SNAP CIRCUITS
ELENCO

EXPLORE CODING

Making Coding a Snap®

FEATURING
THE SNAP CIRCUITS® CODING MODULE

SC CONTROLLER

USE THE BLUETOOTH® POWERED MODULE
AND DOWNLOADABLE *SNAP CIRCUITS® APP*
FOR ENDLESS CODING FUN!

AWARD WINNING SNAP CIRCUITS GENUINE BRAND

Hands-On Electronics Learning
Easy App-Driven Projects
Developing STEM Skills in Coding

Requires four (4) "AA" batteries. Not included.
Ages 8 to 108

Download on the App Store
ANDROID APP ON Google play

Project 24

ELENCO®
Learn by doing.

753061

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.

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

CAUTION: The lamp (L2) has a very warm lamp enclosure.

Basic Troubleshooting

1. **Most circuit problems are due to incorrect assembly, always double-check that your circuit exactly matches the drawing for it.**
2. **Be sure that parts with positive/negative markings are positioned as per the drawing.**
3. **Be sure that all connections are securely snapped.**
4. **Try replacing the batteries.**

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 on page 5 to determine which ones need replacing.

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 with 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.

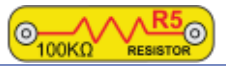
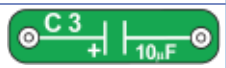
Never modify your parts, as doing so may disable important safety features in them, and could put your child at risk of injury.

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.**
- **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.**

Parts List (Colors and styles may vary) Symbols and Numbers

Important: If any parts are missing or damaged, **DO NOT RETURN TO RETAILER**. Call toll-free (800) 533-2441 or e-mail us at: help@elenco.com.
Customer Service: 150 Carpenter Ave., Wheeling, IL 60090 U.S.A. ● You may order additional / replacement parts at www.elenco.com/replacement-parts

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
❒ 4	1	1- Snap Wire		6SC01	❒ 1	L2	Lamp 6V		6SCL2
❒ 7	2	2- Snap Wire		6SC02	❒ 1	M4	Motor		6SCM4
❒ 4	3	3- Snap Wire		6SC03	❒ 1		Green Fan		6SCM4B
❒ 1	4	4- Snap Wire		6SC04	❒ 1	Q1	PNP transistor		6SCQ1
❒ 1	5	5- Snap Wire		6SC05	❒ 1	Q2	NPN transistor		6SCQ2
❒ 1	6	6- Snap Wire		6SC06	❒ 1	R1	100 ohms Resistor		6SCR1
❒ 2	B1	Battery Holder - uses two (2) 1.5V type "AA" (not Included)		6SCB1	❒ 1	R2	1k ohms Resistor		6SCR2
❒ 1		Base Grid (11.0" x 7.7") Black Tint		6SCBGBK	❒ 1	R4	10k ohms Resistor		6SCR4
❒ 1	C2	0.1µF Capacitor		6SCC2	❒ 1	R5	100k ohms Resistor		6SCR5
❒ 1	C3	10µF Capacitor		6SCC3	❒ 1	RV	Adjustable Resistor		6SCRV
❒ 1	C4	100µF Capacitor		6SCC4	❒ 1	S1	Slide Switch		6SCS1
❒ 1	C5	470µF Capacitor		6SCC5	❒ 1	S2	Press Switch		6SCS2
❒ 2	D2	Green LED		6SCD2	❒ 1	SP2	Speaker		6SCSP2
❒ 1	D3	Diode		6SCD3	❒ 1	U2	Alarm IC		6SCU2
❒ 2	D10	Red/Yellow LED		6SCD10	❒ 1	U6	Recording IC		6SCU6
❒ 1		Jumper Wire, Black		6SCJ1	❒ 1	U33	SC Controller		6SCU33
❒ 1		Jumper Wire, Red		6SCJ2	❒ 1	WC	Whistle Chip		6SCWC
❒ 1		Jumper Wire, Green		6SCJ3C	❒ 1	X1	Microphone		6SCX1

How to Use Snap Circuits®

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, light blocks, battery blocks, different length wire blocks, etc. These blocks are different colors and have numbers on them so that you can easily identify them. The blocks you will be using are shown as color symbols with level numbers next to them, allowing you to easily snap them together to form a circuit.

For Example:

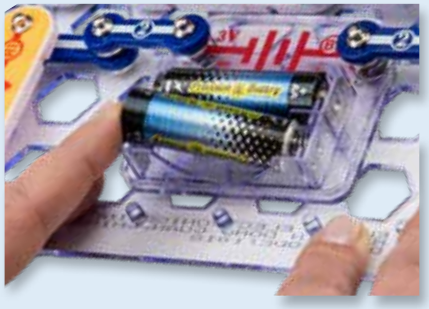
This is the green slide switch block which has the marking (S1) on it. Colors and styles may vary, so the part symbols in this booklet may not exactly match the appearance of the actual parts but will clearly identify them.

This is a wire block which is blue and comes in different wire lengths.

This one has the number (2), (3), (4), or (5) on it depending on the length of the wire connection required.

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

You need a power source to build each circuit. This is labeled (B1) and requires two (2) 1.5V "AA" batteries (not included).



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 black tinted 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. 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.

Some circuits use the jumper wires to make unusual connections. Just clip them to the metal snaps or as indicated.

Whenever the motor (M4) is used, it will have the green fan placed on top; simply push the fan onto the shaft. To remove it, push up on it with a screwdriver or your thumbs, being careful not to break it.

Note: While building the projects, 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.

Guidelines For Classrooms or Home Schooling

This product is a tool for opening the exciting worlds of coding & electronics. Following the Learn by Doing® concept, coding & electronics will be easy for students to understand by using Snap Circuits® to learn about circuits and the Snap Circuits® Coding App to learn about coding. This kit emphasizes the practical applications of coding & electronics, without bogging down in mathematics. This course is as much about thinking processes & science as about coding & electronics.

Why should students learn about coding or electronics? Coding & electronics play important and increasing roles in their everyday lives, and so some basic knowledge of them is a must for everyone in today's society. Learning about them teaches how to do scientific investigation, logical thinking, and helps develop basic skills needed in today's world.

This product is intended for ages 8 and up, for adults and children who have attained sufficient maturity to read and follow directions and warnings.

It should take about 7 hours to do this entire book, or about 5 hours to do just the coding projects (projects 1, 10, 12, 13, 15-18). The focus of this set is to learn about coding and then to code on your own, so teachers should determine what is best for their students.

INSTRUCTOR PREPARATION/ORGANIZATION

- Determine what the learning environment will be. Will the students be learning independently or in small groups? How much teacher instruction will there be for each section? Will the students be reading the lesson as homework and then have limited teacher instruction before performing the experiments? Decide if quizzes will be given and how they will be organized.

- Allocate time within the session as needed for:
  - Teacher instruction about the topics being covered during the session.
  - Getting the Snap Circuits® components into the workspace.
  - Teacher instruction about the specific projects to be performed during that session.
  - Building and testing the circuits.
  - Loading the SC Coding App and connecting to a SC Controller circuit.
  - Performing experiments (and teacher verification if desired).
  - Dismantling the circuits and returning Snap Circuits® components to storage area.
  - Reassembling the class for review.

- Make sure the students know their objectives for the day, how much time they will need for cleanup, and where the materials are being stored.

- Students must understand that there are usually many ways of making the same circuit or program, and that the instructor may not know all the answers. They are doing scientific investigation, and many circuit projects & programs suggest variations to experiment with.

- Have students review the DO's and DON'Ts of Building Circuits on page 4 at the beginning of each session.

DOs 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, LED, 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® is not responsible for parts damaged due to incorrect wiring.**

Here are some important guidelines:

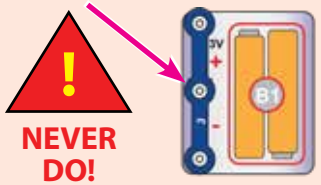
ALWAYS	**USE EYE PROTECTION WHEN EXPERIMENTING ON YOUR OWN.**
ALWAYS	include at least one component that will limit the current through a circuit, such as a lamp, motor, IC, or an LED (which has an internal protection resistor).
ALWAYS	use switches in conjunction with other components that will limit 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.
NEVER	connect to an electrical outlet in your home in any way.
NEVER	leave a circuit unattended when it is turned on.

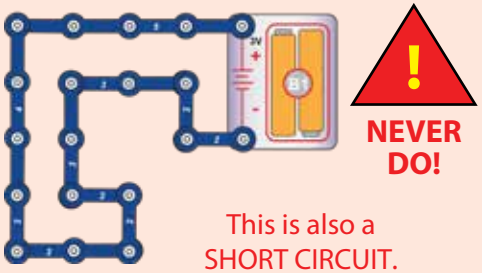
For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

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.

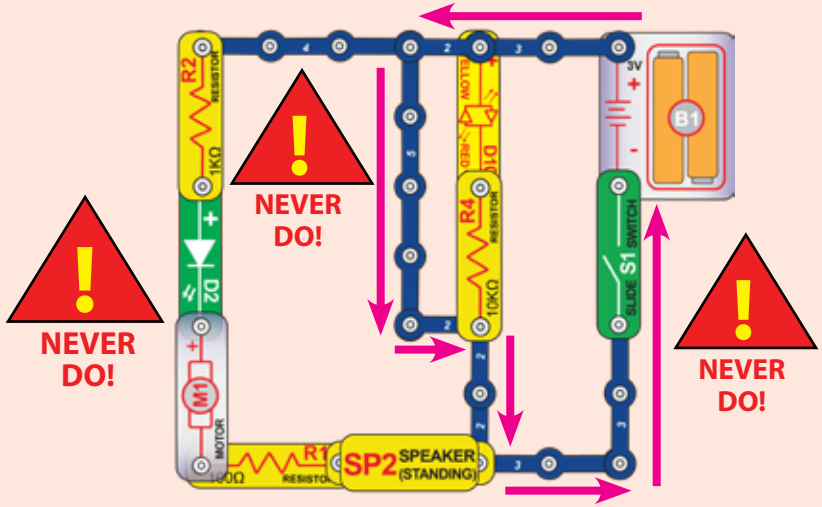
Examples of SHORT CIRCUITS - NEVER DO THESE!!!

Placing a 3-snap wire directly across the batteries is a SHORT CIRCUIT.





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 and structures you create. If they are unique, we will post them with your name and state on our website at: **elenco.com/showcase**
Send your suggestions (with photos) to ELENCO®: **info@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!

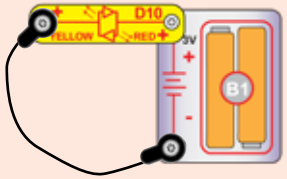
Advanced Troubleshooting (Adult supervision recommended)

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

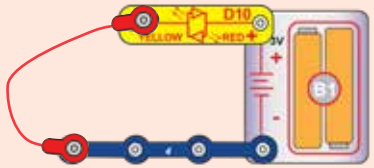
If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:

1. **Battery holder (B1), motor (M4), lamp 6V (L2), and LEDs (D2, & D10):** Place batteries in holder. Place each LED directly across the battery holder (LED "+" to battery "+"), it should light. The red/yellow LED (D10) should be red in one direction and yellow in the other direction. Touch the motor across the battery snaps (motor + to battery +), it should spin to the right at high speed. If none work, then replace your batteries and repeat, if still bad then the battery holder is damaged. If the motor spins but does not balance the fan in the projects, check that there is a black plastic piece with 3 prongs at the top of the motor shaft.

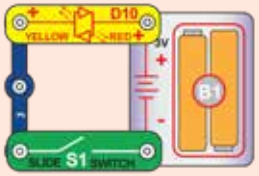
2. **Jumper wires:** Use this mini-circuit to test each jumper wire, the LED should light.



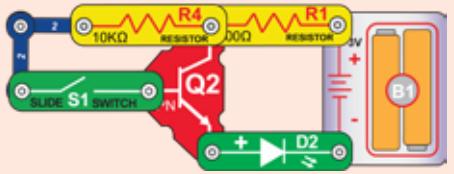
3. **Snap wires:** Use this mini-circuit to test each of the snap wires, one at a time. The LED should light.



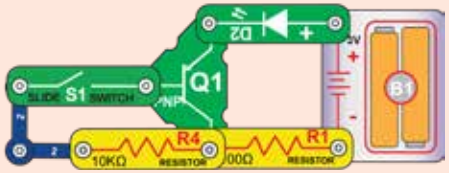
4. **Slide switch (S1 & S2), speaker (SP2), diode (D3), and resistors (R1, R2, R3,& R4):** Use this mini circuit, the LED should be on when the switch is on and off when the switch is off, or the switch is broken. Replace the switch with the speaker, the LED should light or the speaker is broken. Replace the speaker with the diode ("+" on left), the LED should light or the diode is broken. Replace the diode with the R1 resistor; the LED should light. Replace R1 with R2, LED should be dimmer. Replace R2 with R4, the LED should be much dimmer but still light.



5. **NPN transistor (Q2):** Use this mini circuit, the green LED (D2) should only be on when the switch (S1) is on, or the transistor is broken.



6. **PNP transistor (Q1):** Use this mini circuit, the green LED (D2) should only be on when the switch (S1) is on, or the transistor is broken.



7. **100kΩ resistor (R5):** Use the mini circuit from step 6 but replace R4 with R5, the green LED (D2) should be on when the switch (S1) is on. Swap the locations of R1 and R5, now the LED should not light (or be extremely dim) even if the switch is on.

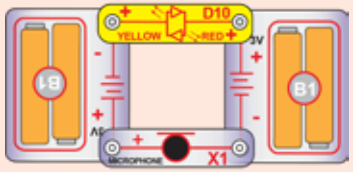
8. **Alarm IC (U2):** Build project 16, you should hear a siren. Then make the variants in parts B-D to get different sounds.

9. **Whistle chip (WC):** Build project 17; you should hear a siren.

10. **Microphone (X1):** Use this mini-circuit; blowing on the

Advanced Troubleshooting (Continued)

microphone should change the LED brightness or the microphone is broken.



11. **Adjustable resistor (RV):** Build project 10; setting RV's lever to the left should make the left LED bright and right LED dim, setting RV's lever to the right should make the left LED dim and the right LED bright, otherwise RV is broken.

12. **Recording IC (U6):** Build Project 20; be sure you can make a recording and then play it back followed by a pre-recorded tune.

13. **0.1µF (C2) capacitor:** Build Project 11. Adding C2 on top of the whistle chip (WC) should lower the pitch of the sound, or C2 is broken.

14. **10µF, 100µF, and 470µF capacitors (C3, C4, & C5:** Build Project 8. Turn S1 on and off, then press S2; LED D10 should light briefly. Replace C5 with C4, turn S1 on and off, then press S2, D10 should light more briefly than before. Replace C4 with C3, the LED should light very briefly.

15. **SC Controller (U33):** Build project 1, the blue (Bluetooth) light on the SC Controller should be blinking when the switch (S1) is turned on. Connect the SC Controller to the App and use the Circuit screen of Control mode to light the LEDs connected to the 5 outputs (D1-D4 and A) on the SC Controller. Note: if this test works but turning on the motor (M1)/fan in other projects resets the SC Controller (making the blue Bluetooth light on it flashing instead of staying on) then replace your batteries.

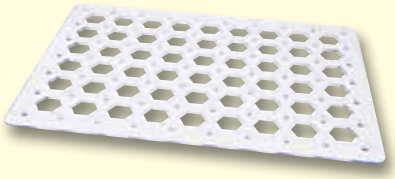
BOTCode™ NOTE: If you are using previously entered code then you may need to reassign commands to make that code work, as per page 49.

Project Listings

About Your Snap Circuits® Parts

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.



SNAP WIRES & JUMPER WIRES

The blue **snap wires** are wires used to connect 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.

The red, black, and blue **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.

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.

(Part designs are subject to change without notice).

BATTERY HOLDER

The **batteries (B1)** produce an electrical voltage using a chemical reaction. This "voltage" can be thought of as electrical pressure, pushing electricity through a circuit just like a pump pushes water through pipes. This voltage is much lower and much safer than that used in your house wiring. Using more batteries increases the "pressure", therefore, more electricity flows.

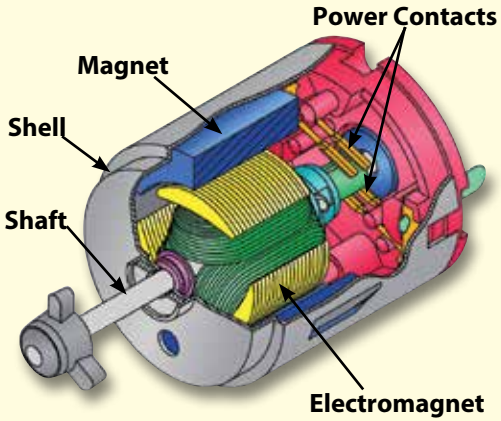
Battery Holder (B1)

MOTOR

The **motor (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.

Motor (M4)

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 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.



About Your Snap Circuits® Parts

DIODES & LEDs

The **diode (D3)** is like a one-way valve that only lets current flow in the direction of the arrow in its symbol. The diode has a turn-on threshold of about 0.7V that voltage must exceed before any current will flow.

The **green and red/yellow LEDs (D2 & D10)** are light emitting diodes, and may be thought of as special one-way light bulbs. The color emitted depends on the material used in their construction. Their turn-on threshold is higher than for a normal diode, about 1.5V for red and yellow, and about 2.0V for green; brightness then increases. The red/yellow LED contains red and yellow LEDs connected in opposite directions in the same package. A high current will burn out an LED, so the current must be limited by other components in the circuit, however your Snap Circuits® LEDs have internal resistors to protect against incorrect wiring). Like normal diodes, LEDs block electricity in the "reverse" direction.

Diode (D3) and Green & Red/ Yellow LEDs (D2 & D10)

(Part designs are subject to change without notice).

RESISTORS

Resistors "resist" the flow of electricity and are used to control or limit the current in a circuit. This set includes **100Ω (R1), 1kΩ (R2), 10kΩ (R4), and 100kΩ (R5) resistors** ("K" symbolizes 1,000, so R4 is really 10,000Ω). Materials like metal have very low resistance (<1Ω), while materials like paper, plastic, and air have near-infinite resistance. Increasing circuit resistance reduces the flow of electricity.

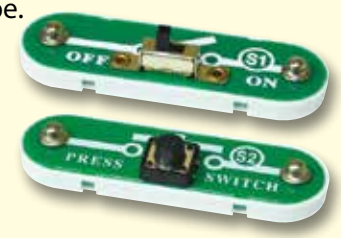
Resistors (R1, R2, R4, & R5)

The **adjustable resistor (RV)** is a 50kΩ resistor but with a center tap that can be adjusted between 200Ω and 50kΩ.

Adjustable Resistor (RV)

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.



Slide & Press Switches (S1 & S2)

SPEAKER

The **speaker (SP2)** 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.

Speaker (SP2)

MICROPHONE

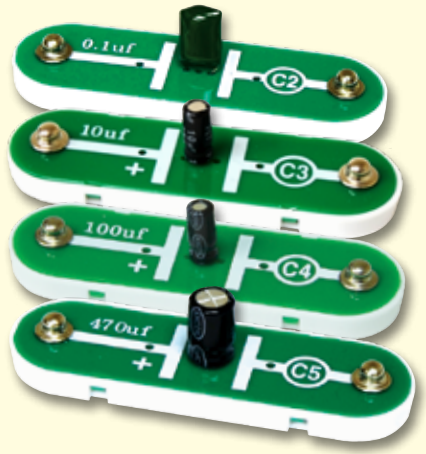
The **microphone (X1)** is actually a resistor that changes in value when changes in air pressure (sounds) apply pressure to its surface. Its resistance typically varies between 1kΩ and 10kΩ.

Microphone (X1)

About Your Snap Circuits® Parts

CAPACITORS

The **0.1µF, 10µF, 100µF, and 470µF capacitors (C2, C3, C4, & C5)** can store electrical pressure (voltage) for periods of time. This storage ability allows them to block stable voltage signals and pass changing ones. Capacitors are used for filtering, delay/timing, and oscillator circuits.



Capacitors (C2, C3, C4, & C5)

LAMP

A light bulb, such as in the 6V **lamp (L2)**, 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.

Lamp (L2)

(Part designs are subject to change without notice).

TRANSISTORS

The **PNP & NPN transistors (Q1 & Q2)** are components that use a small electric current to control a large current, and are used in switching, amplifier, and buffering applications. They are easy to miniaturize, and are the main building blocks of integrated circuits including the microprocessor and memory circuits in computers.

PNP & NPN Transistors (Q1 & Q2)

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. The whistle chip (WC) also acts like a 0.02µF capacitor in addition to its sound properties.

Whistle Chip (WC)

ELECTRONIC MODULES

The **alarm and recording ICs (U2 and U6)** 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.

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

Connect control inputs to (+) power to make five alarm sounds, see project 11 for configurations.

Recording IC Module:
(+) - power from batteries
(–) - power return to batteries
RC - record
Play - play
OUT - output connection
Mic + - microphone input
Mic – - microphone input

See Project ??? for example of proper connections.

The **SC Controller (U33)** lets you control Snap Circuits® parts using Bluetooth. Its functions and use are described in project 1 and page 44.

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).

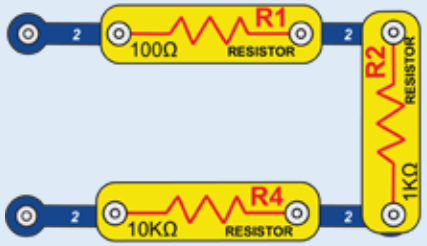
The "**power**" of electricity is a measure of how fast energy is moving through a wire. It is a combination of the voltage and current (Power = Voltage x Current). It is expressed in **watts** (W).

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).

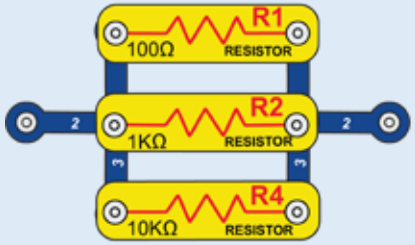
Nearly all of the electricity used in our world is produced at enormous generators driven by steam or water pressure. Wires are used to efficiently transport this energy to homes and businesses where it is used. Motors convert the electricity back into mechanical form to drive machinery and appliances. 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.

