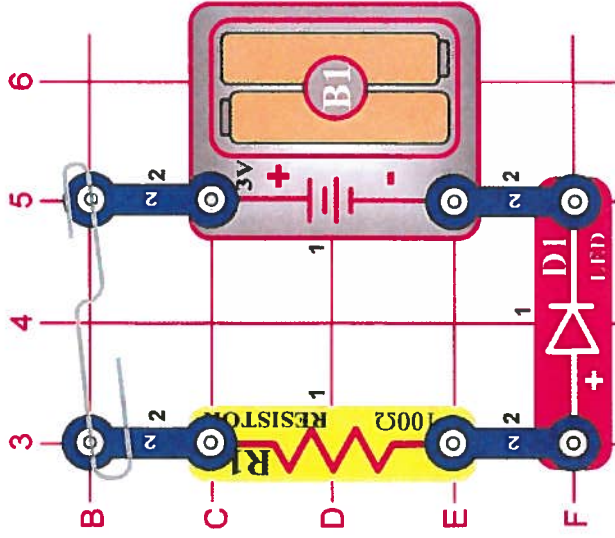
When you close the slide switch (S1), current should flow from the batteries (B1) through the resistor and then through the LED. When current flows through an LED, it lights up. Since the LED is in backwards, current cannot flow. The LED is like a check valve that lets current flow in only one direction.

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

Project #9

Conduction Detector

OBJECTIVE: To make a circuit that detects the conduction of electricity in different materials.



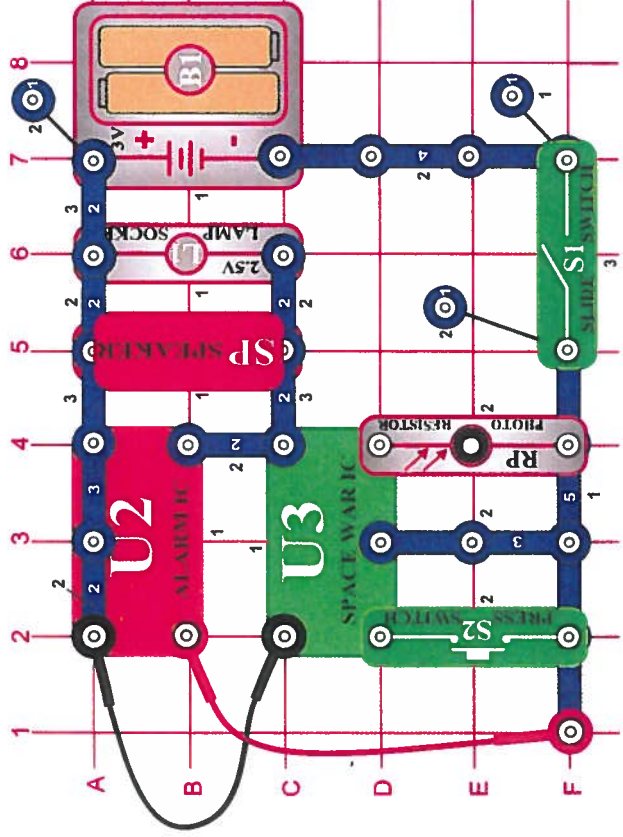
Rebuild the circuit from Project #7 but leave the slide switch (S1) out as shown on the left.

When you place a metal paper clip across the terminals as shown in the picture on the left, current flows from the batteries (B1) through the resistor (R1), through the LED (D1), and back to the battery. The paper clip completes the circuit and current flows through the LED. Place your fingers across the terminals and the LED does not light. Your body has too high of a resistance to allow enough current to flow to light the LED. If the voltage, which is electrical pressure, was higher, current could be pushed through your fingers and the LED would light. This detector can be used to see if a material like plastic is a good conductor or a poor conductor.

Project #10

Space War Alarm Combo

OBJECTIVE: To combine the sounds from the space war and alarm integrated circuits.