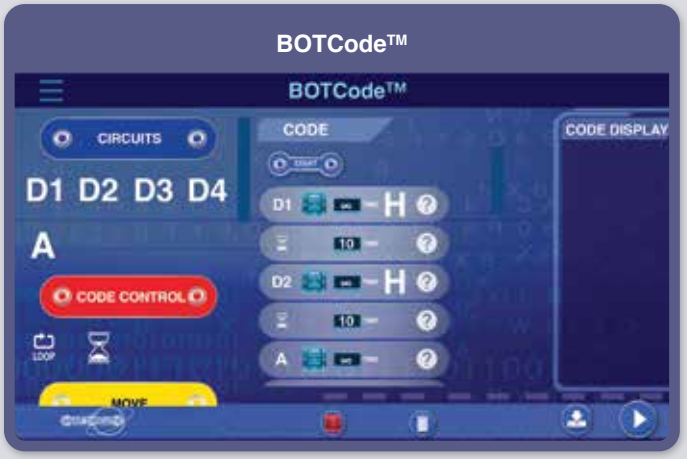
WELCOME TO CODING!

All computers, micro-controllers, apps, and websites are controlled using lines of code, which tell the device what to do, in what order, and when. You probably do not realize how many devices in your home or vehicle have microprocessors or simpler micro-controllers that use code to tell them what to do. Code controls thermostats for heating and air conditioning, digital clocks, vehicle fuel injection systems, oven timers, timers for outdoor lighting systems, stoplights, sprinkler control systems, computers, music players, and many others. Code also controls what you see on websites and apps.

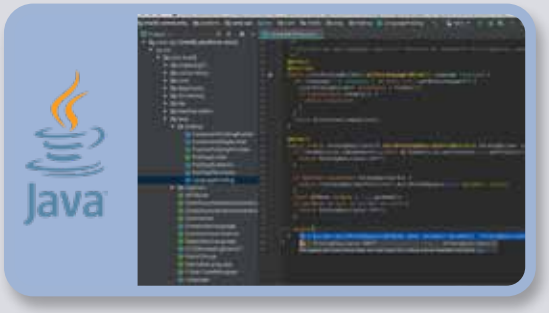
Understanding coding helps you understand logical thinking and problem solving. When you code you create a series of steps to make your device do what you want. It is important that your coding instructions be clear and orderly because a coding controller (or any computer) does what you tell it to do - which may not be what you want it to do.

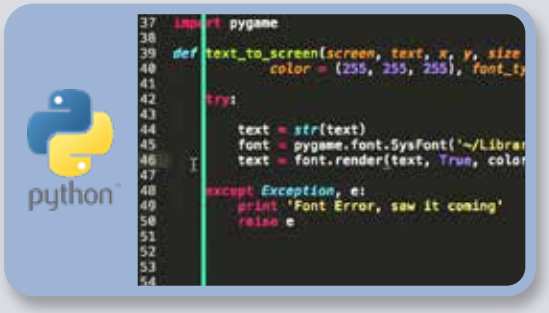
A computer does not understand any of the programming languages we use, or even graphical programming like BOTCode™. A computer is made up of millions of transistors that can only be turned on or off. These transistors can be grouped together in large numbers to form digital memories and do calculations. The computer or app code we write gets translated into a much longer but very simple form that is used to turn transistors on and off. Many different programming languages have been developed to work with the many different designs for computer hardware (microprocessors, micro-controllers, memories, video controllers), to focus on different applications, or to be easier to use. The BOTCode™ that you will be using is simple and easy to use, making it a great introduction to the world of coding.

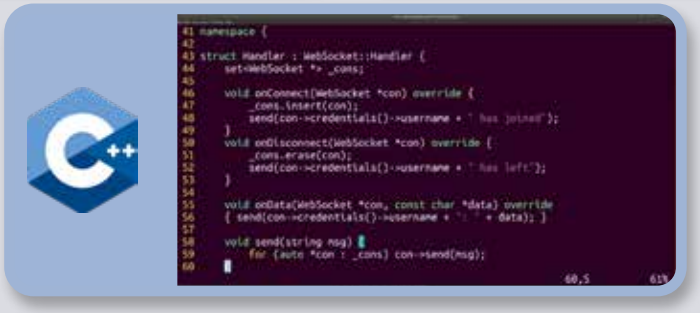
FORMS OF CODE YOU WILL USE

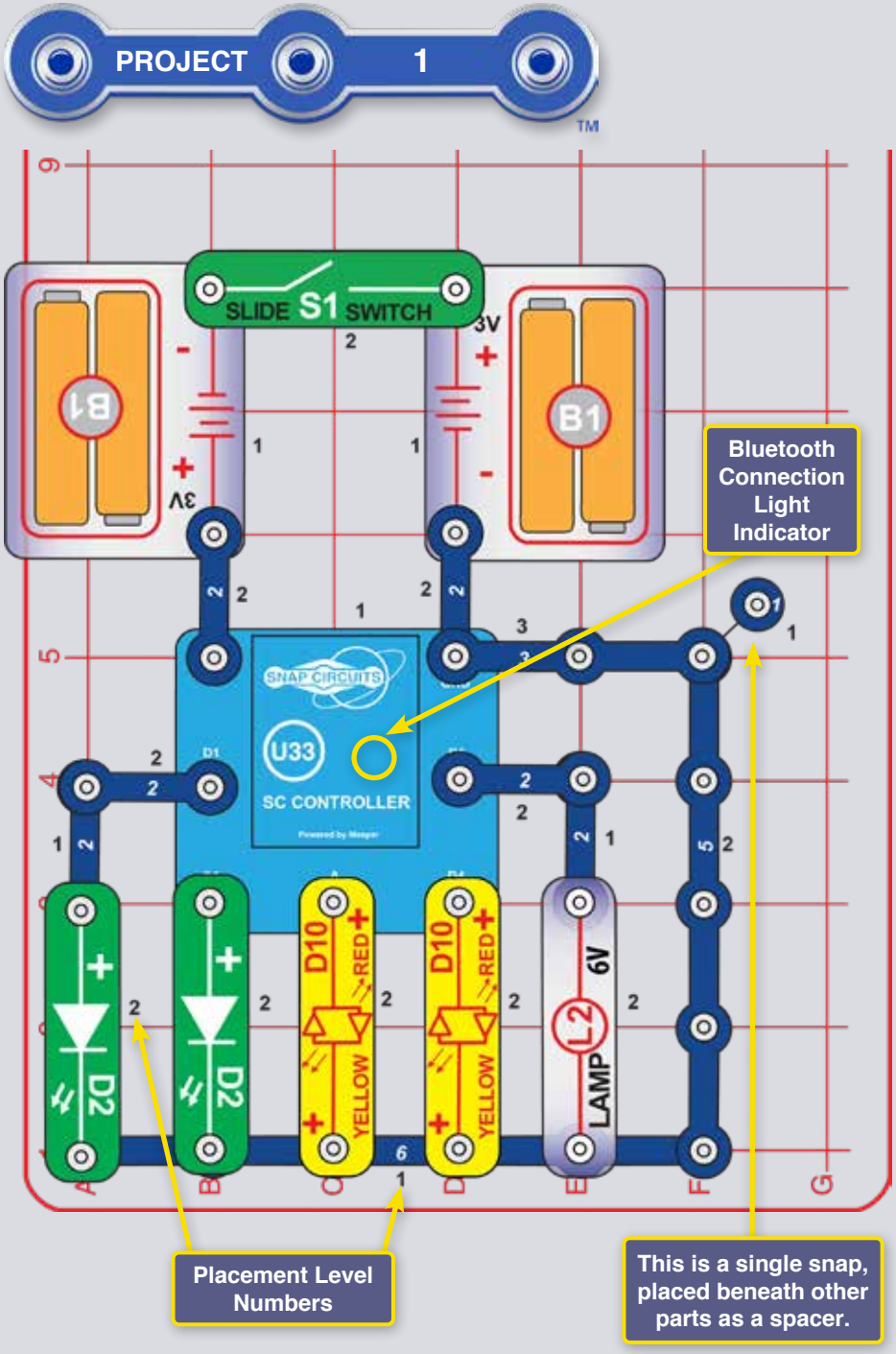


OTHER FORMS OF CODE









CODING 5 LIGHTS

(QUICK START - DIVE INTO CODING)

This is a summarized version of the Snap Circuits® Coding app instructions for those already familiar with Snap Circuits® and apps and want to just start coding. To first learn more about Snap Circuits® start with projects 2-9, 11, and 14. For more detailed app instructions, see page 33.

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.

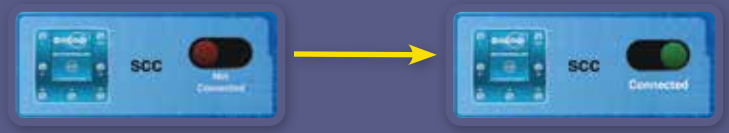
Build the circuit shown on the left by placing all the parts with a black **1** next to them on the board first. Then, assemble parts marked with a **2**. Then, assemble the part marked with a **3**. Install two (2) "AA" batteries (not included) into the battery holders (B1) if you have not done so already. **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.**

1. Build the circuit shown here, and turn on the slide switch (S1). A blue light on the SC Controller (U33) should be flashing, indicating that the module is waiting for a Bluetooth connection to a device.

2. Go to the app store on your device and find the Snap Circuits® Coding app; install and open it.

GET IT ON Google Play Download on the App Store

3. The Connect screen should appear, and show device SCC (your SC controller module (U33)). If the app does not find your SC Controller then press "Start Scan" to search again (make sure your SC Controller is on).Tap on the red "Not Connected" dot to connect the app to your SC Controller. The red dot on the app should turn green, indicating your SC Controller module is now connected to the app. The Bluetooth indicator light on your SC Controller will now be a solid blue, indicating it is connected. You are now ready to Control or Code.

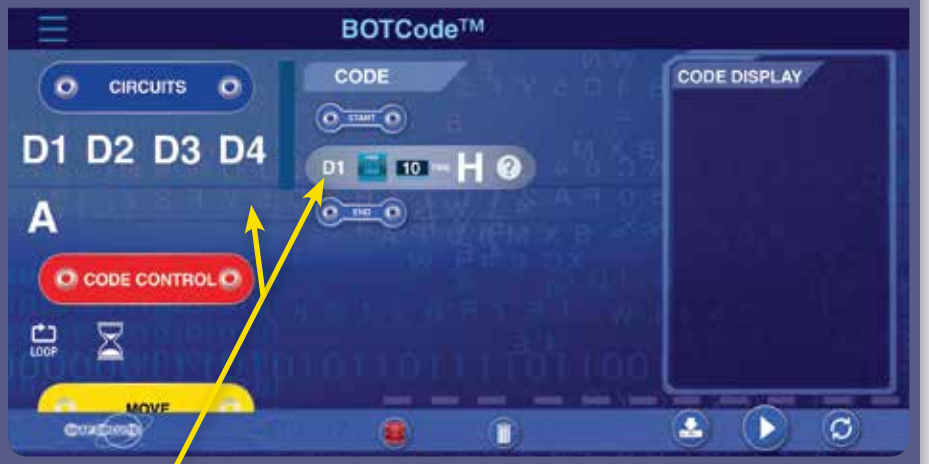


4. Go to the Control Screen by tapping the Control button or using the app menu. The Control screen begins in Circuit mode. The SC Controller has 5 outputs (D1, D2, D3, D4, and A) that are controlled through the app. Outputs D1-D2 and D3-D4 are paired so they can each control a motor in both directions and can be set to either of two output voltage levels, called H (Higher) and L (Lower). Output A has low power and cannot control most motors. Use the app controls to turn the LEDs in your circuit on and off.

Control Screen Mode

5. Go to the BOTCode™ screen using the app menu. Drag commands from the list at left to the program area in the center.

BOTCode™ Screen



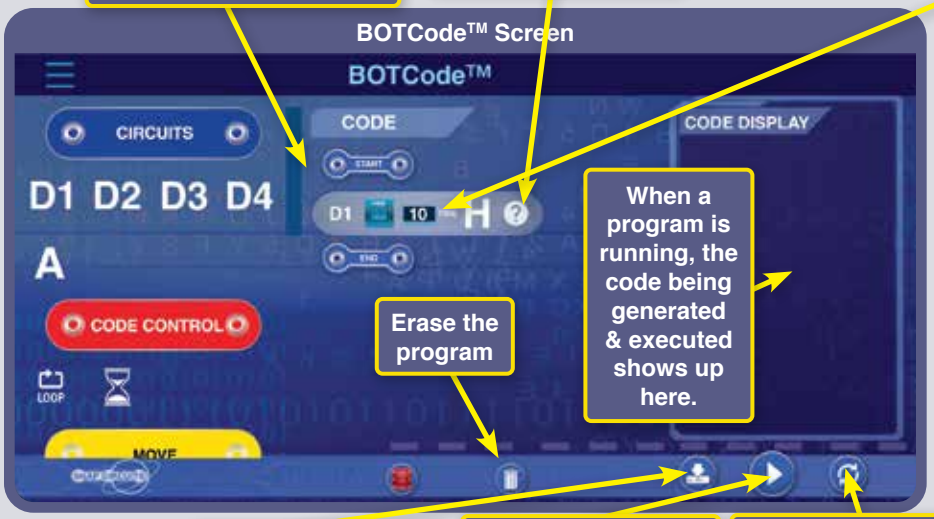
Drag & Drop Commands from the choices at the left to the CODE area in the center to create a program routine.

Drag & Drop Commands to create a program.

? - Add a Comment

Select the command and change the SC Controller voltage level (H=5V and L=3V) and time on each command. NOTE: "TIME" units are roughly 0.1 seconds but varies so "10" is about 1 second.

BOTCode™ Screen



Erase the program

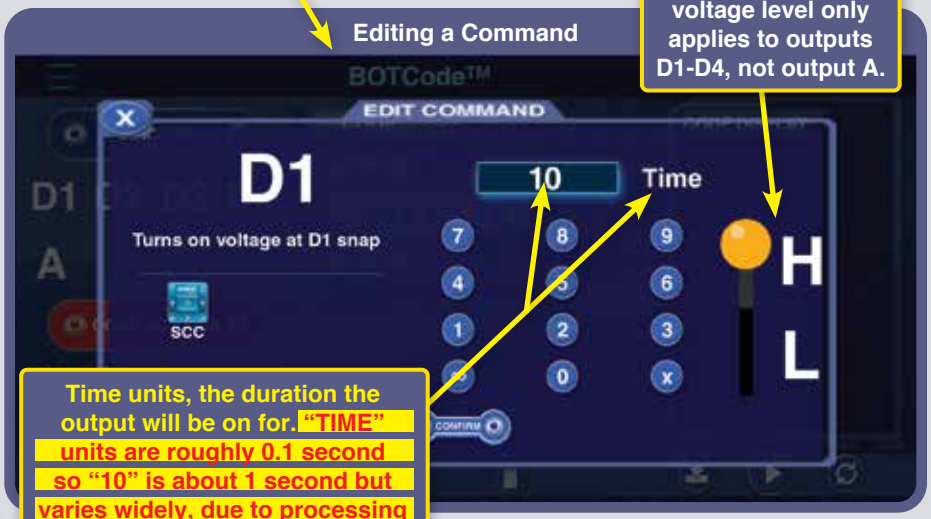
When a program is running, the code being generated & executed shows up here.

Save code & reuse. Modify it later

Run the program on your SC Controller once, then stop.

Run the program on your SC Controller continuously.

Editing a Command



H (Higher=5V) and L (Lower=3V) output voltage level only applies to outputs D1-D4, not output A.

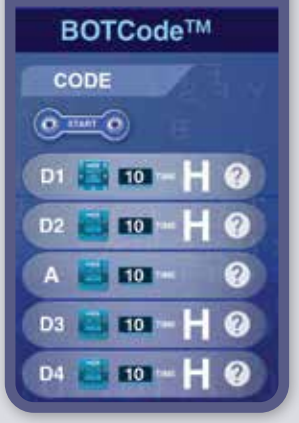
Time units, the duration the output will be on for. "TIME" units are roughly 0.1 second so "10" is about 1 second but varies widely, due to processing and Bluetooth delays). Value can be set from 1 to 100, or ∞ (to leave it on) and 0 (to turn it off).

Now that you know the basics of BOTCode™, program the SC Controller to do different things with the lights in this circuit. Here are some programming examples: drag-n-drop the commands into the program area, edit the time and voltage levels, and then run the program once or continuously.

Experiment with changing parameters for commands, such as the time duration.

Turn on D1, low brightness, then high brightness.

Turn on the 5 LEDs one at a time.



Turn on LEDs one at a time until all are on, then turn them off one at a time.

Limitations of the SC Controller and BOTCode™: The SC Controller has only circuit outputs (no inputs), so cannot make measurements or decisions based on anything happening in your circuit.

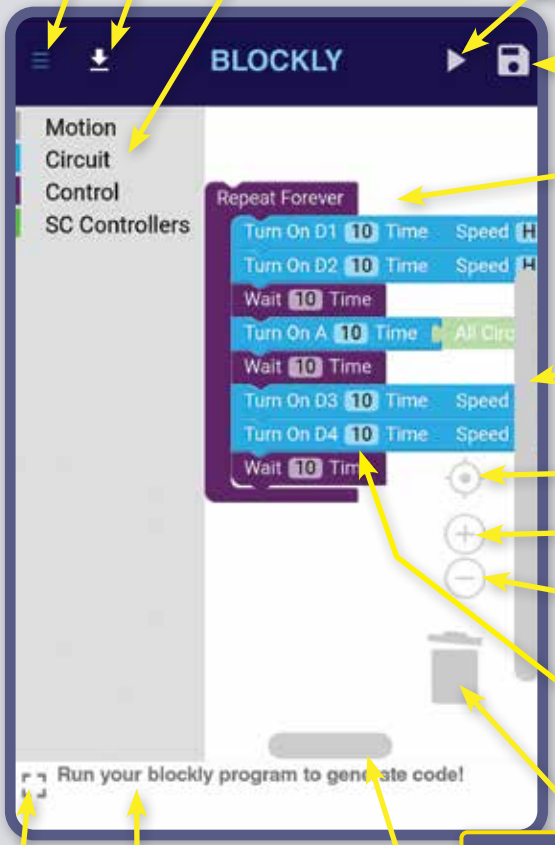
Also, the A output on the SC Controller can only supply low currents, so it cannot be used to control the motor (M4) directly.

CHALLENGES

- Turn on only the green LEDs, then only the red LEDs.
- Make an LED turn on for several seconds, then off for a much shorter time.
- Make an LED flash every 20 seconds.
- Flip one of the red/yellow LEDs (D10) around to its yellow side, then program a stoplight pattern using red, yellow, and green LEDs.
- Try to get the lights blinking in a pattern like a beat to a song.

PART II

Turn on the LEDs, alternately between yellow and red.



Main Menu

Load a Previously Saved Program

Command Categories

Run Program

Save Program

BLOCKLY Code

Vertical Scroll Bar

Center Program

Zoom in

Zoom Out

Select the command and change the SC Controller voltage level (H=5V and L=3V) and time on each command. NOTE: "TIME" units are roughly 0.1 seconds but varies so "10" is about 1 second.

Delete Program

Text code generated from the BLOCKLY code.

Horizontal Scroll Bar

Full Text Screen Mode

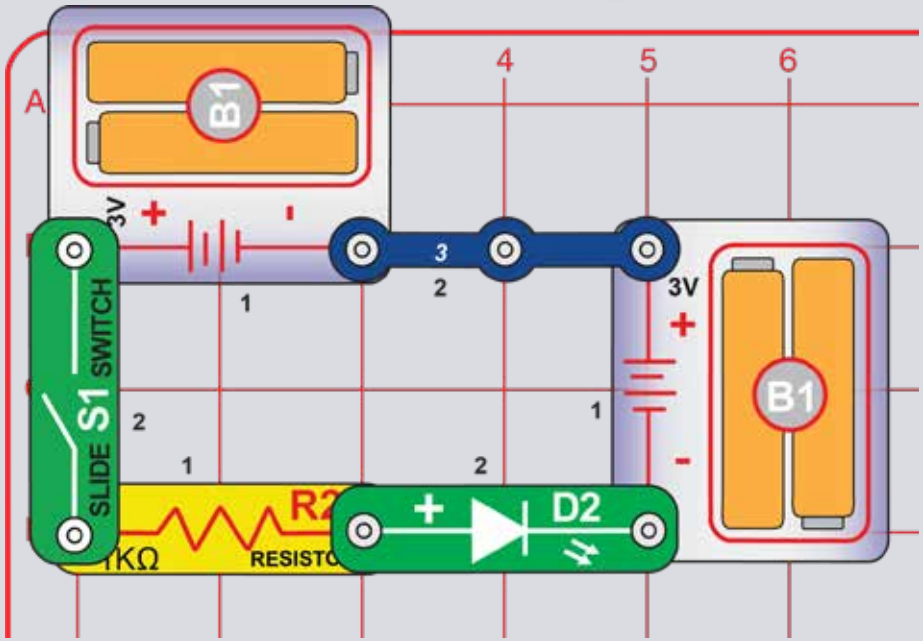
BLOCKLY CODING:

BLOCKLY is another form of visual block programming that makes it easy to program the SC Controller (U33) to turn on lights, sounds, or motors, in any order or for different durations. BLOCKLY is similar to how BOTCode™ works.

To try BLOCKLY coding, build the project 1 circuit, turn on the circuit, open the SC Coding app on your device, and connect your SC Controller to it as described earlier. Go to the BLOCKLY screen and enter a program like this one.

To enter the program, get the D1-D4 and A commands from the Circuit category, and the Delay and Forever command from the Control category. Select the category, click on the command to bring it into your program area, then drag it to attach to the other commands in your program. Put the Forever command around the others. Click on the command to change the Time and voltage level (H or L) if you like. The Run button is at the top of the BLOCKLY screen.

NOTE: Projects 2-11, 13, 14, 16, 17, 20, and 21 are an introduction to your parts and basic circuits. If you want to start with Coding then skip to projects 12, 15, 18, 19, and 22-33.



When you turn on the slide switch, electricity flows from the batteries through the switch, then the resistor, then the LED, and then back to the batteries. If the switch is off, the flow of electricity is blocked, and the LED won't light.

Resistors "resist" the flow of electricity and are used to control or limit the current in a circuit.

LEDs are like one-way light bulbs that can produce different colors depending on the material used in them.

The lamp contains an incandescent light bulb, which uses a special wire that gets so hot that it glows when an electric current flows through it. Incandescent bulbs have low electrical resistance, so they don't prevent an LED from working but the LED prevents the incandescent bulb from working. Incandescent bulbs use much more electricity and are much less energy efficient than LEDs.

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 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.** Install two (2) "AA" batteries (not included) into the battery holders (B1) if you have not done so already. **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 green LED (D2) lights.

Part B: Replace the 1kΩ resistor (R2) with the smaller 100Ω resistor (R1), the larger 10kΩ resistor (R4), or the much larger 100kΩ resistor (R5) and see how the LED brightness changes. With R5 the LED will be very, very dim, so make the room dark to see it.

Part C: Reverse the position of the LED (so it is backwards) and see how the LED works in reverse.

Part D: Replace the green LED with the red/yellow LED (D10); try it in both orientations.

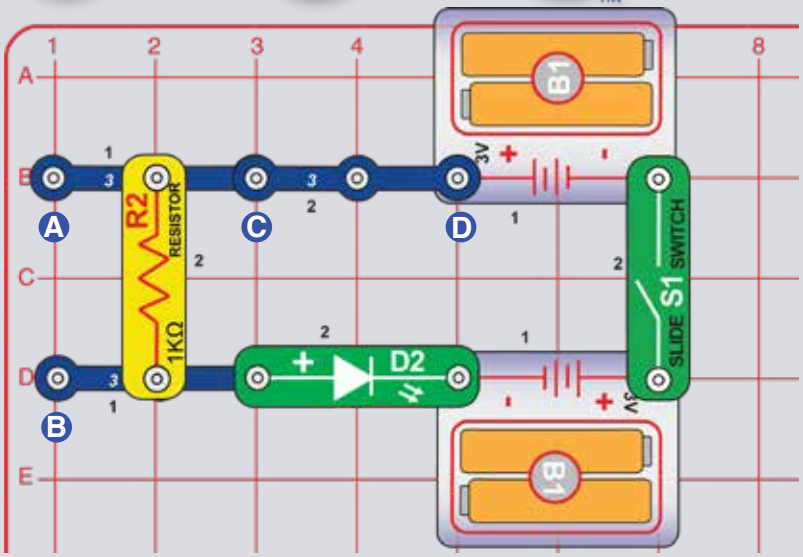
Part E: Reduce the battery voltage by replacing one of the battery holders (B1) with a 3-snap wire and see how the LED brightness changes for any of the above LED-resistor configurations.

Part F: Use the original circuit but replace the 1kΩ resistor (R2) with the 6V lamp (L2), so the batteries are powering the lamp and green LED. Notice that the LED lights but the lamp is off.

Part G: Replace the green LED with a 3-snap wire; now the lamp lights.

Part H: replace one of the battery holders with a 3-snap wire; the lamp is dimmer now.

PROJECT 3



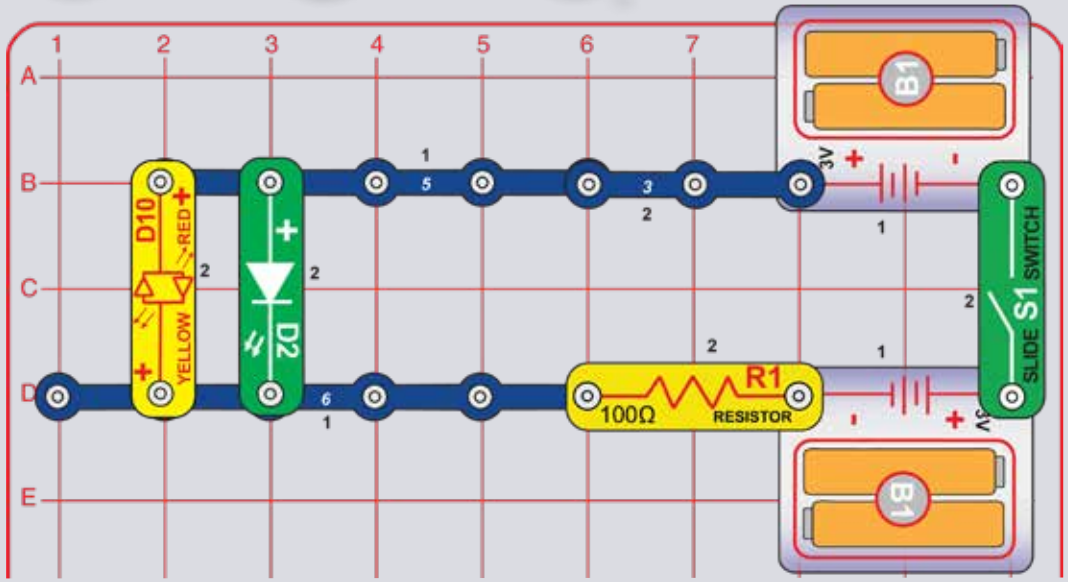
SERIES & PARALLEL CIRCUITS

Build the circuit as shown and turn on the slide switch (S1); the green LED (D2) lights. Now place the larger 10kΩ resistor (R4) or the smaller 100Ω resistor (R1) between the points labeled A & B, so it is next to (and in parallel with) the 1kΩ resistor (R2), and see how the LED brightness changes.

Part B: Use the original circuit but replace the 3-snap wire at points C & D with 10kΩ resistor (R4) or the 100Ω resistor (R1), placing that resistor in series with the 1kΩ resistor (R2). Notice how the resistors combine to affect the LED brightness.

Part C: Use the original circuit but replace the 3-snap wire at points C & D with another LED (D2 with "+" on right, or D10 in either direction). Compare the LED brightness two LEDs are in series. you can also replace the 1kΩ resistor (R2) with the larger 10kΩ resistor (R4) or the smaller 100Ω resistor (R1) and see how the LED brightness changes.

PROJECT 4



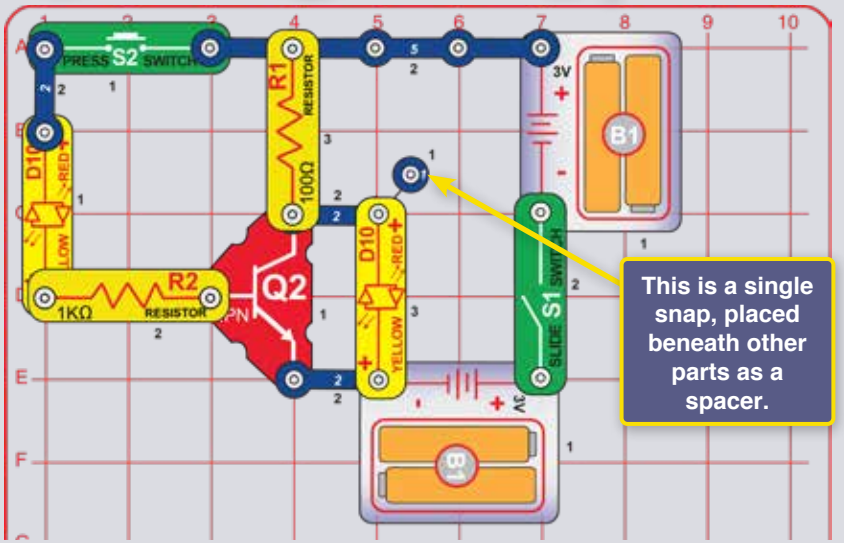
LED COMPARISON

Build the circuit as shown and turn on the slide switch (S1); the two LEDs (D2 & D10) light. Now replace the 100Ω resistor (R1) with the larger 1kΩ resistor (R2) and then the much larger 10kΩ resistor (R4) and see how the brightness changes on each LED.

Try the red/yellow LED (D10) in both red and yellow orientations. Your set includes a second green LED and red/yellow LED, so you can experiment with different LEDs and having up to four at once (add two more to the right of the green LED).

Electricity flows through an LED if the voltage exceeds a turn-on threshold (about 1.5V for red and about 2.0V for green). The resistor limits the voltage/current through all the LEDs, but the green LED is affected more because of its higher turn-on level.

PROJECT 5



TRANSISTOR INVERTER

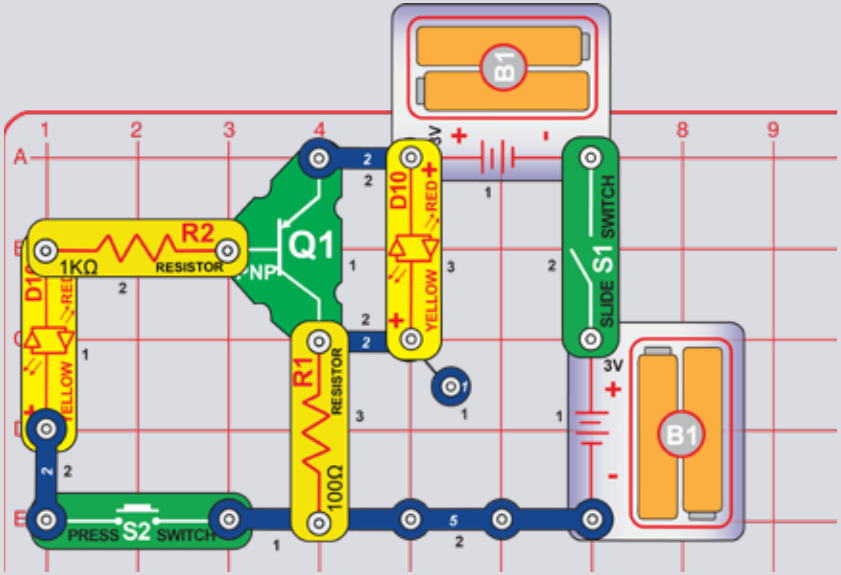
Build the circuit as shown, and turn on the slide switch (S1). The left LED is off and the right one is on.

Push the press switch (S2); now the left LED is on and the right one is off.

Notice that the two LEDs are opposites - when one is on, the other is off.

Transistors like your NPN transistor (Q2) use a small current to control a larger current and are used in switching and amplifier circuits. In this circuit a small current flows into Q2 through R2, controlling a larger current into Q2 through R1. This control allows the right LED to be opposite of the left LED, and the voltage to the left LED to be opposite to the voltage at the right LED or inverted. The transistor will later be used to invert a voltage in some of the coding projects.

PROJECT 6



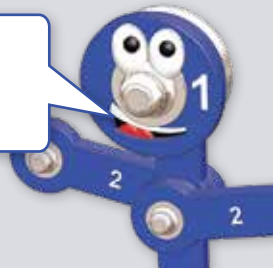
TRANSISTOR INVERTER PNP

This circuit is equivalent to the above one but uses an opposite transistor (a PNP instead of an NPN). It works the same: the two LEDs are opposites - when one is on, the other is off.

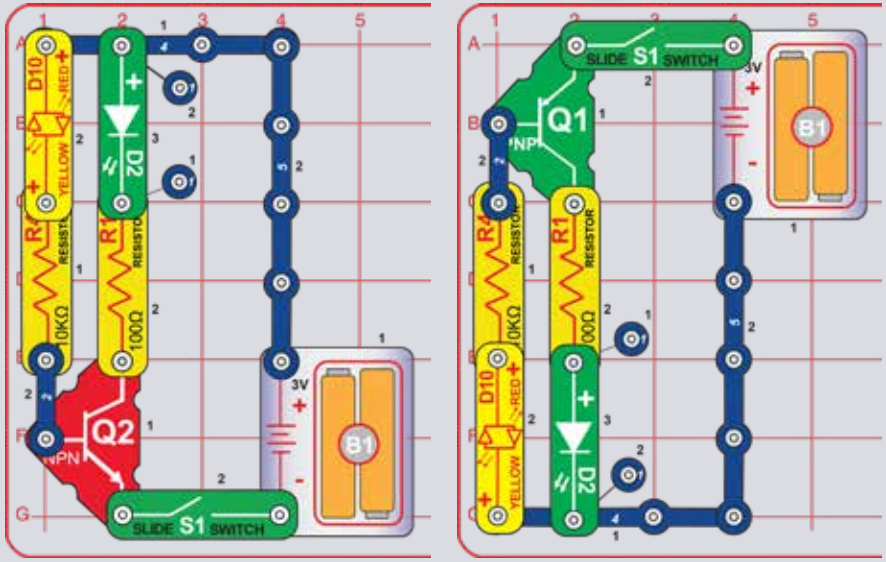
Turn on the slide switch (S1); the left LED is off and the right one is on.

Push the press switch (S2); now the left LED is on and the right one is off.

For transistors, NPN stands for Negative-Positive-Negative, which relates to how materials are arranged in the transistor construction. PNP stands for Positive-Negative-Positive. NPN and PNP transistors are opposites, and are used in similar circuit situations.



PROJECT 7

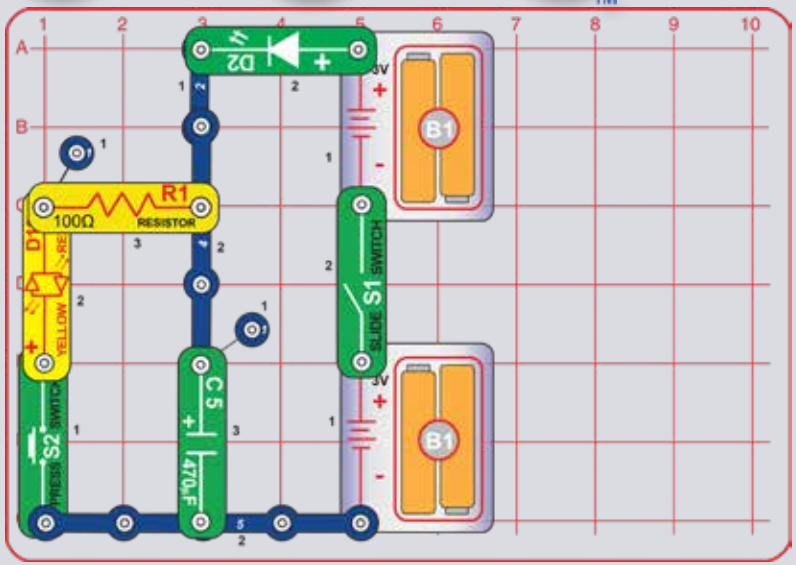


TRANSISTOR CURRENTS

Build the circuit as shown, and turn on the slide switch (S1). The red/yellow LED (D10) is dim and the green LED (D2) is bright. Try removing each LED and see if the other still lights.

The left and right circuits are equivalent but use opposite transistors (NPN and PNP).

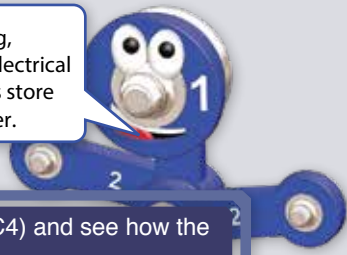
PROJECT 8



CAPACITORS

Build the circuit as shown and turn on the slide switch (S1). The green LED (D2) lights briefly as the 470µF capacitor (C5) charges up. Now turn off the slide switch, and then push the press switch (S2) to discharge the capacitor and light the red/yellow LED (D10). Repeat turning S1 on and off and then push S2, several times.

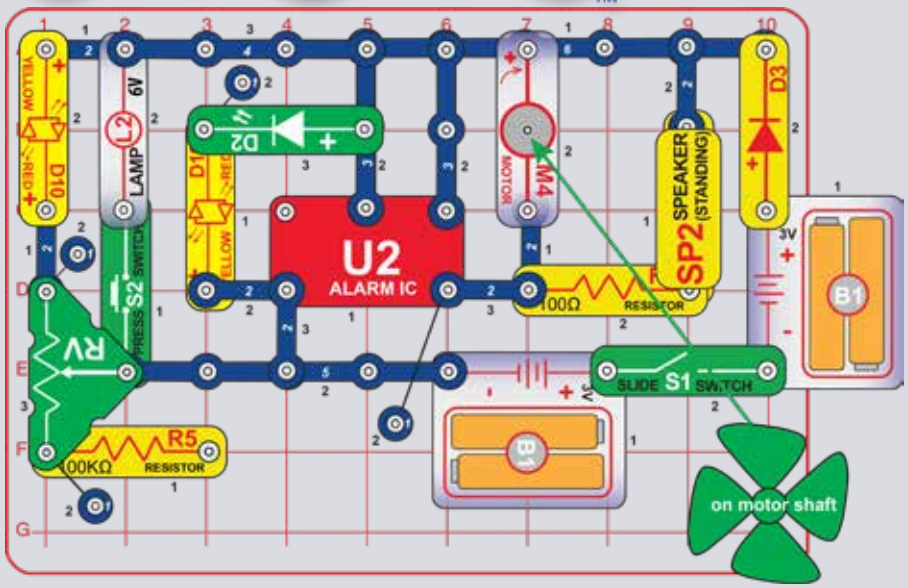
Capacitors can store electrical energy, which makes them useful in timing, filtering, and oscillation circuits. Capacitors store electrical energy in an electrical field, while batteries store energy in chemical form; as a result, capacitors store less electricity than batteries, but they can store and release it much faster.



CHALLENGES

- Replace the 470µF capacitor (C5) with the 100µF capacitor (C4) and see how the circuit changes.
- Replace the 100Ω resistor (R1) with the 1KΩ resistor (R2) or a 3-snap wire and see how the circuit changes.

PROJECT 9



FUN CIRCUIT

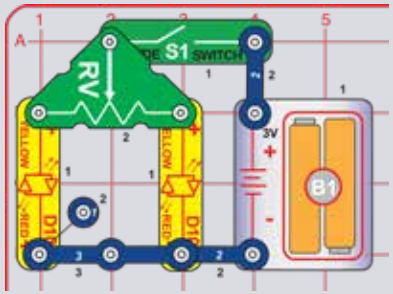
Build the circuit as shown and turn on the slide switch (S1). Lights shine, the motor (M1) spins, and a machine gun sound is heard. Push the press switch (S2) to light the lamp (L2). Use the lever on the adjustable resistor (RV) to adjust the brightness of the left red/yellow LED (D10).

If you replace the 100Ω resistor (R1) with the 1kΩ resistor (R2) then the sound will not be as loud.

PROJECT 10

LEFT-RIGHT RESISTOR

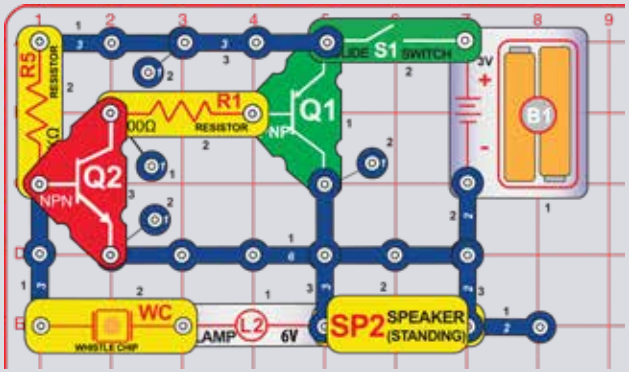
Build the circuit as shown and turn on the slide switch (S1). Move the lever on the adjustable resistor (RV) to vary the brightness of the LEDs.



PROJECT 11

OSCILLATOR

Build the circuit and turn on the slide switch (S1), you'll hear a high-pitch sound. To lower the pitch of the sound, place the 0.1µF capacitor (C2) directly on top of the whistle chip (WC).



This circuit is an oscillator, it uses interaction between transistors, resistors, and capacitors to turn the transistors on and off in a repeating pattern. The whistle chip is used as a small capacitor.

PROJECT 12

LAMP A CONTROL

The lamp (L2) needs a lot more electric current to light than the green and red/yellow LEDs (D2 and D10) need, or than the motor (M4) needs to spin. The A output on the SC Controller (U33) can only supply a small current, it is enough to light an LED or spin the motor but not enough to light the lamp.

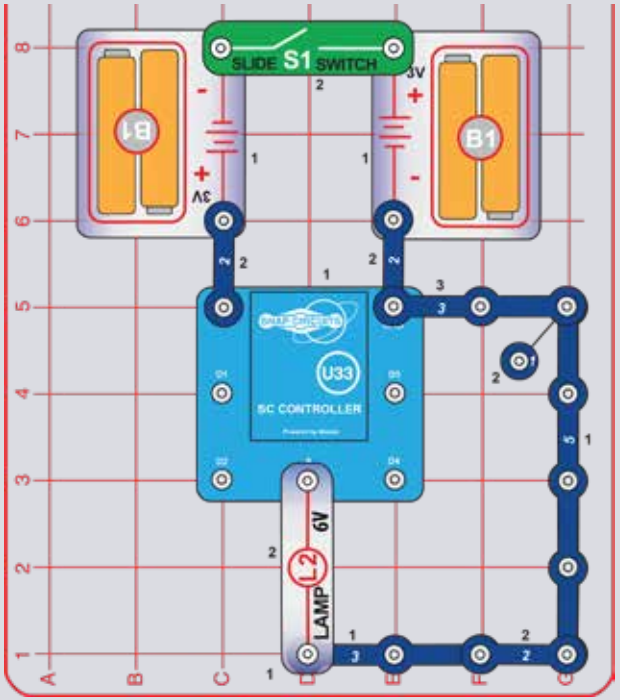
Part A: build the Part A circuit and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to turn on the A output on the SC Controller; the lamp will not light. Replace the lamp with one of your LEDs (D2 or D10, LED "+" to U33); unlike the lamp, the LED lights when the A output is turned on. See project 1 and pages 44-53 if you need to review how to use the app.