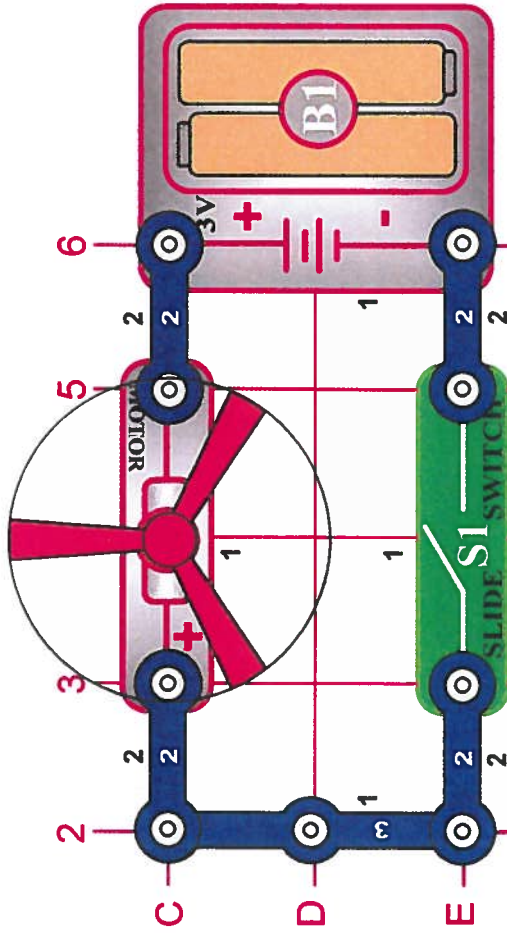


Build the circuit shown and add the jumpers to complete it. Turn it on, press the press switch (S2) several times, and wave your hand over the photoresistor (RP) to hear all the sound combinations. If the sound is too loud you may replace the speaker (SP) with the whistle chip (WC).

Project #11

Flying Saucer

OBJECTIVE: To make a circuit that launches the fan blade to simulate a flying saucer.



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

WARNING: Do not lean over the motor.

Rebuild the circuit from Project #2, but reverse the polarity on the motor (M1) so the negative (-) on the motor goes to the positive (+) on the battery (B1). New alkaline batteries are recommended for this project.

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

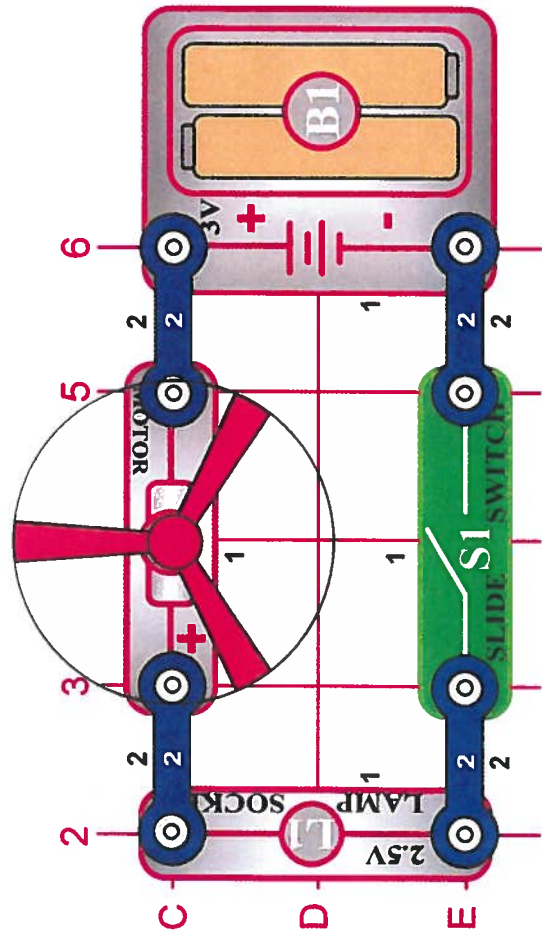
The air is being blown down through the blade and the motor rotation locks the fan on the shaft. When the motor is turned off, the blade unlocks from the shaft and is free to act as a propeller and fly through the air. If speed of rotation is too slow, the fan will remain on motor shaft because it does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

If the fan doesn't fly off, then turn the switch on and off several times rapidly when it is at full speed.