Part B: modify the circuit to be the Part B circuit turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to turn on the A output on the SC Controller; now the A output controls the lamp through the NPN transistor (Q2).

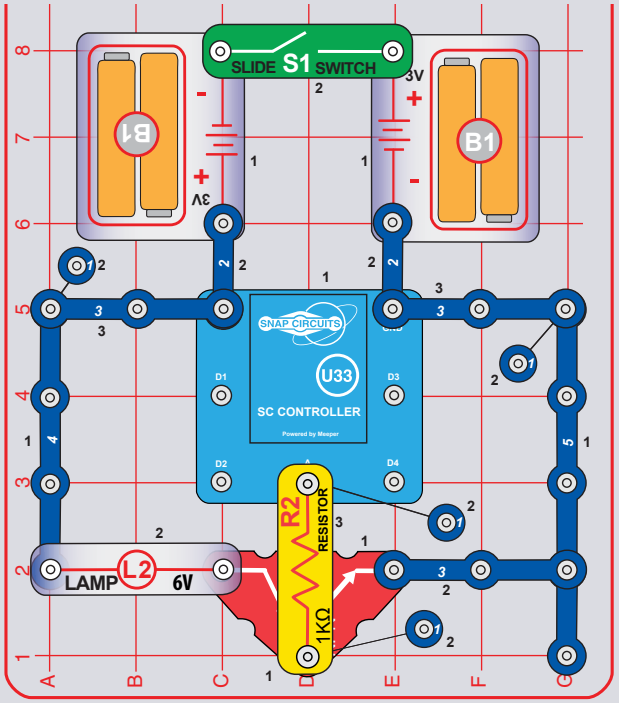
You can also use BOTCode™ to create some code to control the lamp.

Do not leave the lamp for two minutes because the lamp will be hot.

⚠ **CAUTION:** very warm lamp enclosure.



Part A Circuit

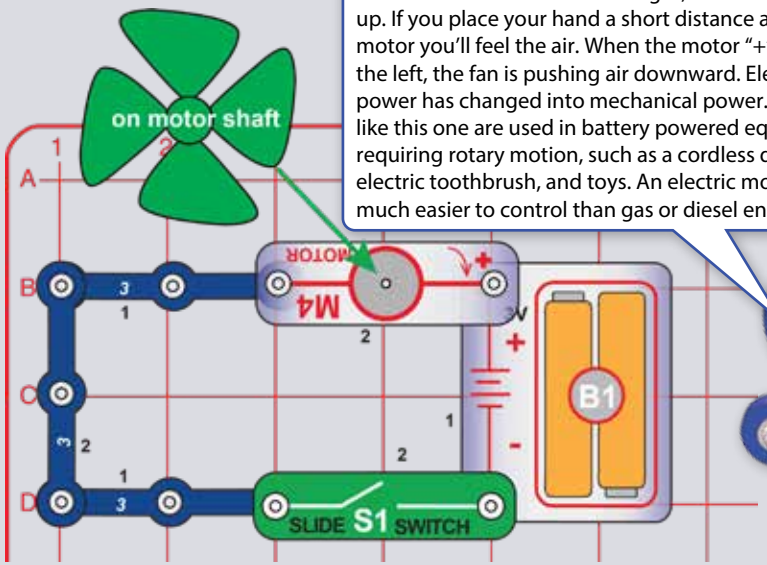


Part B Circuit

Control Screen in Circuit Mode

In Part B the transistor allows a small current from the A output on the SC Controller to control a large current through the lamp.

PROJECT 13



When the motor "+" is on the right, the fan blows air up. If you place your hand a short distance above the motor you'll feel the air. When the motor "+" is on the left, the fan is pushing air downward. Electrical power has changed into mechanical power. Motors like this one 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.

FAN

Build the circuit as shown. Turn on the slide switch (S1) to spin the fan. Do not touch the fan while it is spinning.

Part B: Replace one of the 3-snap wires with another battery holder (B1). The fan will spin faster now.

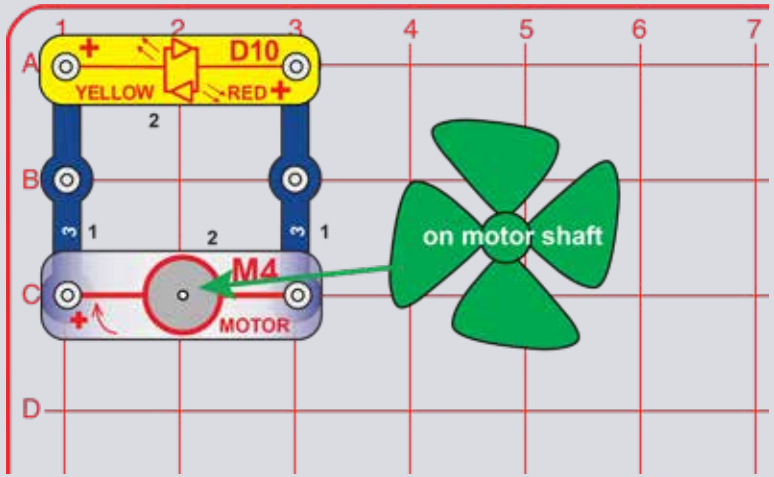
Part C: Use either of the preceding circuits but reverse the position of the motor (M4), so its "+" is on the left. Now the fan spins in the other direction.

Part D: Use any of the preceding circuits but replace one of the 3-snap wires with the 100Ω resistor (R1). The fan spins slower now. If the fan does not spin at all then give it a push with your finger to get it started.

Part E: Use the preceding circuit but replace the 100Ω resistor with the red/yellow LED (D10, in either direction). The LED lights, but the fan may not spin.

NOTE: See project 15 to spin the fan using coding, and see how much more control coding gives you.

PROJECT 14



GENERATOR

Blow hard on the fan to spin it, if you make it spin fast enough then the red/yellow LED (D10) will light. You can also try spinning the fan with your fingers. If you reverse either the motor (M4) or the LED then the LED will light in its other color.

Part B: Replace the red/yellow LED with the lamp (L4), and try to light it by spinning the fan (you can't).

Here the motor is used in reverse, to produce electricity from mechanical motion. Blown air (representing wind) spins the fan, which spins the motor shaft, producing an electric current in a coil inside the motor, which lights the LED.

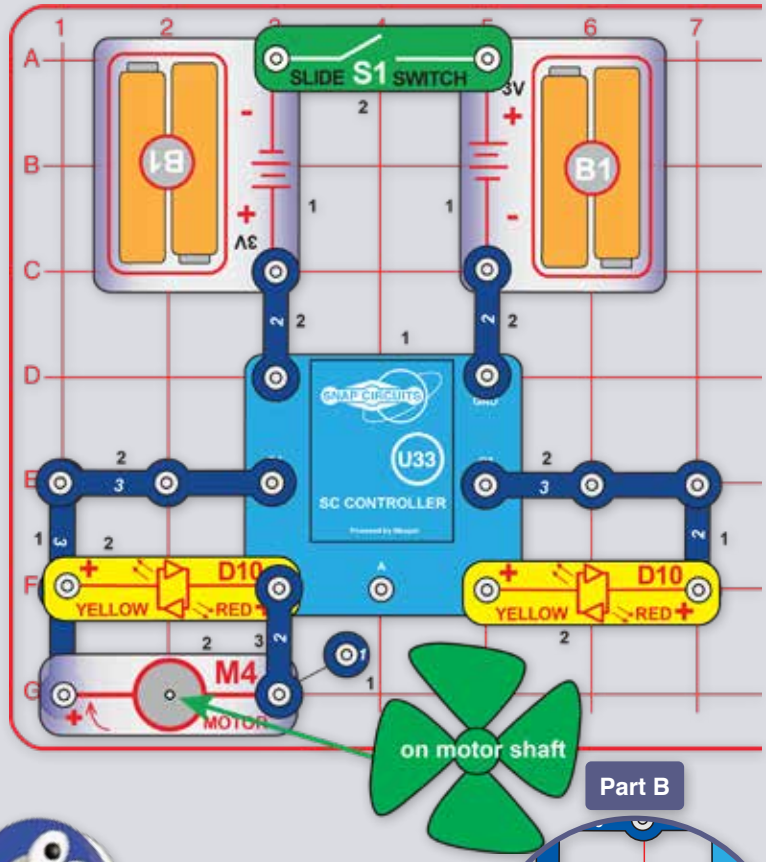
The lamp needs a lot more electricity to light than the LED needs, so you cannot spin the fan fast enough to light the lamp. Also notice that it is harder to spin the fan with the lamp in the circuit than with the LED.

PROJECT 15

FAN CODING

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to spin the fan and light the LEDs. See project 1 and pages 44-53 to review how to use the app.

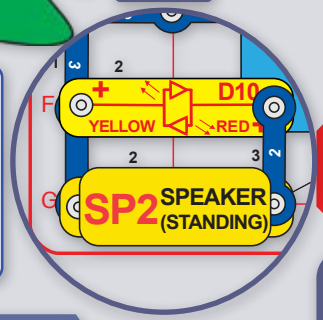
Next, put the app in BOTCode™ mode and create some code to light the LEDs and spin the fan. Experiment with changing parameters for commands, such as the time duration.

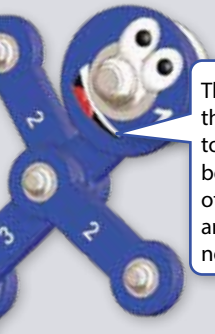


BOTCode™ Screen: Turn on LED & fan, speed up the fan, then reverse the fan.

Control Screen in Circuit Mode

Part B

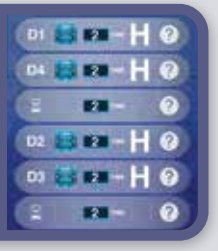




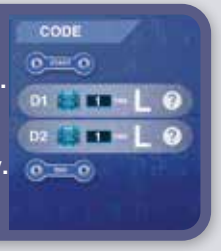
The D1-D2 and D3-D4 outputs on the SC Controller are connected together so an electric current flows between them if one is on and the other is off. If both D1 and D2 (or D3 and D4) are both on or both off, then no current flows between them.

Part B, Beep & Flash: Replace motor (M1) with the speaker (SP2), then create the program shown here.

Turn on the LEDs, alternately between yellow and red.



Beep & flash. Run this program continuously.

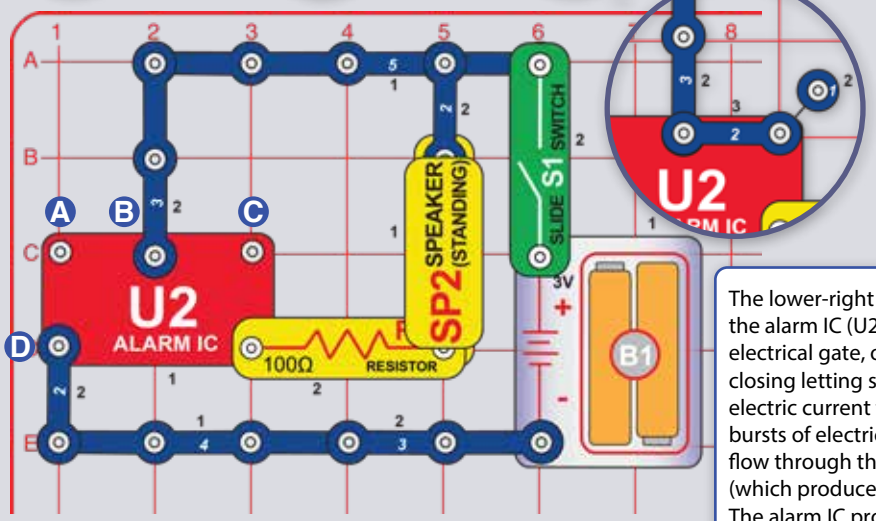


WARNING: Moving parts. Do not touch the fan or motor during operation.

CHALLENGES

- Make the right LED flash several times, turn on fan.
- Make fan spin in short bursts in opposite directions.

PROJECT 16



NOTE: See project 18 to control the alarm IC using coding, and see how much more control coding gives you.

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

SIRENS

Turn on the slide switch (S1), siren sounds.

Part B: Add a connection between the points marked B & C using a 1-snap wire and a 2-snap wire (or you can use the red jumper wire). Now it sounds like a machine gun.

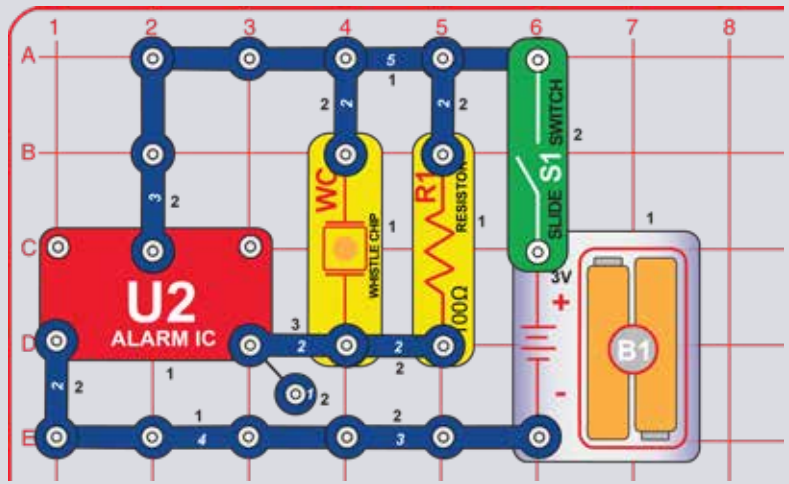
Part C: Remove the connection between B & C, and add a connection between A & B. Now it sounds like a fire engine.

Part D: Remove the connection between A & B, and add a connection between A & D. Now it sounds like a European siren.

Part E: For any of the above circuits replace the 100Ω resistor (R1) with a 3-snap wire to make the sound louder, or with the 1kΩ resistor (R2) to make the sound softer.

Part F: Use the part B circuit but replace the 100Ω resistor (R1) with the red/yellow LED (D10, in either direction) or the green LED (D2, "+" on right). Now the LED is blinking as the machine gun sounds.

PROJECT 17

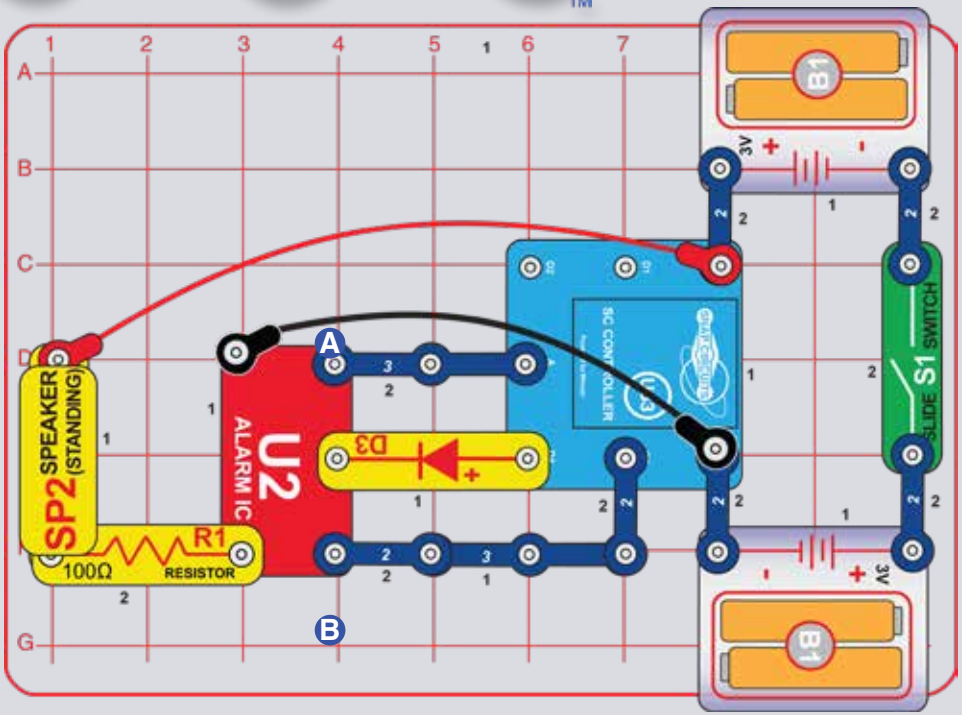


WHISTLE SIRENS

The whistle chip (WC) can make sound-producing mechanical vibrations like a speaker does. Re-build the preceding circuit as shown here and turn on the slide switch (S1) to hear a siren.

Variants: Replace the 100Ω resistor (R1) with the red/yellow LED (D10, in either direction) or add the connections described in parts B-D of the preceding circuit.

PROJECT 18



SIRENS CODING

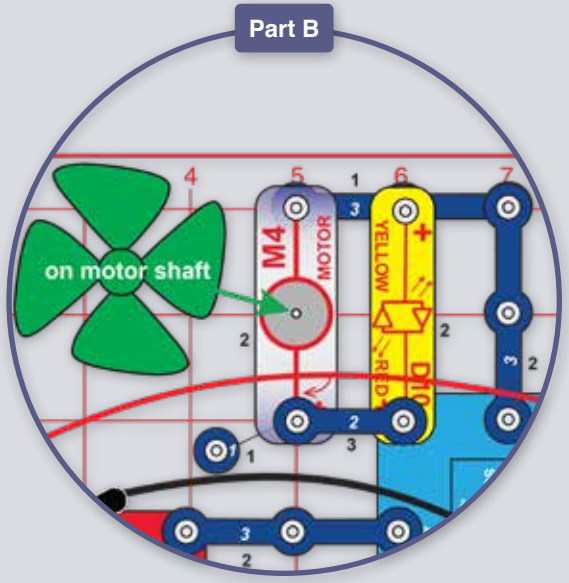
Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to activate sirens. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to sound different sirens. Experiment with changing parameters for commands, such as the time duration.

The alarm IC (U2) can produce four siren sounds, as shown in project 16. Those sirens can be produced by controlling the SC Controller outputs as follows:

- Siren 1. D4 on, A and D3 off.
- Siren 2. D4 and A on, D3 off.
- Siren 3. D4 and D3 on, A off.
- Siren 4. D4 on, and change the circuit by removing the Snap wires from points labeled A and B on the alarm IC.

You can make the sound louder by replacing the 100Ω resistor (R1) with the green jumper wire, or make the sound softer by replacing R1 with the 1kΩ resistor (R2) or an LED ("+" on top).

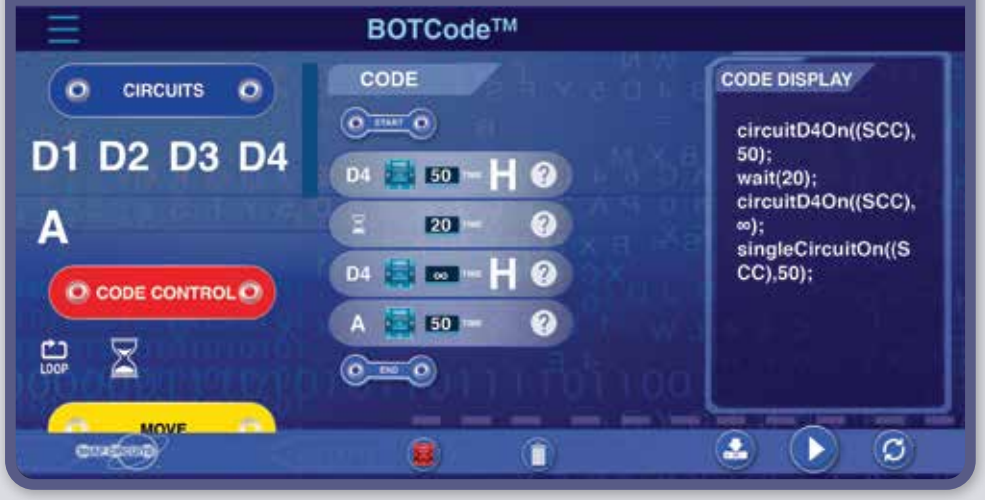


Part B: Add the motor (M4), fan, and red/yellow LED (D10).

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

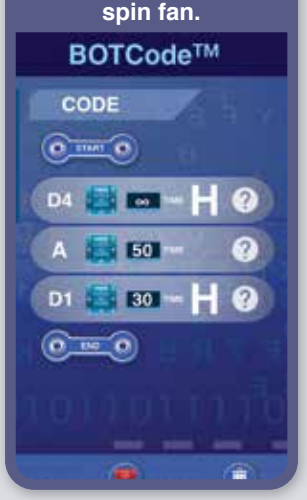
Control Screen in Circuit Mode

BOTCode™ Screen: Play 2 Sirens



Play 3 Sirens

Play a siren and then spin fan.



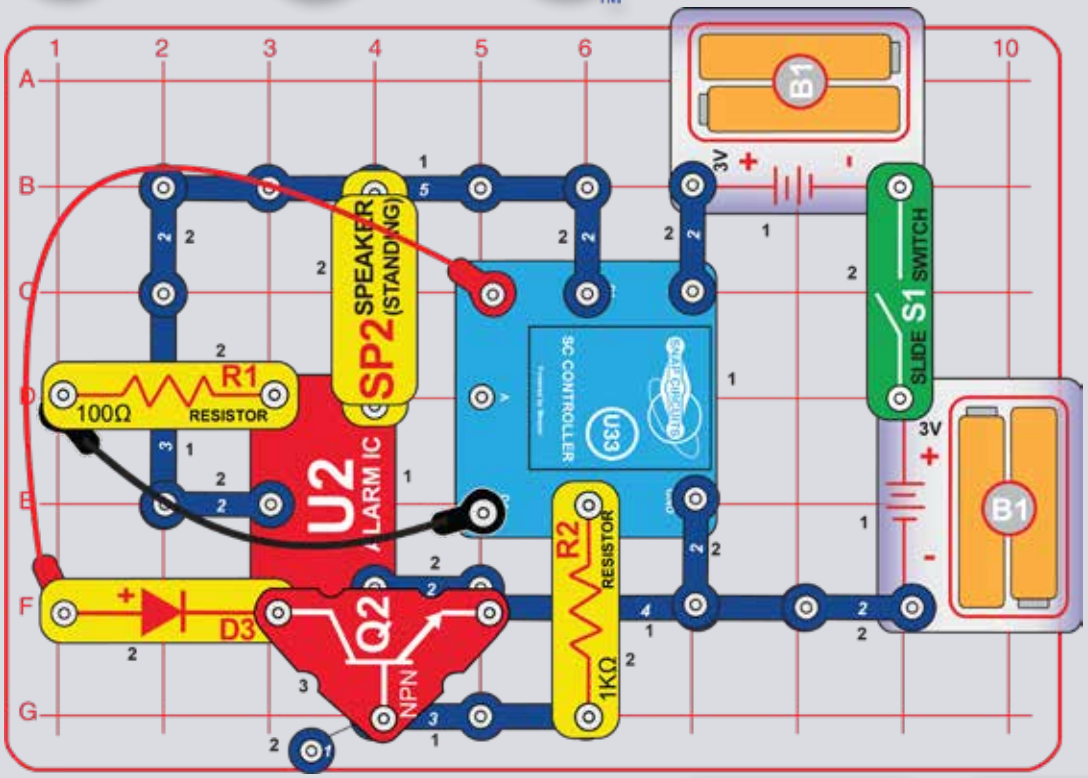
NOTE: If your batteries are weak then turning on the motor(M4)/fan may reset the SC Controller (making the blue Bluetooth light start flashing instead of staying on); if this happens then replace your batteries.