Project #12

Decreasing Saucer Lift

OBJECTIVE: To show how voltage affects speed of a DC motor and can decrease the lift of the saucer.



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

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

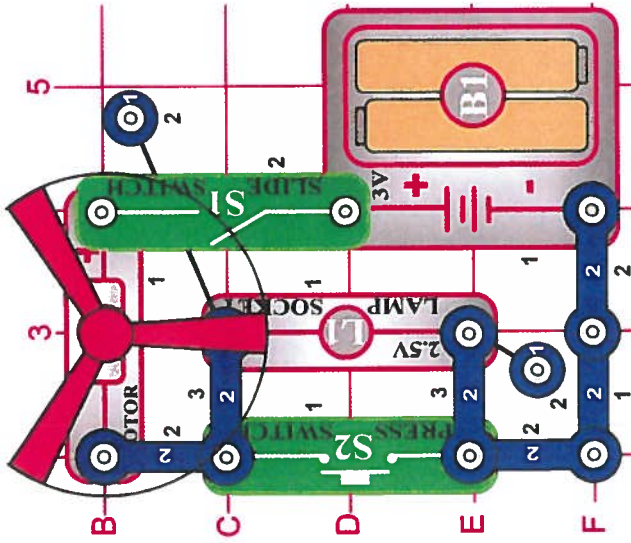
WARNING: Moving parts. Do not touch the fan or motor during operation.

WARNING: Do not lean over the motor.

Project #13

Two-Speed Fan

OBJECTIVE: To show how switches can increase or decrease the speed of an electric fan.



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

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

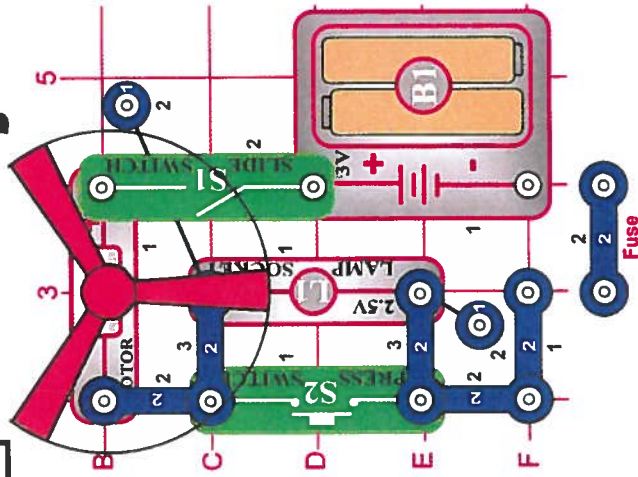
When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), motor (M1), the lamp (L1), and back to the battery (B1). When the press switch (S2) is closed, the lamp is shorted and motor speed increases.

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

Project #14

The Fuse

OBJECTIVE: To show how a fuse is used to break all current paths back to the voltage source.



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

Use the circuit built in Project #13.