The diode (D3) blocks electricity from flowing from the A or D3 outputs (when they are turned on) on the SC Controller through the alarm IC, and back into the D4 output (when it is turned off) on the SC Controller. The alarm IC would not operate properly if that happened.

CODING CHALLENGE

- Play a siren for different durations using the same program.
- Turn motor forwards and then backwards.

PROJECT 19



4 SIRENS CODING

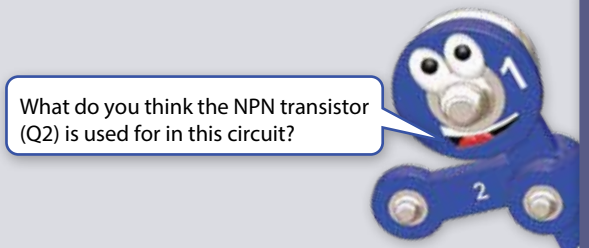
Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to activate sirens. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to sound different sirens. Experiment with changing parameters for commands, such as the time duration.

The alarm IC (U2) can produce four siren sounds, as shown in project 61. Those sirens can be produced by controlling the SC Controller outputs as follows:

- Siren 1. D1 on, others off.
- Siren 2. D1 and D2 on, others off.
- Siren 3. D1 and D3 on, others off.
- Siren 4. D1 and D4 on, others off.

You can make the sound softer by replacing the speaker (SP2) with the whistle chip (WC) and the red/yellow LED (D10), stacked together.



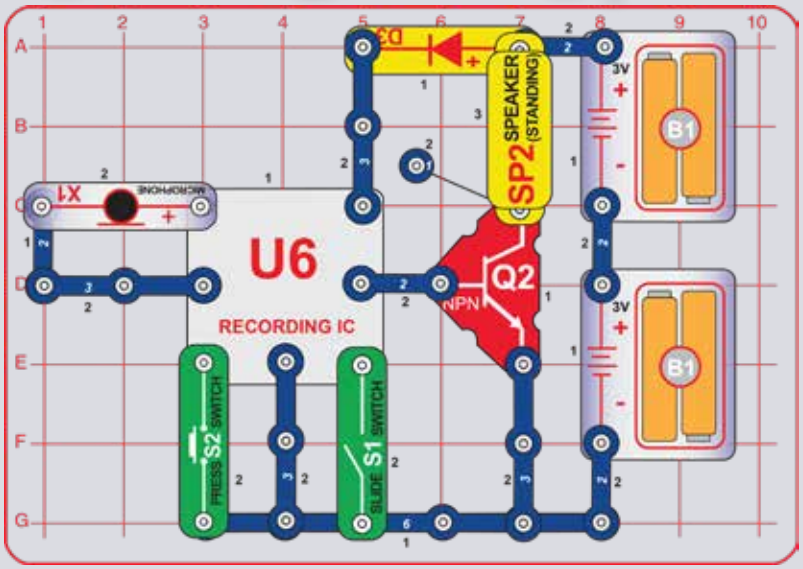
Control Screen in Circuit Mode

BOTCode™ Screen: Play 4 Sirens

CODING CHALLENGE

- Play 4 different sirens with increasing duration for each.

PROJECT 20



RECORDING & PLAYBACK

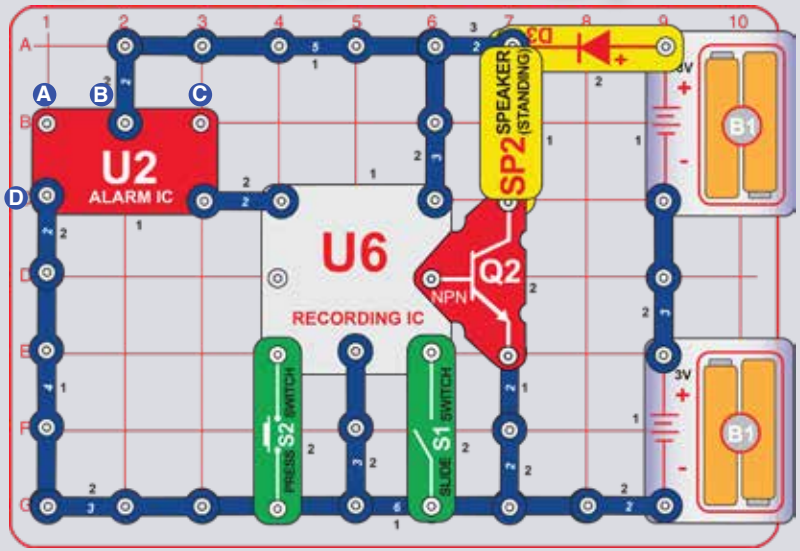
Build the circuit shown. Turn on the slide switch (S1), you hear a beep signaling that you may begin recording. Talk into the microphone (X1) for up to 5 seconds, and then turn off the slide switch (it also beeps after the 5 seconds expires). Turning the slide switch on and off quickly will erase any previous recording.

Push the press switch (S2) for playback. It plays the recording you made followed by one of three songs. If you press the press switch before the song is over, music will stop. You may press the press switch several times to play all three songs.

Disconnect the 2-snap wire between the battery holders when you are finished to turn off the circuit.

NOTE: See project 22 to control the recording using coding, and see how much more control coding gives you.

PROJECT 21



SIREN RECORDING

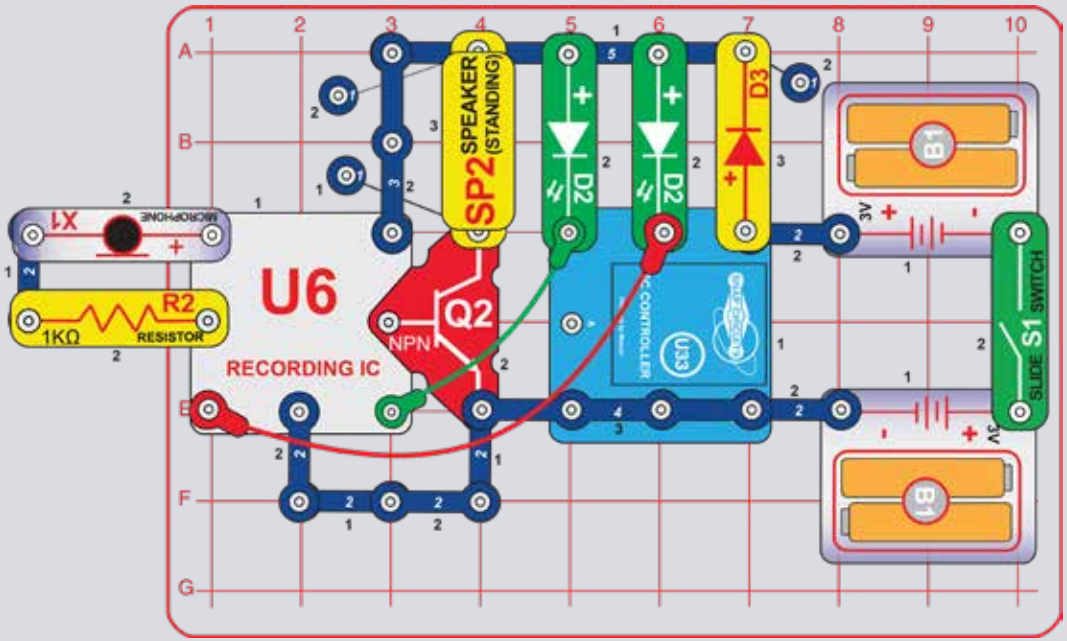
Build the circuit shown. Turn on the slide switch (S1) for up to 5 seconds to silently record a siren, you hear a beep signaling that recording has started, and then it beeps if the 5 seconds expires before you turn off the slide switch.

Push the press switch (S2) for playback. It plays the siren recording you made followed by one of three songs. If you press the press switch before the song is over, music will stop. You may press the press switch several times to play all three songs.

To change the siren sound connect a jumper wire between the points labeled A & B, B & C, or A & D.

Disconnect the 3-snap wire between the battery holders when you are finished to turn off the circuit.

PROJECT 22



RECORDER CODING

Build the circuit shown here and turn on the switch (S1); you hear a beep. Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to control the recording IC (U6). See project 1 and pages 44-53 if you need to review how to use the app.

Note: as shown in project 20, the recording IC inputs are activated by turning them off (connecting them to 0V), so start by turning on SC Controller outputs D1 and D2 (which turns them off), then:

- Turn off SC Controller output D2; you hear a beep signaling that you may begin recording. Talk into the microphone (X1) for up to 5 seconds, and then turn on D2 again to finish (it also beeps after the 5 seconds expires).

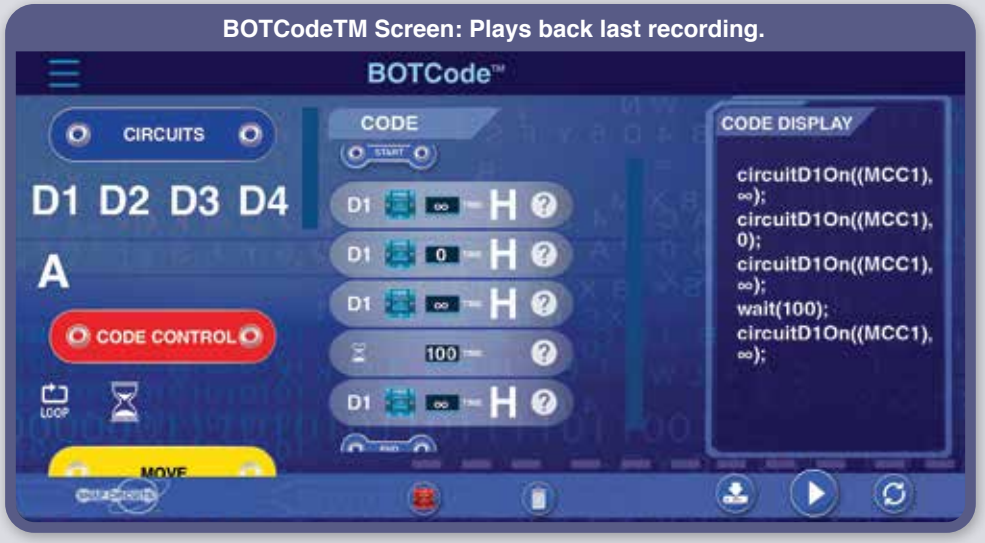
- Turn SC Controller output D1 off and then on for playback. You hear the recording you made followed by one of three songs. To stop the music, turn D1 off and on before the song is over. You may turn D1 off and on several times to play all three songs.

Next, put the app in BOTCode™ mode and create some code to control the recording IC. Experiment with changing parameters for commands, such as the time duration.

If the sound is too loud then replace the speaker (SP2) with the whistle chip (WC) and lamp (L2), stacked together.

Control Screen in Circuit Mode

BOTCodeTM Screen: Plays back last recording.

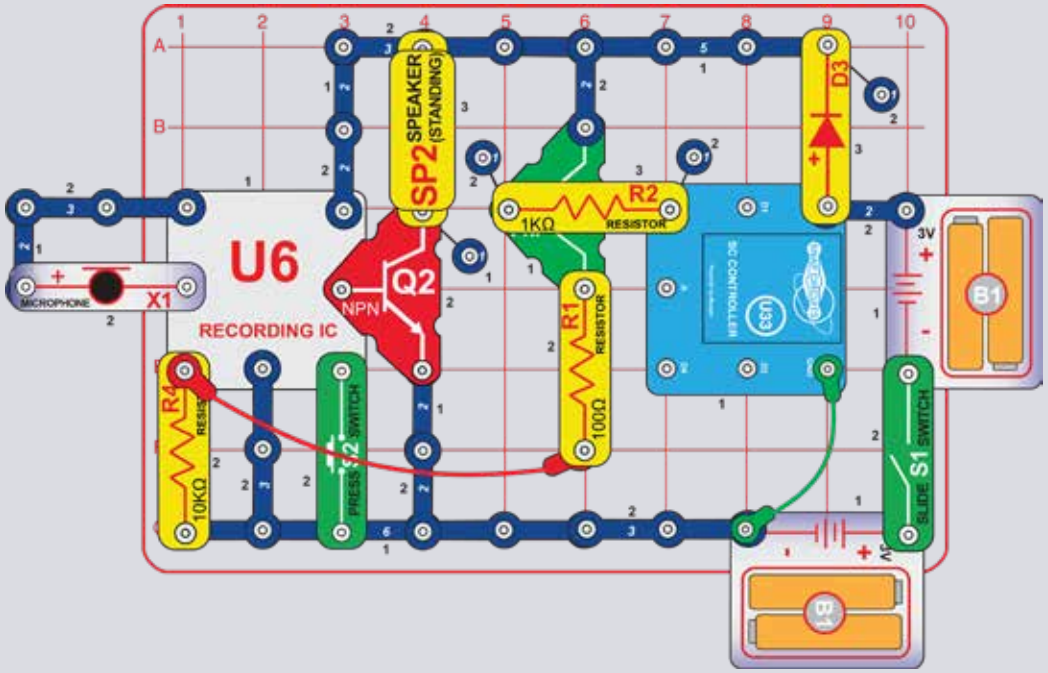


Make a recording and then play it back.

CODING CHALLENGE

- With one program, erase any previous recording, then play 3 different tunes, and then stop.

PROJECT 23



RECORDER PLAYBACK CODING

Build the circuit shown here and turn on the slide switch (S1); you hear any previous recording followed by a tune. If the sound is too loud then replace the speaker (SP2) with the whistle chip (WC) and lamp (L2), stacked together. Open the Snap Circuits Coding app, connect to the SC Controller, and use Circuit Control mode to control the D2 output of the SC Controller. Turning ON D2 will either stop the sound (if it is playing), or re-start the sound. See project 1 and pages 44-53 if you need to review how to use the app.

Push and hold down the press switch (S2) and talk near the microphone (X1) to make a new recording of up to 5 seconds (you hear a beep when first press S2 and will hear another beep if your recording time ends before you release S2. Pressing S2 for just a moment will erase any previous recording.

Next, put the app in BOTCode™ mode and create some code to the recording followed by one of three tunes.

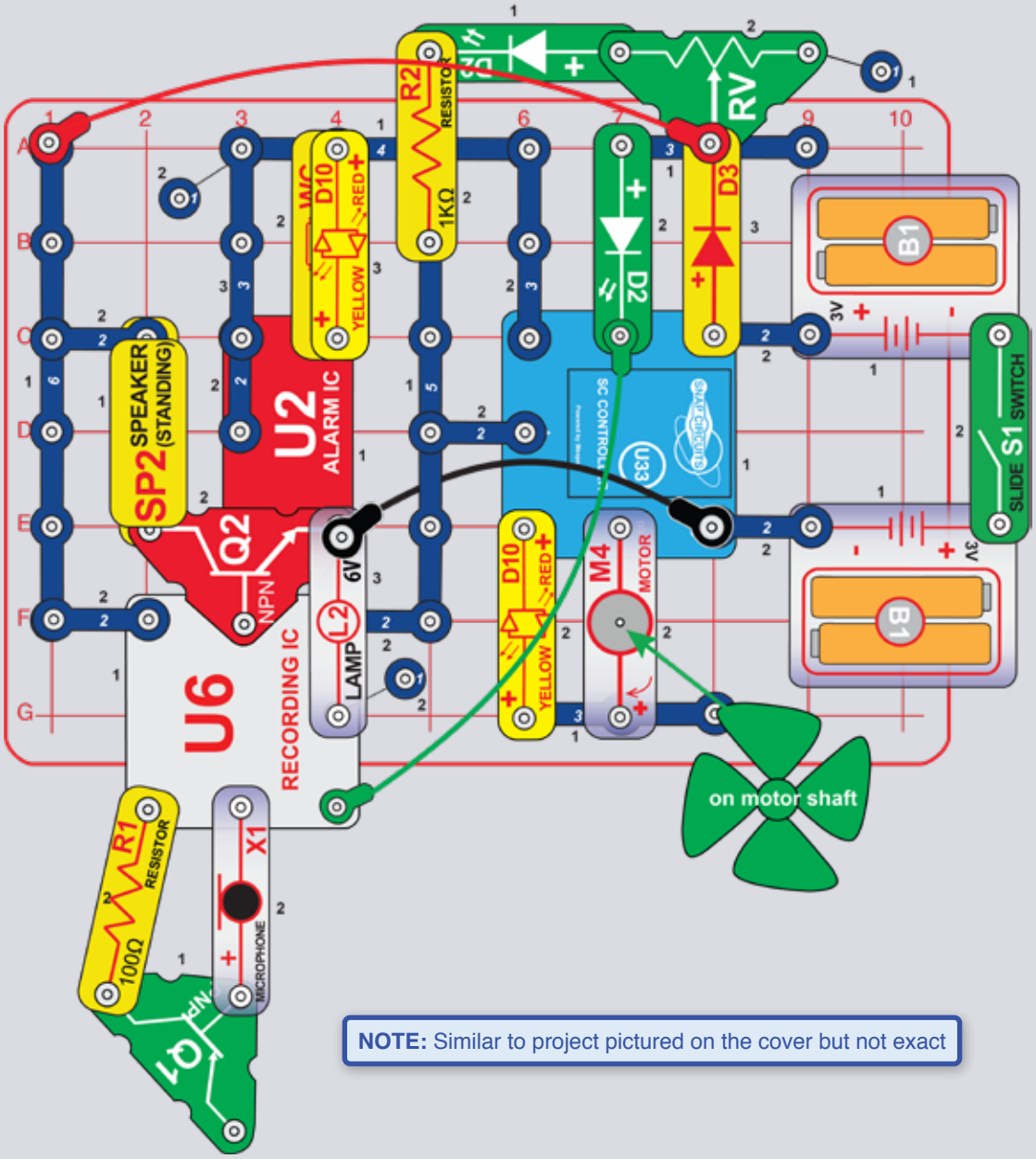
CODING CHALLENGE

- Play a recording 5 times, followed by a tune.

Control Screen in Circuit Mode

BOTCode™ Screen: Play the recording followed by one of three tunes, run it continuously to hear all three tunes.

PROJECT 24



NOTE: Similar to project pictured on the cover but not exact

BOX COVER CIRCUIT

This project combines many of your set's features into one circuit. Build the circuit shown here, set the adjustable resistor (RV) to the left, and turn on the slide switch (S1); you hear a beep. Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to control the recording IC (U6). See project 1 and pages 44-53 if you need to review how to use the app.

Note: as shown in project 8, the recording IC inputs are activated by turning them off (connecting them to 0V), so start by turning on SC Controller outputs D1 and A (which turns them off), then:

- Turn off SC Controller output A; you hear a beep signaling that you may begin recording. Talk into the microphone (X1) for up to 5 seconds, and then turn on A again to finish (it also beeps after the 5 seconds expires).

- Turn SC Controller output D1 off and then on for playback. You hear the recording you made followed by one of three songs. To stop the music, turn D1 off and on before the song is over. You may turn D1 off and on several times to play all three songs.

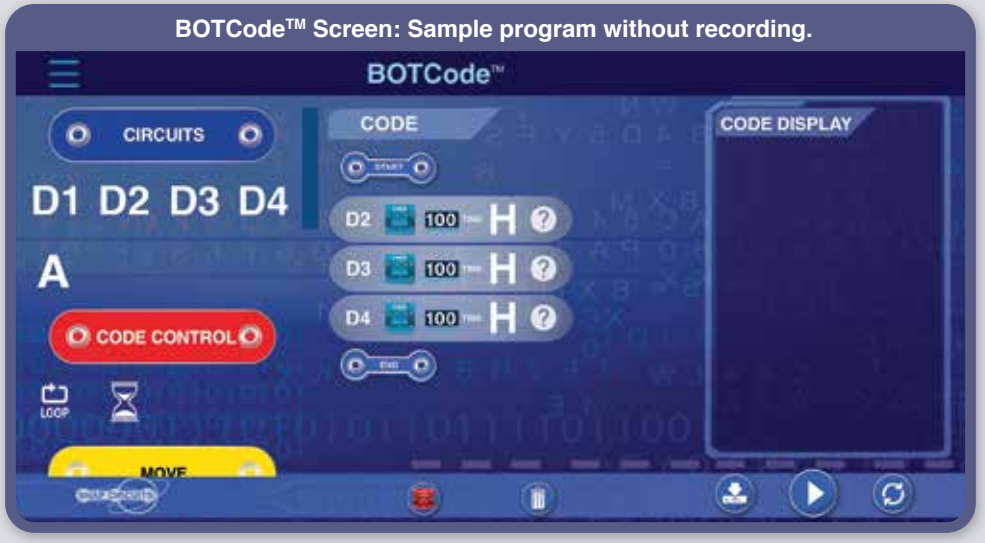
- Turn on SC Controller output D2 to hear machine gun sounds.

- Turn on SC Controller output D3 or D4 to spin the fan and light a red/yellow LED (D10).

Next, put the app in BOTCode™ mode and create some code to control the recording IC. Experiment with changing parameters for commands, such as the time duration.

Control Screen in Circuit Mode

BOTCode™ Screen: Sample program without recording.



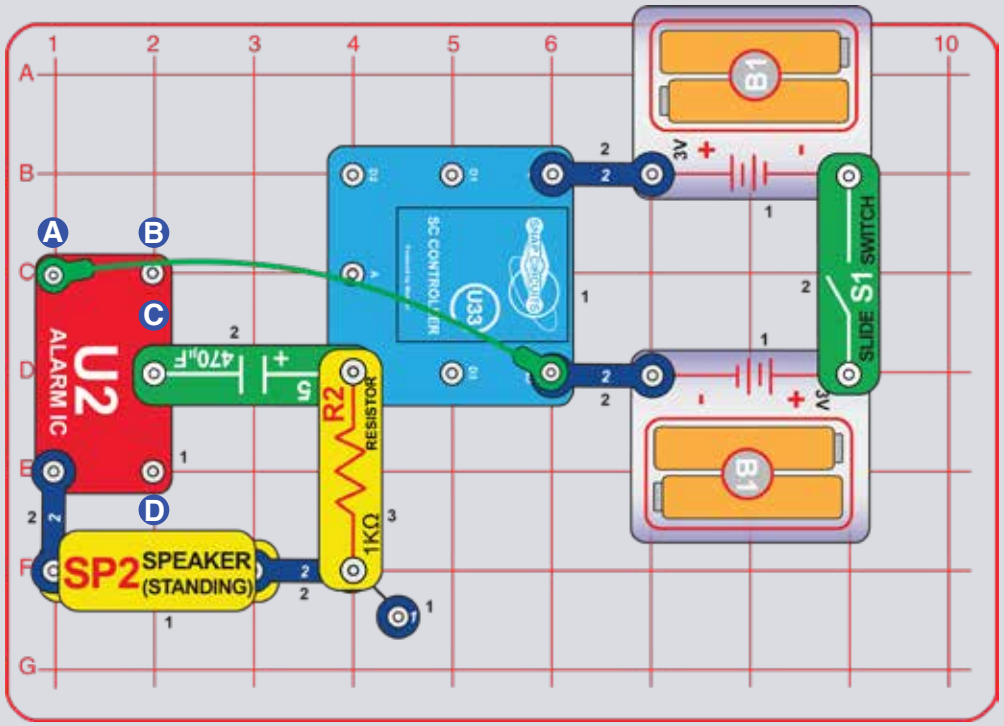
Make a recording & play it back, and spin the fan.

This complex circuit is shown on the cover of your box and manual, use that picture as a guide in building it.

CODING CHALLENGE

- Play a siren, then spin the fan, then play a recording followed by a tune, then light a green LED, all in one program.

PROJECT 25



FADING SIREN WITH CODING RESET

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to turn on output D4 repeatedly. A fading siren plays when D4 is turned on. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and make the fading siren play repeatedly using BOTCode™.

You can change the siren sound by adding a connection between points marked A & B, B & C, or C & D using a 1-snap wire and a 2-snap wire (or you can use the red jumper wire).

If you replace the 470µF capacitor (C5) with the smaller 100µF capacitor (C4) then the siren will not fade out or stop unless you turn output D4 off. If you replace C5 with the smaller 100µF capacitor (C4) then the sound will fade out more quickly.

Turning on the D4 output makes a current flow which charges up the 470µF capacitor, and current also goes into the alarm IC (U2) to play a siren. Once the capacitor is charged up the current stops, so the siren stops. Turning off the D4 output discharges the capacitor and resets the circuit.

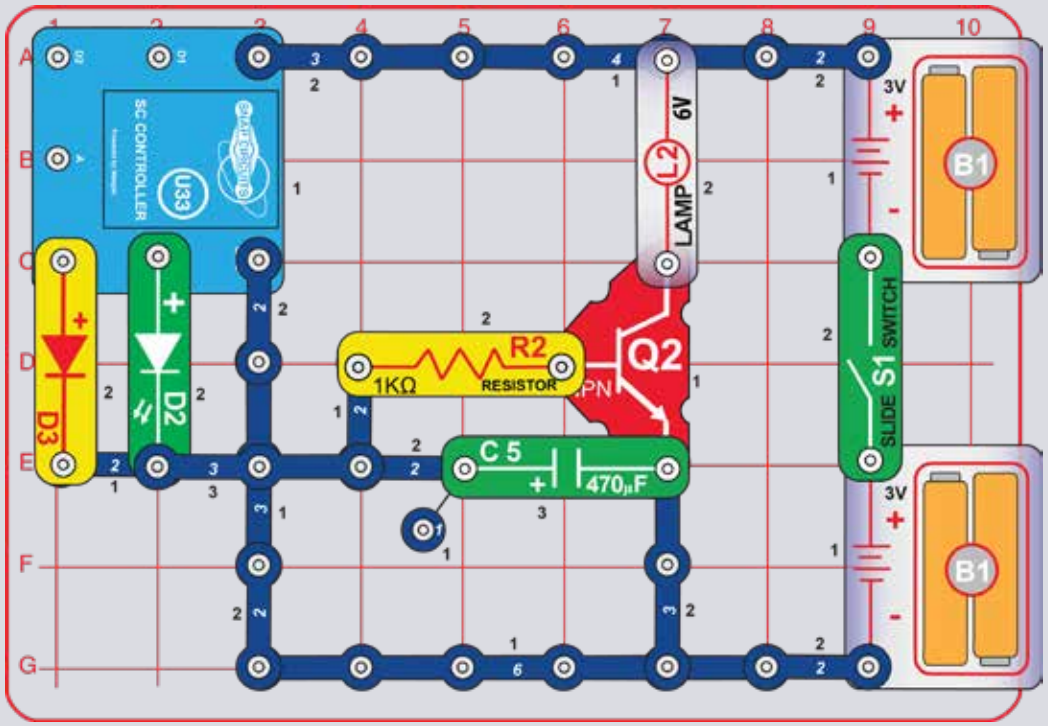
Control Screen in Circuit Mode

BOTCode™ Screen: Play fading siren continuously.

CODING CHALLENGE

- Play a fading siren but only in short bursts.

PROJECT 26



FADING LAMP CODING

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to turn the SC Controller D3 and D4 outputs on and off. The outputs charge the 470µF capacitor (C5) and control the lamp (L2). See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and control the lamp repeatedly using BOTCode™.

Variants:

- Speed up the fading rate by replacing the 470µF capacitor (C5) with the 100µF capacitor (C4).
- Remove the 470µF capacitor (C5) and compare how quickly the lamp turns off.
- Replace the lamp (L2) with the red/yellow (LED (D10, in either direction). The LED stays on a lot longer than the lamp, because even a small discharging current from the capacitor is enough to control the LED.
- Replace the lamp with the motor (M4) and fan.

Do not leave the lamp for two minutes because the lamp will be hot.

⚠ **CAUTION:** very warm lamp enclosure.

Turning on the SC Controller's D3 or D4 outputs makes a current flow which charges up the 470µF capacitor, (C5) and turns on the lamp If the D3 and D4 outputs are turned off then the capacitor discharges into the NPN transistor (Q2), causing the lamp to slowly fade out instead of turning off immediately when D3 and D4 are turned off.

Notice that the D4 output (with the diode (D3)) turns on the lamp faster than the D3 output (with the green LED (D2). This is because the D3/D4 outputs must also charge up the capacitor, and the LED has an internal protection resistor that slows the capacitor charge-up, while the diode does not have an internal resistor.

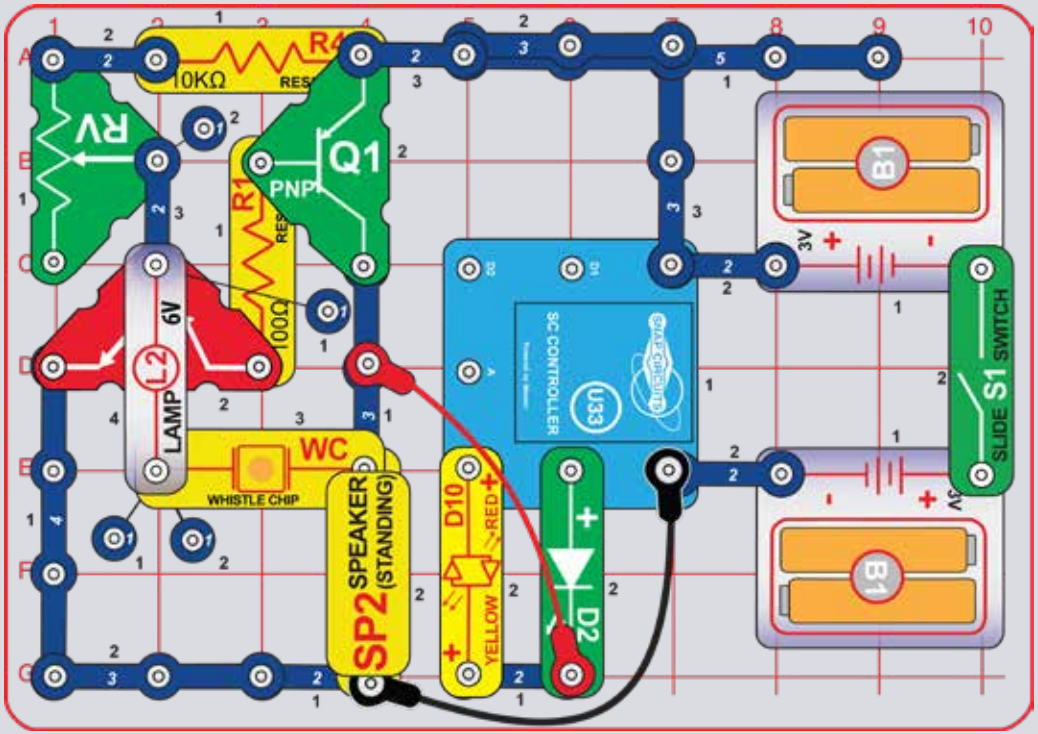
Control Screen in Circuit Mode

BOTCode™ Screen: Sample program.

CODING CHALLENGE

- Make the lamp turn on and fade out 5 times.

PROJECT 27



TONE CODING

Build the circuit shown here, set the adjustable resistor (RV) to mid range, and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use the D3 & D4 controls in Circuit Control mode to change the tone. You can also change the sounds by adjusting the setting on RV, but there may not be sound at all RV settings. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create code to sound different sirens. Experiment with changing parameters for commands, such as the time duration. You may want to remove the speaker (SP2) to silence the circuit while you are writing your code.

Variants:

- Replace the 10kΩ resistor (R4) with the 100kΩ resistor (R5). See how the tones change.
- Replace the whistle chip (WC) with the 0.1µF capacitor (C2). See how the tones change.

This circuit is an oscillator, it uses interaction between transistors, resistors, and capacitors to turn the transistors on and off in a repeating pattern. The whistle chip is used as a small capacitor.

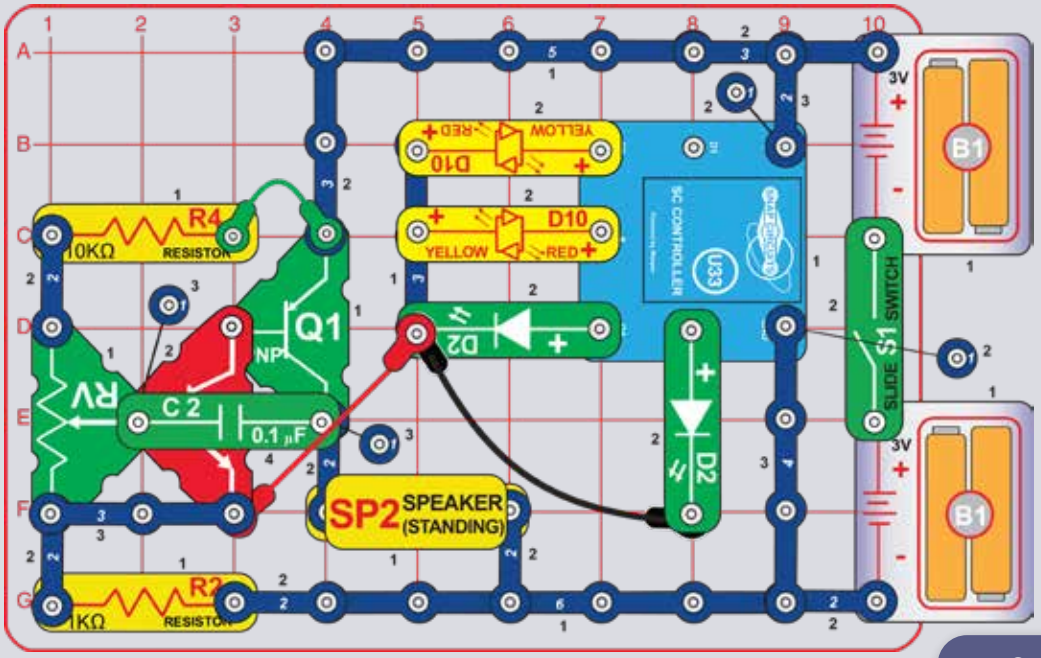
CODING CHALLENGE

- Play 2 tones with different durations in the same program.

Control Screen in Circuit Mode

Sample BOTCode™ program, run continuously.

PROJECT 28



TONE CODING 2

Build the circuit shown here and turn on the slide switch (S1). Set the lever on the adjustable resistor (RV) so there is sound; there may only be sound for a small part of RV's adjustment range. Open the Snap Circuits® Coding app, connect to the SC Controller, and use the D2, D3, D4, and A controls in Circuit Control mode to change the tone. If there is no sound then you may need to re-adjust the setting on RV, but there may not be sound at all RV settings. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to sound different sirens. Experiment with changing parameters for commands, such as the time duration. You may want to disconnect the speaker (SP2) to silence the circuit while you are writing your code.

Variant: Replace the 0.1µF capacitor (C2) with the whistle chip (WC). See how the tones change.

Control Screen in Circuit Mode

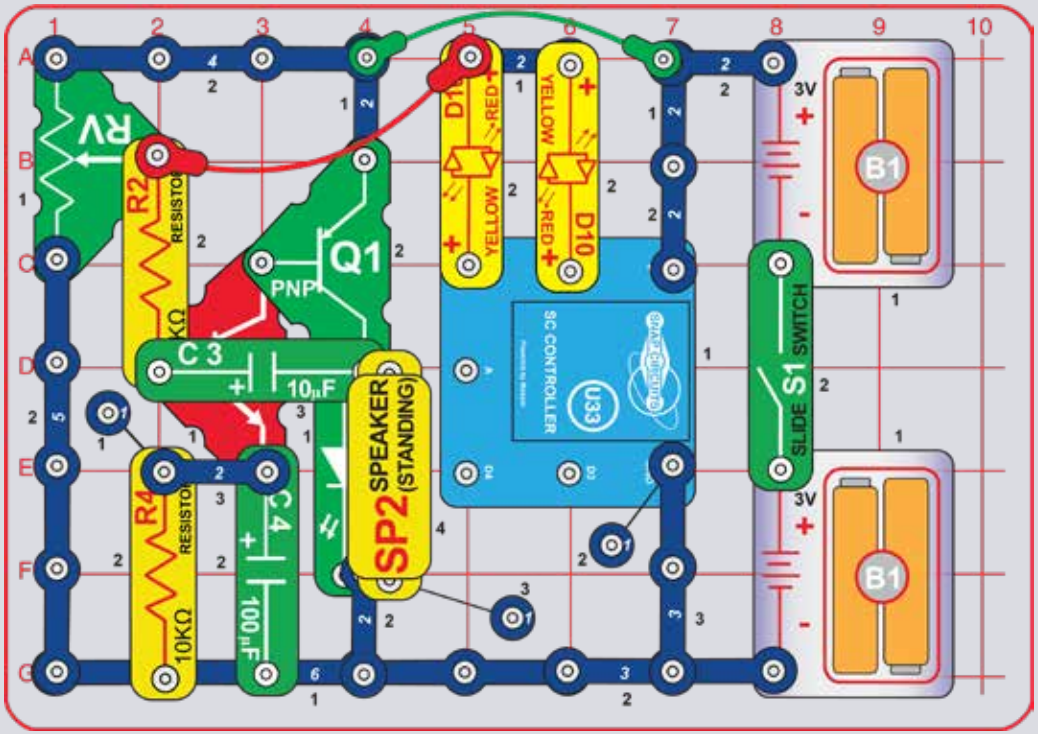
Sample BOTCode™ program, run continuously.

Sample BOTCode™ program, run continuously.

CODING CHALLENGE

- Play 3 tones with different durations in the same program.

PROJECT 29



BEEPER CODING

Build the circuit shown here and turn on the slide switch (S1). Set the adjustable resistor (RV) at or near the top so you hear beeping; the green LED (D2) is also blinking. Open the Snap Circuits® Coding app, connect to the SC Controller, and use the D1 & D2 controls in Circuit Control mode to change the beeping rate. You can also change the beeping by adjusting the setting on RV, but there may not be sound at all RV settings. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to make different sounds. Experiment with changing parameters for commands, such as the time duration. You may want to remove the speaker (SP2) to silence the circuit while you are writing your code.

Variant: Replace the 10µF capacitor (C3) with the 0.1µF capacitor (C2). See how the tones change.

Control Screen in Circuit Mode

Sample BOTCode™ program, run continuously.

CODING CHALLENGE

- Make 2 beeping patterns with different durations in the same program.

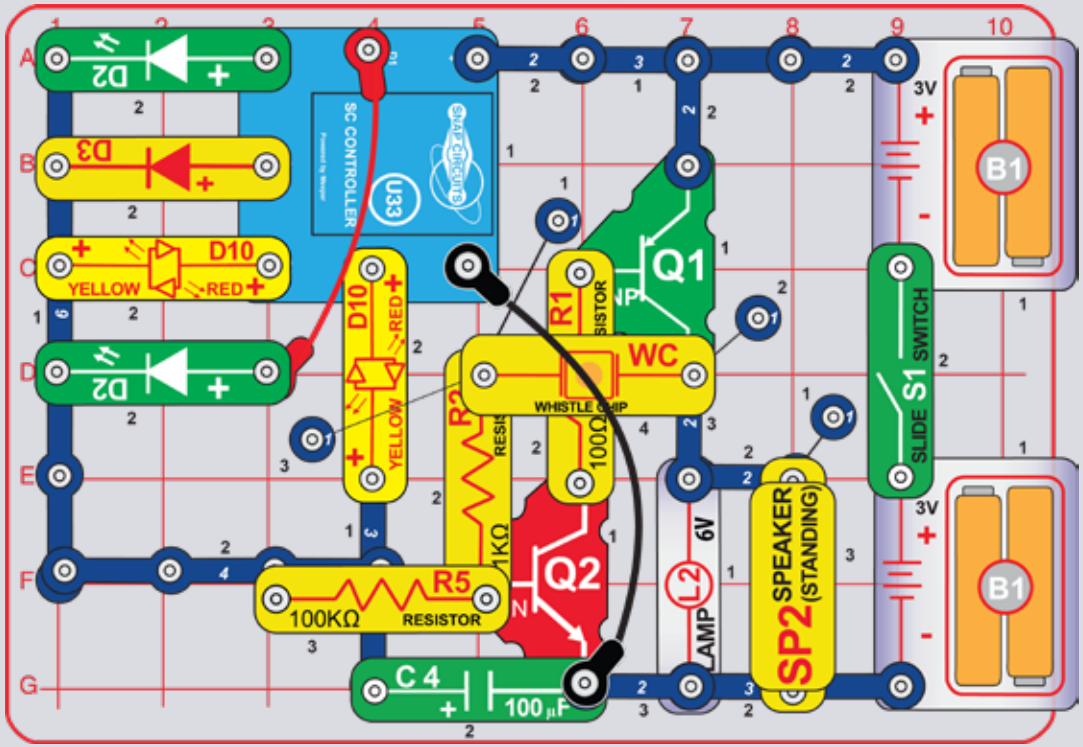
PROJECT 30

FADING WHINE CODING

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to turn any of the SC Controller outputs on and off. The outputs charge the 100µF capacitor and control a whining sound generation circuit. See project 1 and pages 44-53 if you need to review how to use the app.

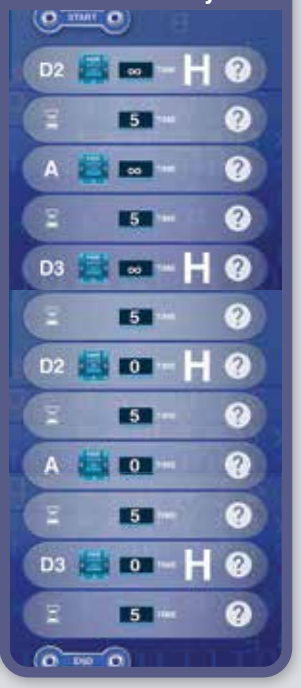
Next, put the app in BOTCode™ mode and change the sound repeatedly using BOTCode™.

You can change the tone by replacing the whistle chip (WC) with the 0.1µF capacitor (C2), or change the fading rate by replacing the 100µF capacitor (C4) with the 10µF capacitor (C3) or the 470µF capacitor (C5).