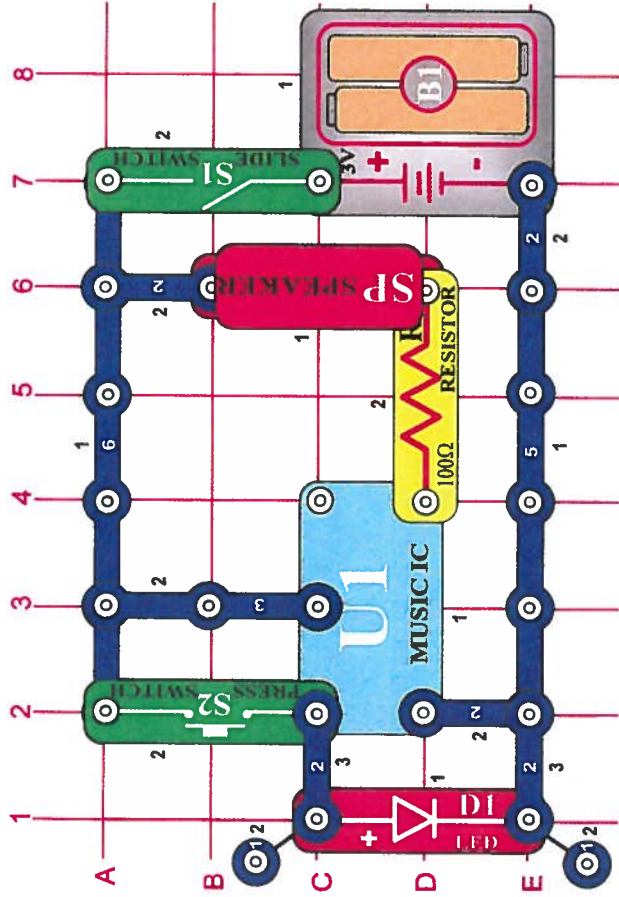
When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), the lamp (L1), motor (M1), and back to the battery (B1). Pretend the 2-snap wire marked fuse in the drawing on the left is a device that will open the circuit if too much current is taken from the battery.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

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

Project #15

Musical Doorbell

OBJECTIVE: To show how an integrated circuit can be used as a musical doorbell.



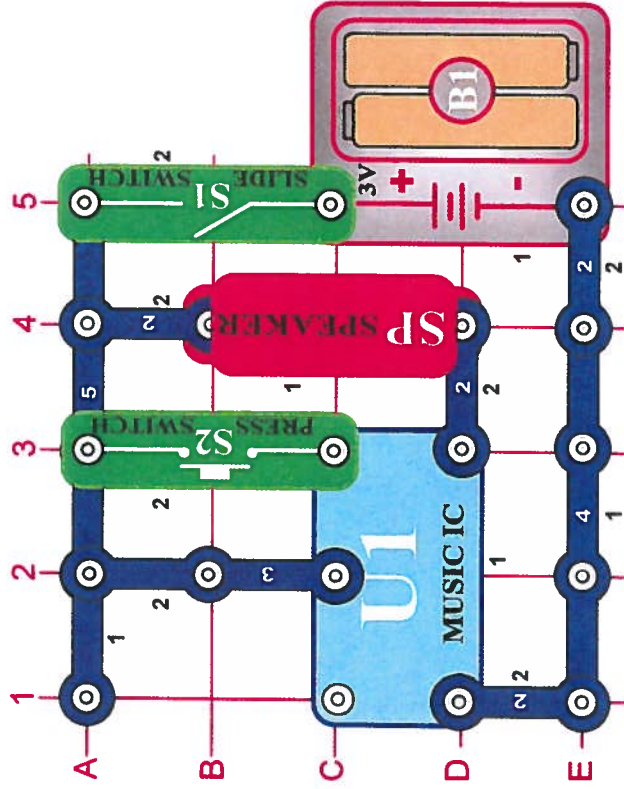
Build the circuit shown on the left. When you close the slide switch (S1), the music integrated circuit (U1) may start playing one song then stop. Each time you press the press switch "doorbell button" (S2) the song will play again and stop. Even if you let go of the press switch (S2), the integrated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

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

Project #16

Momentary Alarm

OBJECTIVE: To show how integrated circuits can also create loud alarm sounds in case of emergencies.