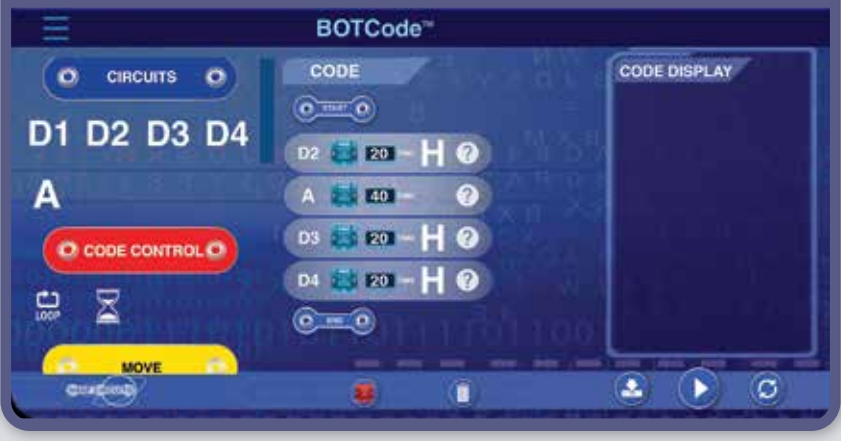
Turning on the SC Controller outputs makes a current flow which charges up the 100µF capacitor, (C4) and drives the whining sound generator. If all the SC Controller outputs are turned off then the capacitor discharges into the whining sound circuit, keep the sound on for a while. stays on for a while.

Sample program to vary the fading, only uses 3 outputs. Run continuously.



Control Screen in Circuit Mode

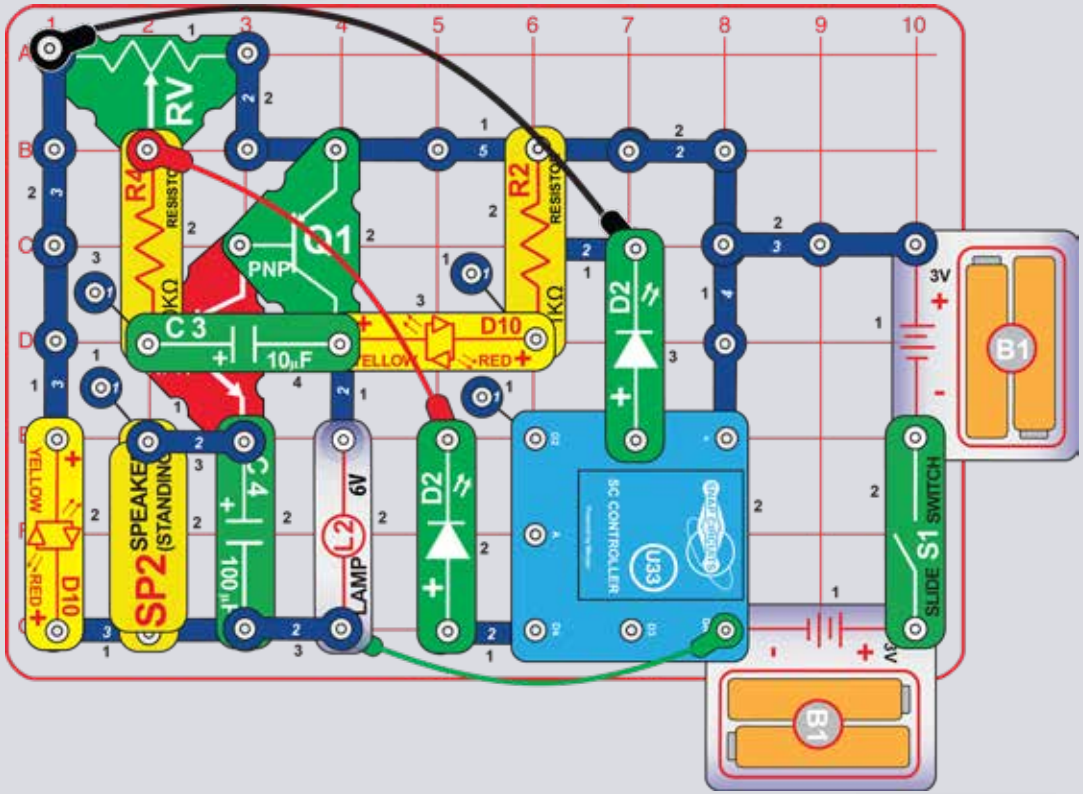
BOTCode™ Screen: Sample program.



CODING CHALLENGE

- Use all 5 of the SC Controller outputs to control/vary the fading sound.

PROJECT 31



SYNCHRONIZED FLASHER CODING

Build the circuit shown here and turn on the slide switch (S1). Set the adjustable resistor (RV) towards the left so lights are flashing and you hear beeping. Open the Snap Circuits® Coding app, connect to the SC Controller, and use the D1 or D4 controls in Circuit Control mode to change the beep/flash rate. You can also change the beep/flash by adjusting the setting on RV, but there may not be sound/flashing at all RV settings. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to sound different sirens. Experiment with changing parameters for commands, such as the time duration. You may want to remove the speaker (SP2) to silence the circuit while you are writing your code.

Variants:

- Replace the 10µF capacitor (C3) with the 0.1µF capacitor (C2). See how the sound changes.
- Replace the 100µF capacitor (C4) with the 470µF capacitor (C5). See how the beep/flash rate changes.

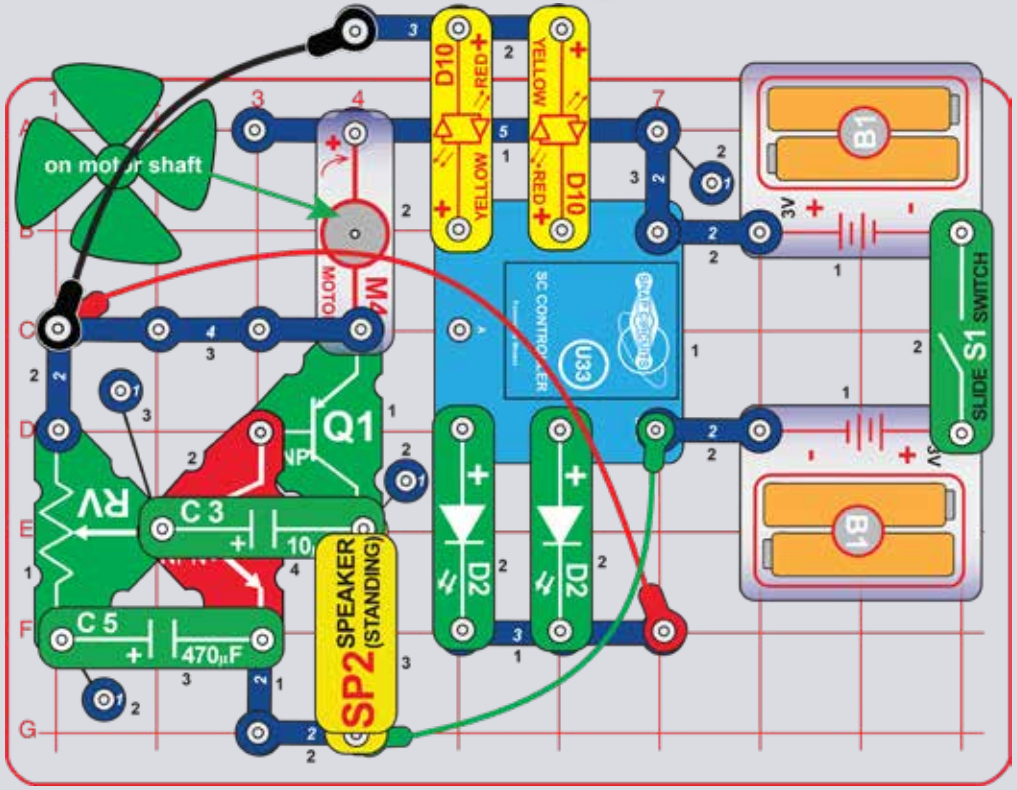
Control Screen in Circuit Mode

BOTCode™ Screen: Sample program, run continuously.

CODING CHALLENGE

- Have 2 different beep/flash rates, playing for about 5 seconds each in the same program.

PROJECT 32



SCREAMING FAN CODING

Build the circuit shown here and turn on the slide switch (S1). Set the adjustable resistor (RV) to any setting where the green fan is spinning and you hear sound. Open the Snap Circuits® Coding app, connect to the SC Controller, and use the D1, D2, D3, & D4 controls in Circuit Control mode to change the sound (the fan speed will also vary). You can also change the sound/fan by adjusting the setting on RV, but there may not be sound/spinning at all RV settings. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to sound different sirens. Experiment with changing parameters for commands, such as the time duration. You may want to remove the speaker (SP2) to silence the circuit while you are writing your code.

Variant: Replace the 10µF capacitor (C3) with the 0.1µF capacitor (C2). See how the sound changes.

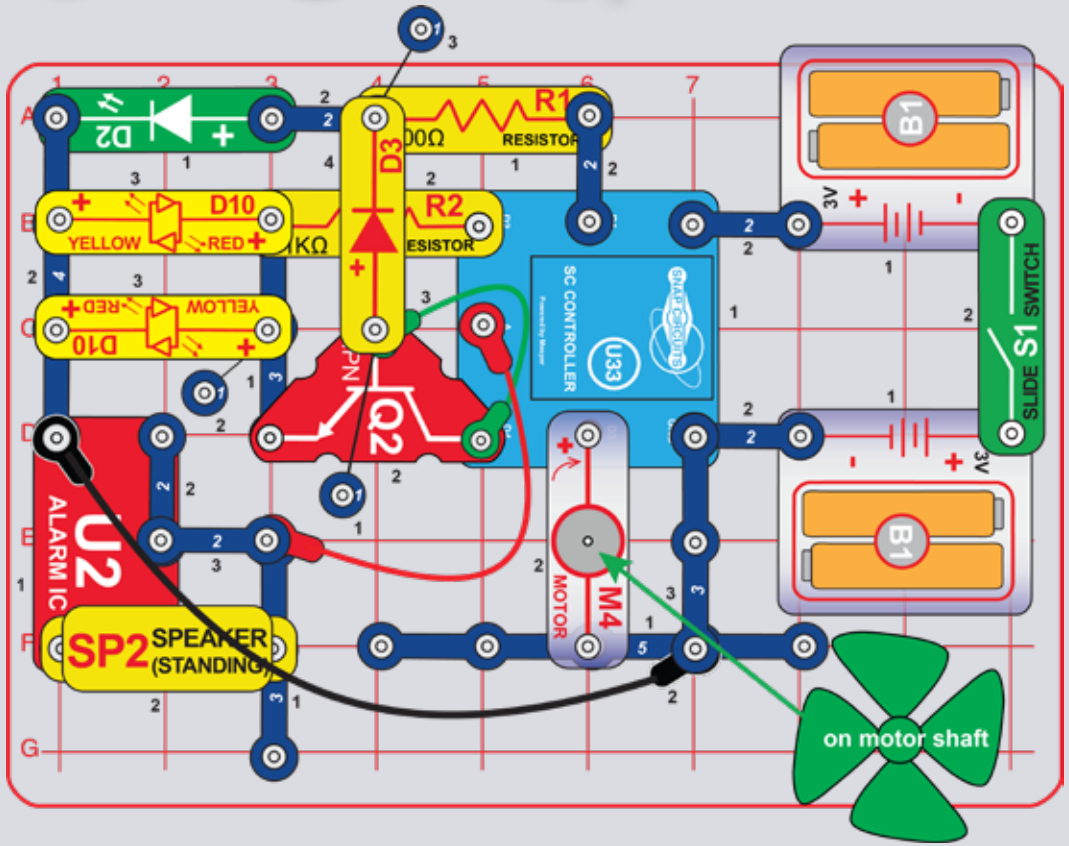
Control Screen in Circuit Mode

Sample BOTCode™ program, run continuously.

CODING CHALLENGE

- Configure RV and the SC Controller outputs to make a propeller or racing car sound.

PROJECT 33



COUNTDOWN

Build the circuit shown here, note that the blue 1-snap-wire is connected beneath the NPN transistor (Q2). Turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode to activate lights, a siren, or the motor (M4) and fan. See project 1 and pages 44-53 if you need to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to activate lights, sound, or motion, or use the "Countdown" program shown below. Experiment with changing parameters for commands, such as the time duration.

What to do next? Repeat the preceding projects using BLOCKLY coding. BLOCKLY is described at the end of project 1.

Now you are ready to code on your own!

Control Screen in Circuit Mode

BOTCode™ Screen: Countdown: light 1 LED, then 2 LEDs, then 3 LEDs, then siren, then launch fan

CODING CHALLENGE

- Spin the fan, play a siren, and light 3 LEDs at the same time.

SNAP CIRCUITS® CODING APP INSTRUCTIONS:

MEET THE SC CONTROLLER

The SC Controller module (U33) has 5 outputs (D1, D2, D3, D4, and A) that are controlled through Bluetooth using an app on your device. D1-D2 and D3-D4 are paired so they can each control a motor in both directions and can be set to either of two output voltage levels, called H (Higher) and L (Lower). Output A has low power and cannot control most motors.

The SC Controller can be controlled from the Snap Circuits® Coding App on your Bluetooth device in three ways:

1. Control (remote control in real-time).
2. BOTCode™ (simple graphical coding).
3. BLOCKLY coding.

SC CONTROLLER:

(+) - power input from batteries
GND - power return to batteries
D1 - output connection for a motor, paired with D2, higher & lower levels
D2 - output connection for a motor, paired with D1, higher & lower levels
A - output connection for low current uses, 4V output level
D3 - output connection for a motor, paired with D4, higher & lower levels
D4 - output connection for a motor, paired with D3, higher & lower levels

DOWNLOAD THE SNAP CIRCUITS® CODING APP:

GET IT ON Google Play

Download on the App Store

Go to the App Store on your device. The most recent version of the Snap Circuits® Coding App is available on iOS and Android, and may also be available on other devices. Check the Discover Coding product page at www.elenco.com/discover-coding.com for more information on what devices support the Snap Circuits® Coding App.

Search for 'Snap Circuits Coding'. Look for a page like the one shown here. Download the app, install it, and open it. Contact Elenco® if you have any problems.

CONNECT TO THE SNAP CIRCUITS® CODING APP:

1. Open the Snap Circuits® Coding App, it should be showing the connect screen. (If you already had the app open then tap the icon in the upper-left corner and tap "Connect" on the menu.)

Main Menu

Return to Main Menu

2. Make sure Bluetooth is turned on your device; If it's off, the app should prompt you to turn it on.

Bluetooth is off

3. Turn on the slide switch (S1) in your circuit to turn on the SC Controller (U33). The Bluetooth connection light indicator on the top of the SC Controller will flash blue to indicate the SC Controller has power and the SC Controller's Bluetooth chip is waiting to be connected to a device.

SC Controller is Off

4. The connect screen of the app will scan for available SC Controllers and within moments yours should appear as "Not Connected".

5. Tap on the red "Not Connected" dot to connect the app to your SC Controller. The red dot on the app should turn green, indicating your SC Controller module is now connected to the app. The Bluetooth indicator light on your SC Controller will now be a solid blue, indicating it is connected. You are now ready to Control or Code.

Unconnected

Connected

NOTE: If the app does not find your SC Controller then press "Start Scan" to search again (make sure your SC Controller is on).

6. If connecting for the first time, by default your SC Controller name will be SCC. You can change your SC Controller name and other settings in the MY SCC screen. See page 50 for more details on personalizing your SC Controller.

7. You may select multiple SC Controllers (up to 8) to Connect to on this screen.

To Disconnect: Turn the SC Controller circuit off with the slide switch **OR** return to the Connect screen and tap the Connected button next to your SC Controller's name. This will disconnect your device from the SC Controller and someone else can now connect.

How to Reconnect: Turn on your SC Controller. Return to the Connect screen and select the SC Controller you wish to reconnect.

Up to 8 Can Be Shown

CONTROL:

The easiest way to use your SC Controller is with Control mode, which uses your device as a remote control.

1. The Snap Circuits® Coding App should be open on your device and your SC Controller module should be connected to it as described on page 45.

2. From the Connect screen, tap the Control button. (You can also use the navigation menu to go to the Control screen from anywhere in the app.)

Connect Screen

Main Menu

3. The Control screen begins in Circuit mode, you can switch to Drive mode using the mode icon. Circuit mode will be emphasized for the projects in this booklet. Drive mode is primarily intended for using your SC Controller with vehicles using two motors, which may be available in other sets. Drive Control mode is described on page 51.

4. Use the controls to turn the LEDs in your circuit on and off.

Control Screen In Circuit Mode

Changing Control Screen Mode

CIRCUIT MODE FEATURES:

- 5 outputs for controlling your circuits: D1, D2, D3, D4 and A. Simply press the button to turn on/off the circuit output. Use these to turn the LEDs in your circuit on and off.
- D1-D4 have Higher and Lower Voltage Level Controls (typically 5V and 3V but varies depending on your battery voltage). Select Higher (H) or Lower (L) voltage to change the output voltage level. D1 & D2, and D3 & D4, are paired and must always be the same voltage level (H or L). Use H and L to change the brightness of LEDs in your circuit that are turned on.
- The A output is 4V but can only supply low currents, so it cannot be used to control the motor (M1) directly.
- You can Control & Code circuit paths independently or together. You can turn on all 5 circuit outputs (controlling 5 LEDs in this circuit) at a time or turn them on/off individually.
- You can control 2 SC Controllers in the App at once (for up to 10 outputs).

Control Screen In Circuit Mode

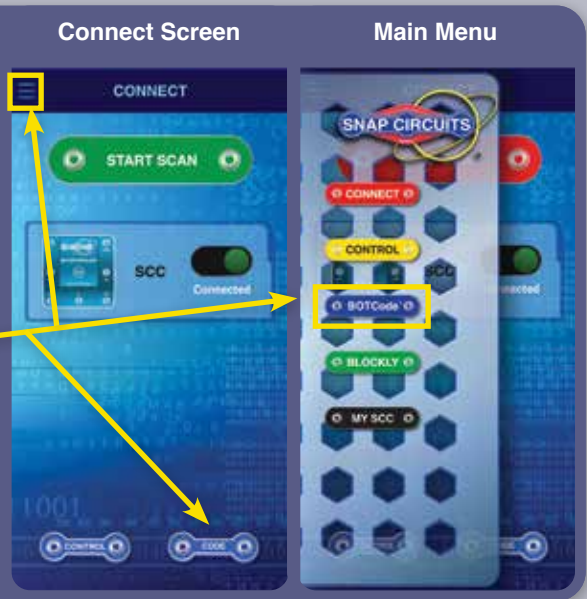
2 SC Controllers Can Be Controlled At Once

CREATE BOTcode™:

BOTCode™ uses Scratch-like drag and drop coding to make it easy to program the SC Controller. You can turn on lights, sounds, or motors, in any order or for different durations.

1. The Snap Circuits® Coding App should be open on your device and your SC Controller module should be connected to it as described earlier.

2. From the Connect screen, tap the Code button to get to the BOTCode™ screen. (You can also use the navigation menu to go to the Code screen from anywhere in the app.) With BOTCode™ you can program sequences of actions for your SC Controller and see them in action. Turn your device sideways – BOTCode™ will always be locked in landscape mode.



3. To start, tap & drag one of the actions from Code Control to the Code section.

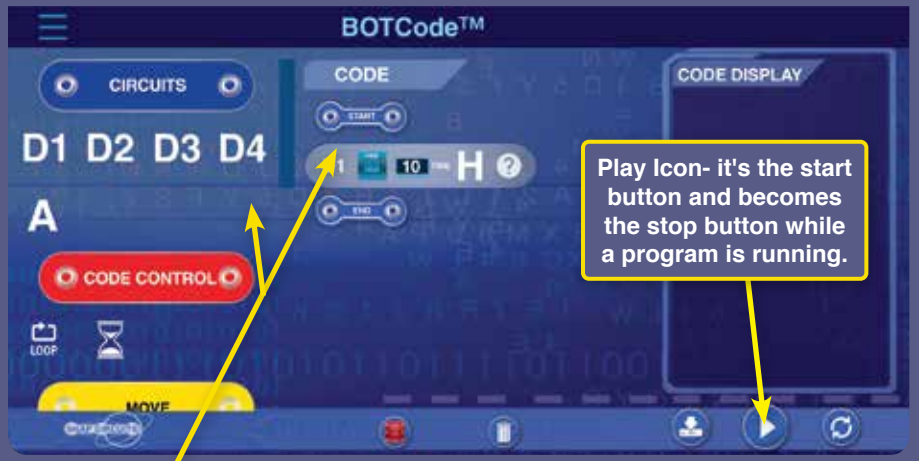
4. If you want to rearrange actions in the sequence, just tap-n-drag those, too!

5. Now, tap the Button with the Play icon in the lower right hand corner. The SC Controller activates the LEDs in this circuit as per the program you entered.

6. Watch your Code execute in the BOTCode™ section.
   a. The command that is running will be highlighted in the BOTCode™ section.
   b. The Java code that is generated for that command is displayed in the Code Display section. Learn real Java Code with your BOTCode™ programs.

7. To repeat running the Code, hit the Loop Sequence button next to the Play icon. To stop repeatedly running the Code press the stop button.

8. Utilize different types of commands:
   a. Circuits Control: commands to turn on and off the SC Controller outputs.
   b. Code Control: commands to loop or delay your code.
   c. Move & Turn Controls. commands for Forward, Reverse, Turns, & Spins for time durations or by rotations. These will mostly be used with vehicles.



EDITING & SAVING BOTCode™

You can change the duration or output voltage level for your BOTCode™ commands:

1. The App should be open to the BOTCode™ screen with some commands entered.

2. Tap that command in the CODE section.

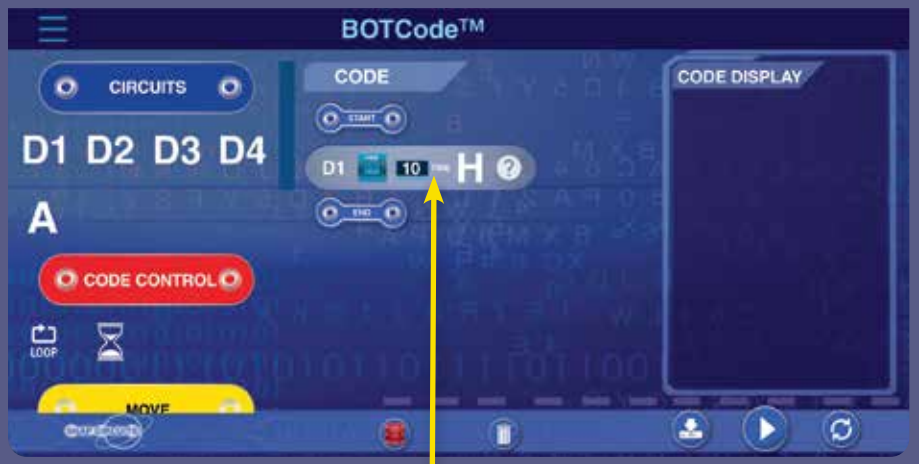
3. The Edit Command screen will appear.

   a. Change the duration of the command. "TIME" units are roughly 0.1 seconds but varies due to processing and Bluetooth delays.
   b. Change whether the output voltage level is H (Higher) or L (Lower). This only applies to outputs D1-D4, not output A.
   c. If you are running more than one SC Controller then select the SC Controllers that will run this command.
   d. Press 'Confirm' to save your changes.

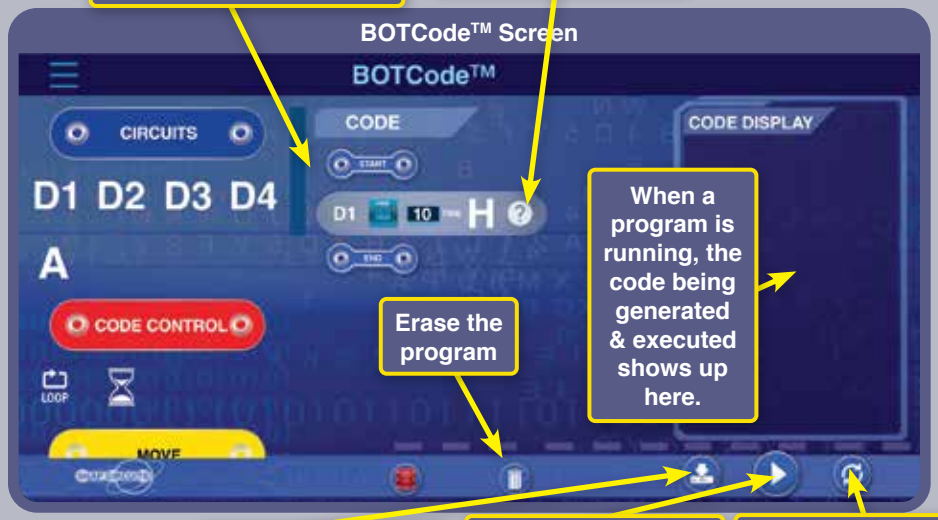
8. Run your code.

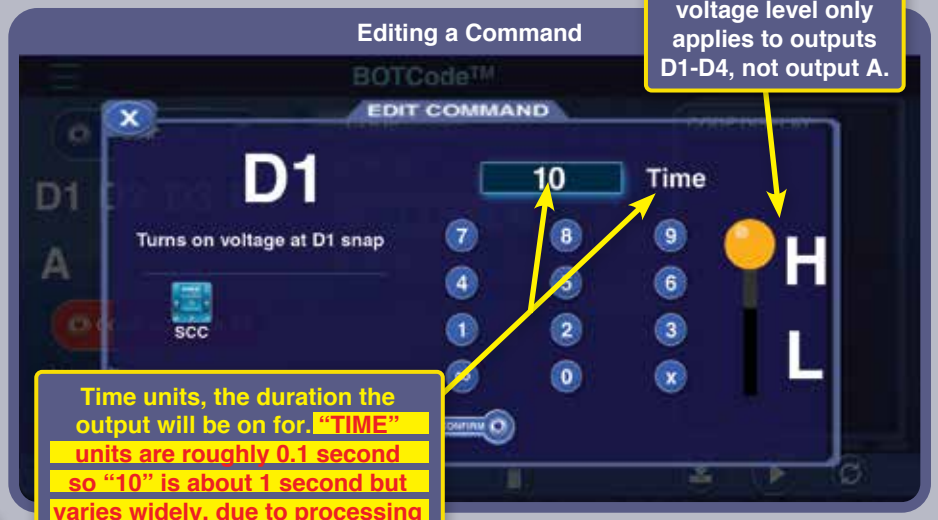
Note: You must be connected to your SC Controller in order to program it with commands.

BOTCode™ Screen



Select the command and change the SC Controller voltage and time variables on each command.





To Save your programs:

1. Tap the ‘Save’ Button in the lower right corner. Enter in the Name for your routine, then tap ‘Save’. You have now saved your new routine to your device.

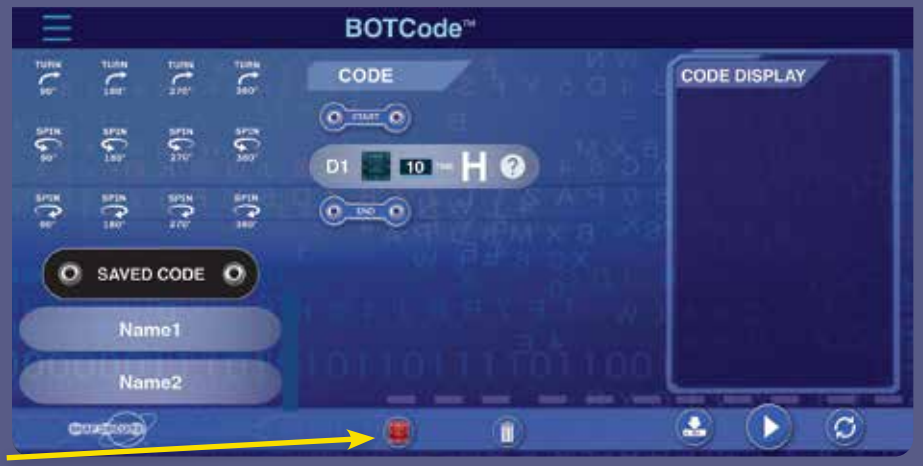
2. To find your newly saved masterpiece, go to the bottom of the commands menu (where you drag commands from). Your program will appear under the ‘Saved Code’ banner.

To run previously saved programs:

Drag the saved routine in to the CODE section, just like any other command. To save changes you make to a previously saved program, be sure that you call it the exact same name when you tap ‘Save’ again.

Note: Re-assign commands - if you do not have the same SC Controller connected when a command was added to the program (or if no SC Controller was connected) then BOTCode™ will ask you to reassign commands. What this does is take all connected SC Controllers and assign. them to any unassigned commands. You can also press the Reassign Commands button.

BOTCode™ Screen



Saved programs are below the commands menu

CODE SHARING: For instructions on how to import BOTCodeTM programs that other people created, or to export your programs to others, go to www.elenco.com/discover-coding. Some of the sample programs in this booklet are available there.

PERSONALIZING YOUR SC CONTROLLER

You can change the name used for your SC Controller in the app, as well as change the icons and colors. This is not necessary, but makes it easy to know which SC Controller is which when multiple SC Controllers are nearby.

1. Open Snap Circuits Coding app and connect your SC Controller module. (NOTE: in order to personalize any SC Controller you must be connected to it.

2. Navigate to the MY SCC screen using the icon in the upper left hand corner.

Connect Screen

Main Menu

3. Your SC Controller should show up with an icon and name. If several SC Controllers are connected then all will be shown.

4. Tap your SC Controller to pull up the Edit instructions.

MY SCC Screen

5. Read the instructions and tap "Confirm" button to proceed.

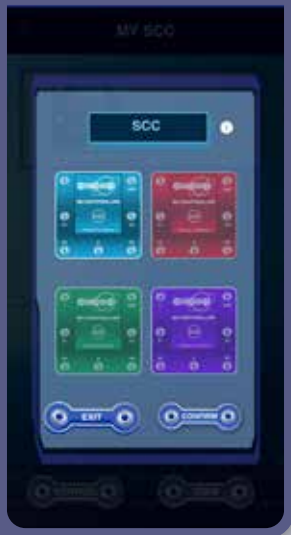
Change Instructions

6. Tap the icon color you like and rename it.

7. To save your changes, tap the "Confirm" button.

8. To ensure that the changes were saved, disconnect the SC Controller, then turn off the SC Controller, then turn on the SC Controller, and then reconnect the SC Controller.

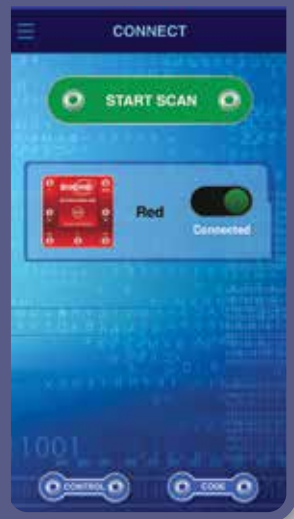
Personalize Screen



9. Your new SC Controller's name will now be displayed in the Connect, Control, and MY SCC screens.

10. Other users will see your SC Controller's new name when they return to the Connect screen in their app.

MY SCC Screen After Personalizing



DRIVE CONTROL MODE

The Control screen will usually be used in Circuit Control mode, but a Drive Control mode is also available. Drive Control mode is primarily intended for using your SC Controller with vehicles using two motors, which may be available in other sets. All the projects in this book use only Circuit Control mode, however Drive mode can be used with your Discover Coding set to turn on several outputs at once and produce some interesting effects.

1. The Control screen begins in Circuit mode, you can switch to Drive mode using the landscape icon.

Changing Control Screen Mode

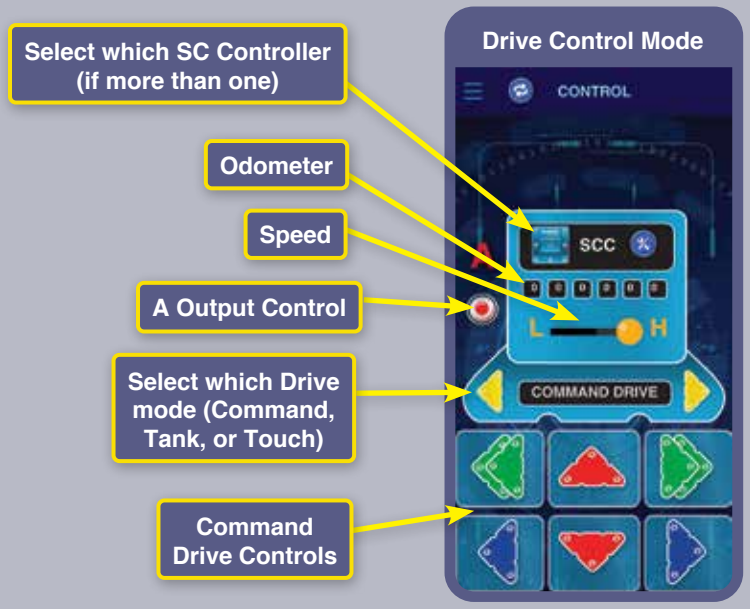
2. There are 3 different Drive modes. You can experiment by having these control the 5 LEDs in project 1 circuit and others.

a. Command Drive, is the easiest mode. Great to get started.
b. Tank Drive, a two-handed drive control which gives you direct control over each of the back motors.
c. Touch Drive, a super-responsive, joystick-like controller which lets you touch and drag where you want the vehicle to go (touch the center of the controls area and drag it in the direction you want to go).

3. The Driving Controls provide the commands for Forward/ Reverse, Left/Right Turn and Left/Right Spin, replacing the D1-D4 controls in Circuit mode. The A output is available to control other functions, such as a horn.

4. Switch Drive modes using the left and right arrows above the Driving Controls.

Drive Control Mode



VEHICLE CONTROL WITH THE SC CONTROLLER (U33): Vehicle commands assume that D1-D2 outputs on the SC Controller are connected to a vehicle's left motor (motor "+" or forward to D1), and that the D3-D4 outputs on the SC Controller are connected to a vehicle's right motor (motor "+" or forward to D3). The A output on the SC Controller is free to be used for sound, a light, or other functions.

Tank Drive Controls

Touch Drive Controls

Driving two or more vehicles:

1. Open the Snap Circuits® Coding App, connect two (or more) SC Controllers, and go to the Drive Control mode screen.

2. Once on the Drive screen (and with your vehicles on a safe surface), try to drive your vehicles. Each of them now drive in perfect sync with one another! Note: in DRIVE mode all SC Controllers receive the same control signals - they cannot be controlled independently at the same time.

3. If you want to select specific SC Controller vehicles to drive at once, simply tap that SC Controller's icon to Stop/Start driving it. The other SC Controller(s) will remain connected, but if it's faded, it won't receive a signal.

4. You can connect up to eight SC Controller vehicles and see what kinds of synchronized builds you can create!

Drive Mode With Several SC Controllers

SC Controllers not receiving Drive commands

SC Controllers receiving Drive commands

BOTCODE™ WITH MULTIPLE SC CONTROLLERS

If you have several sets then you can code multiple SC Controllers (which could be on separate vehicles of some form) to do the same or different commands.

The app should be open to the Code screen, with some commands entered, and the app connected to your SC Controllers.

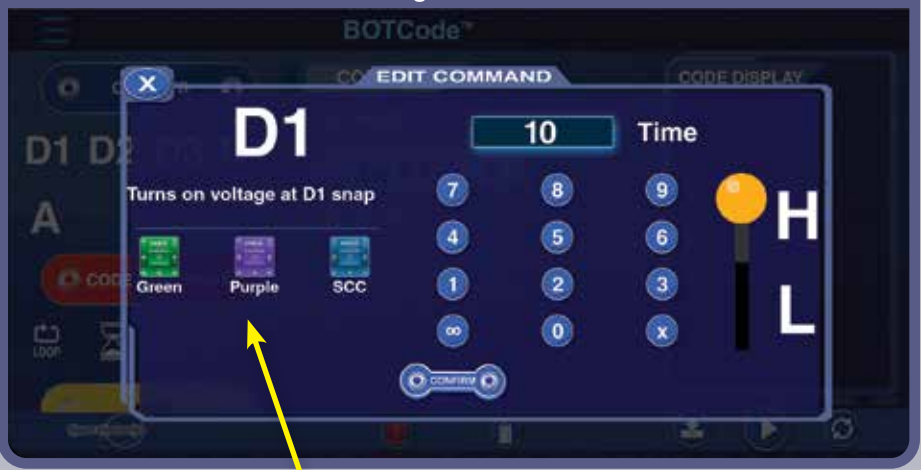
1. When you edit a command to change the time or voltage level, you can also select which SC Controller(s) the command will apply to.

2. Assign one command to one SC Controller and another to your other SC Controller – tap their portrait to choose which SC Controllers execute the command.

3. Try running the code and watch your SC Controllers start to work in tandem!

Multiple SC Controllers Connected

Editing a Command



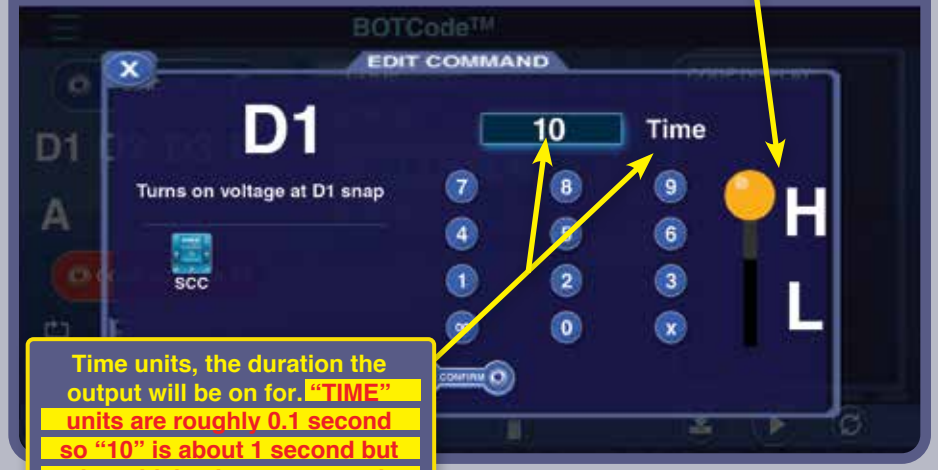
Select which SC Controllers to command, up to 8 may be controlled at once

DESCRIPTION OF BOTCODE™ COMMANDS

D1	Turn on D1 output (similar for D2, D3, D4) for the time duration shown and at the voltage level (H or L) shown.
A	Turn on A output for the time duration shown.
LOOP	Set up a group of commands to be executed for the specified number of times (1-100).
	Wait for the time duration shown before executing any more commands. **Time units are roughly 0.1 seconds (varies widely, due to processing and Bluetooth delays). Value can be set from 1 to 100.**

H (Higher=5V) and L (Lower=3V) output voltage level only applies to outputs D1-D4, not output A.

Editing a BOTCode™ Command



Time units, the duration the output will be on for. "TIME" units are roughly 0.1 second so "10" is about 1 second but varies widely, due to processing and Bluetooth delays). Value can be set from 1 to 100, or ∞ (to leave it on) and 0 (to turn it off).

VEHICLE COMMANDS WITH THE SC CONTROLLER (U33): Vehicle commands assume that the D1-D2 outputs on the SC Controller are connected to a vehicle's left motor (motor "+" or forward to D1), and that the D3-D4 outputs on the SC Controller are connected to a vehicle's right motor (motor "+" or forward to D3). The A output on the SC Controller is free to be used for sound, a light, or other functions.

NOTE: Turning on D1-D4 and A for a set time means the program will turn that output on, wait for that duration, then turn that output off before moving on to the next command. Set the duration to ∞ to turn an output on and leave it on (while the program performs other commands), then later set the duration to 0 if you want to turn it off later in the program.

NOTES:

NOTES:

CREATE YOUR OWN CHALLENGES:

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FCC Regulatory Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

ISED Regulatory Compliance

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions: (1)This device may not cause interference.(2)This device must accept any interference, including interference that may cause undesired operation of the device.

RF Exposure Compliance

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

CAN ICES-3 (B)/NMB-3(B)

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Smart-phone shown not included.

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Model SCM-165

- Over 50 parts and over 165 projects

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- Over 80 parts and over 750 projects

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Important: If any parts are missing or damaged, **DO NOT RETURN TO RETAILER**. Call toll-free at: (800) 533-2441 **or** e-mail us at: help@elenco.com.

Customer Service
150 Carpenter Ave. Wheeling, IL 60090 U.S.A.

Note: A complete parts list is on page 2 in this manual.

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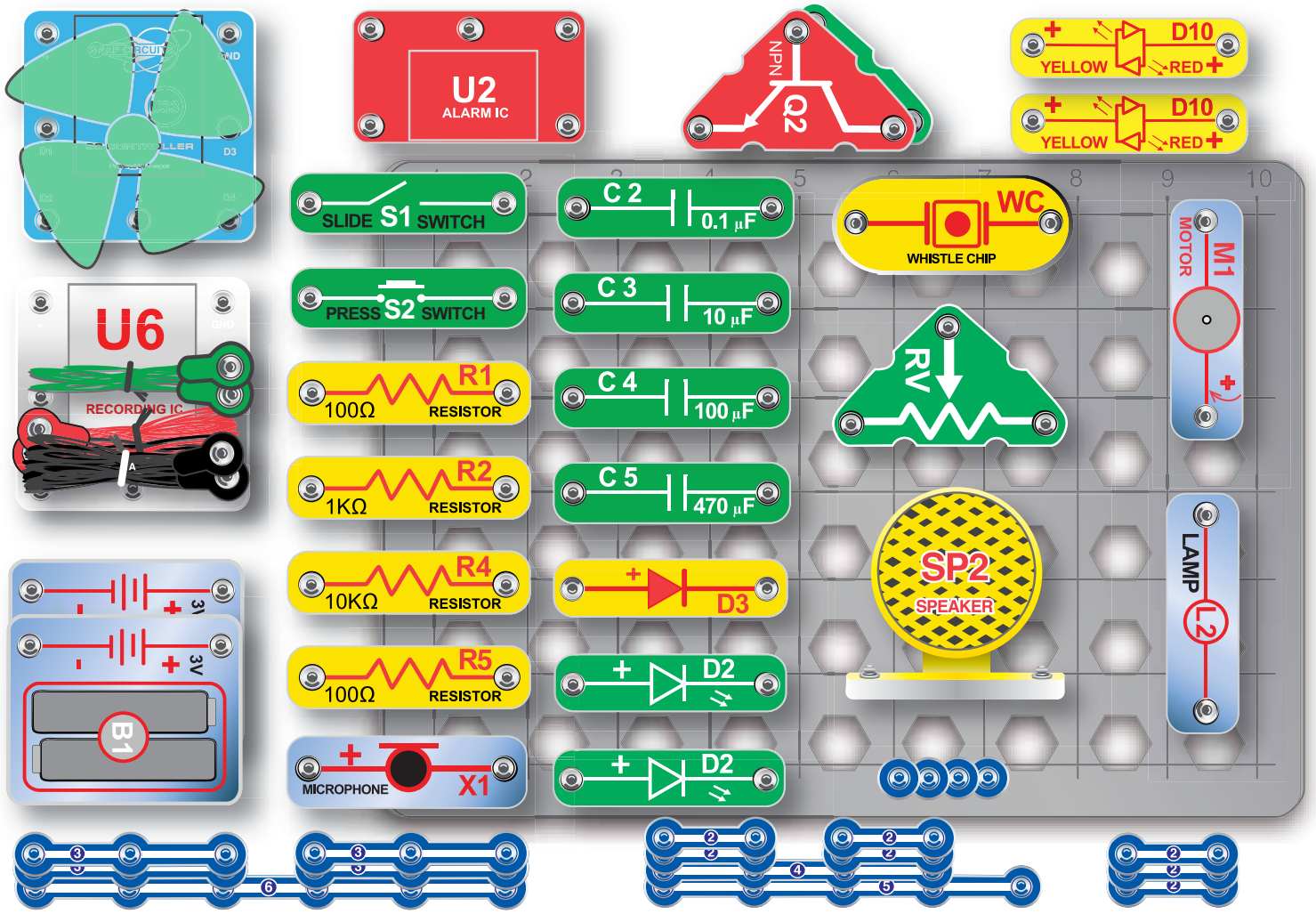
SCE-30 Explore Coding Parts Layout



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