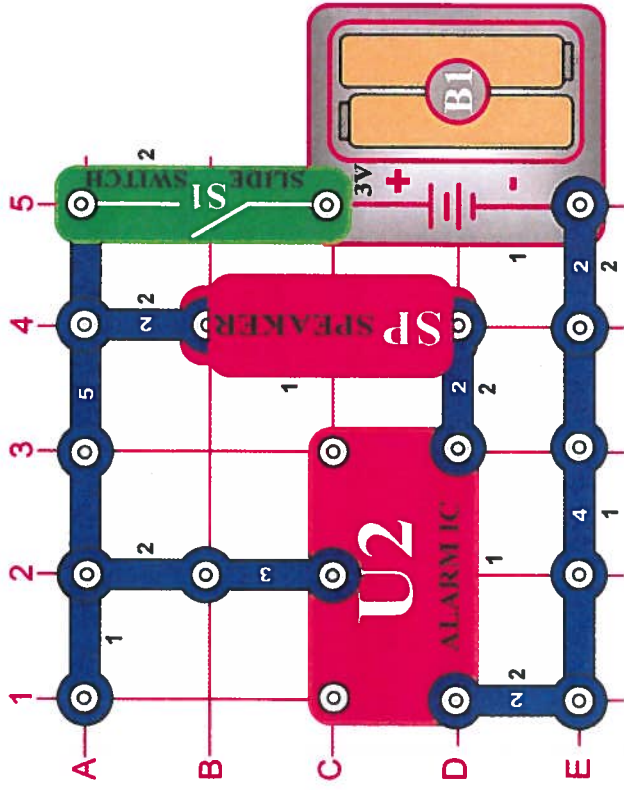


Modify the circuit used in Project #15 to look like the one shown on the left.

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

Project #17

Alarm Circuit



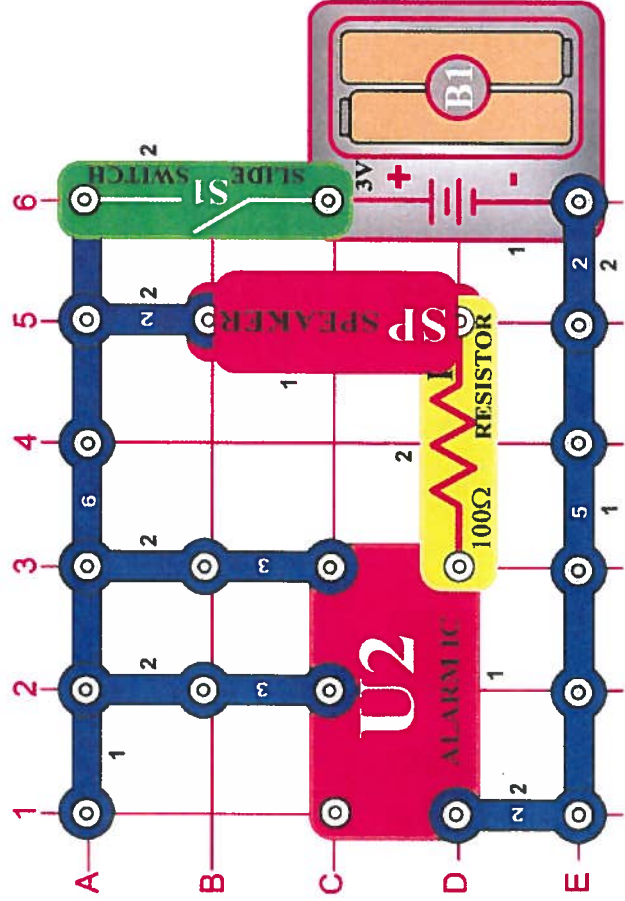
OBJECTIVE: To show how an integrated circuit can be used to make real alarm sounds.

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. When you close the slide switch (S1), the integrated circuit (U2) should start sounding a very loud alarm sound. This integrated circuit is designed to sweep through all the frequencies so even hard of hearing people can be warned by the alarm.

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

Project #18

Laser Gun



OBJECTIVE: To show how integrated circuits sound can easily be changed to exciting space war sounds.

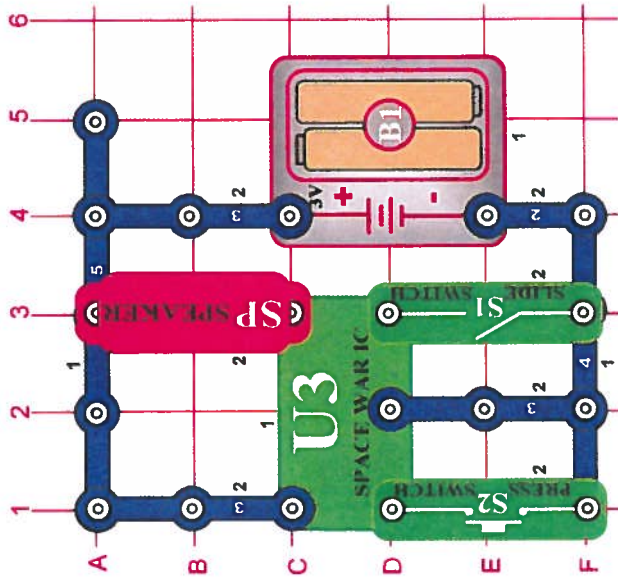
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the base grid first. Then, assemble parts marked with a 2.

When you close the slide switch (S1), the integrated circuit (U2) should start sounding a laser gun sound. This integrated circuit is designed to produce different sounds that can easily be changed. You can even switch the sound on and off quickly to add sound effects to your games or recordings.

Project #19

Space War

OBJECTIVE: To introduce you to the space war integrated circuit and the sounds it can make.



Build the circuit shown on the left, which 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!

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

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

Project #20 Light Switch

OBJECTIVE: To show how light can control a circuit using a photoresistor.



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

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

Project #21 Paper Space War

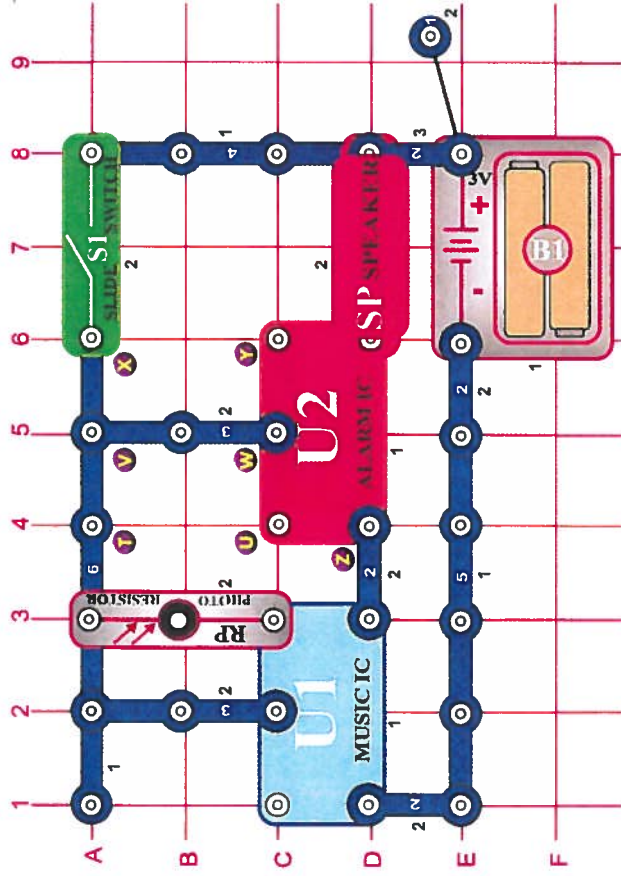
OBJECTIVE: To give a more dramatic demonstration of using the photoresistor.

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



Project #22

Light Police Siren



OBJECTIVE: To build a police siren that is controlled by light.

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

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

Project #23

More Loud Sounds

OBJECTIVE: To show variations of the circuit in Project #22.

Modify the Project #22 by connecting points X & Y. The circuit works the same way but now it sounds like a machine gun with music.

Project #24

More Loud Sounds (II)

OBJECTIVE: To show variations of the circuit in Project #22.

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

Project #25

More Loud Sounds (III)

OBJECTIVE: To show variations of the circuit in Project #22.

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

Project #26

More Loud Sounds (IV)

OBJECTIVE: To show variations of the circuit in Project #22.

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