SNAP CIRCUITS
ELENCO

Simply Snap Together!

# CODE JOURNEY

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**

Project 18

Requires six (6) "AA" batteries. Not included.
Ages 8 to 108

Download on the App Store
ANDROID APP ON Google play

ELENCO
Learn by doing.

753192

# Table of Contents



**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).

## 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 46 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:

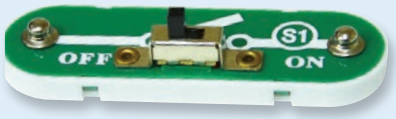
- Use only 1.5V AA type, alkaline batteries (not included).
- Insert batteries with correct polarity.
- Non-rechargeable batteries should not be recharged. Rechargeable batteries should only be charged under adult supervision, and should not be recharged while in the product.
- Do not mix old and new 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.

# 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.




Snap wire blocks are used for making connections, they are blue and come in different wire lengths. This one has the number (2) on it but there are other numbers 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.

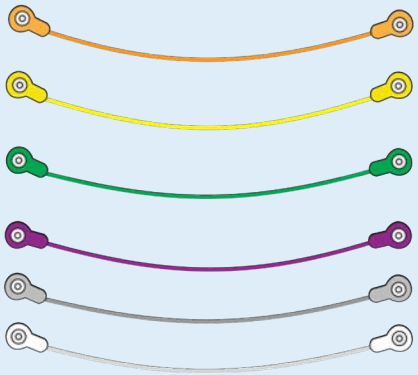

Install six 1.5V "AA" batteries (not included) into the bottom of the Rover body.

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.

Jumper wires are used to connect your circuits to the batteries and motors in the Rover body. Snap them on as shown in the projects. The colors are interchangeable, so it doesn't matter which color you use (however the red and black wires are longer than the rest).



**WARNING:** Never operate Snap Rover® in the street.

**WARNING:** Never drive your Rover in rain, snow, mud, sand, dirt, or on a wet floor, as damage may result.

**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.

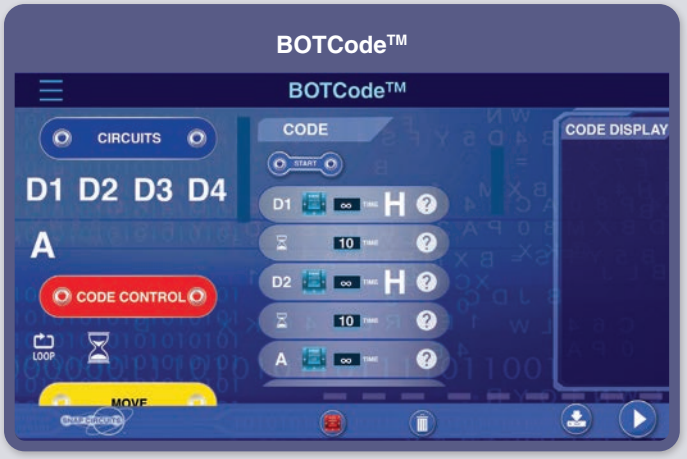
# WELCOME TO CODING!

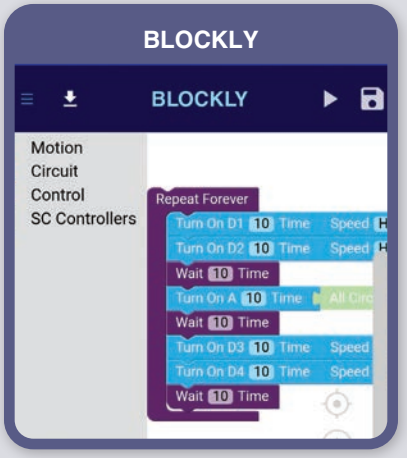
All computers, micro-controllers, apps, and websites are controlled using lines of code, which tell the device what to do, in what order, and when. You probably do not realize how many devices in your home or vehicle have microprocessors or simpler micro-controllers that use code to tell them what to 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.

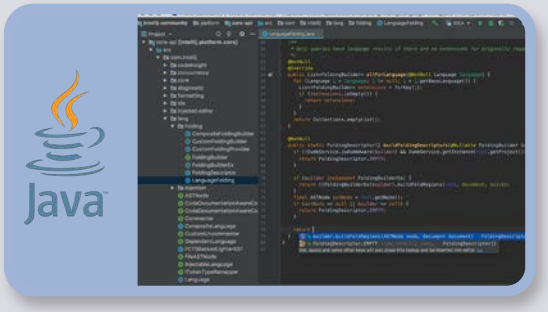
A computer does not understand any of the programming languages we use, or even graphical programming like BOTCode™. A computer is made up of millions of transistors that can only be turned on or off. These transistors can be grouped together in large numbers to form digital memories and do calculations. 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.

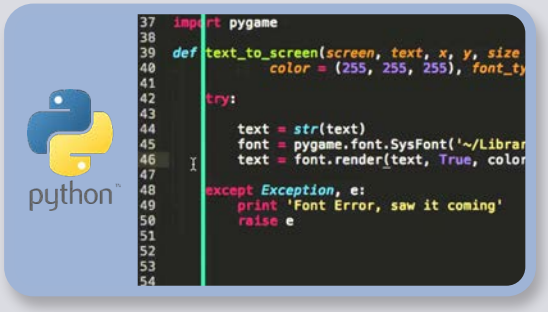
## FORMS OF CODE YOU WILL USE




## OTHER FORMS OF CODE



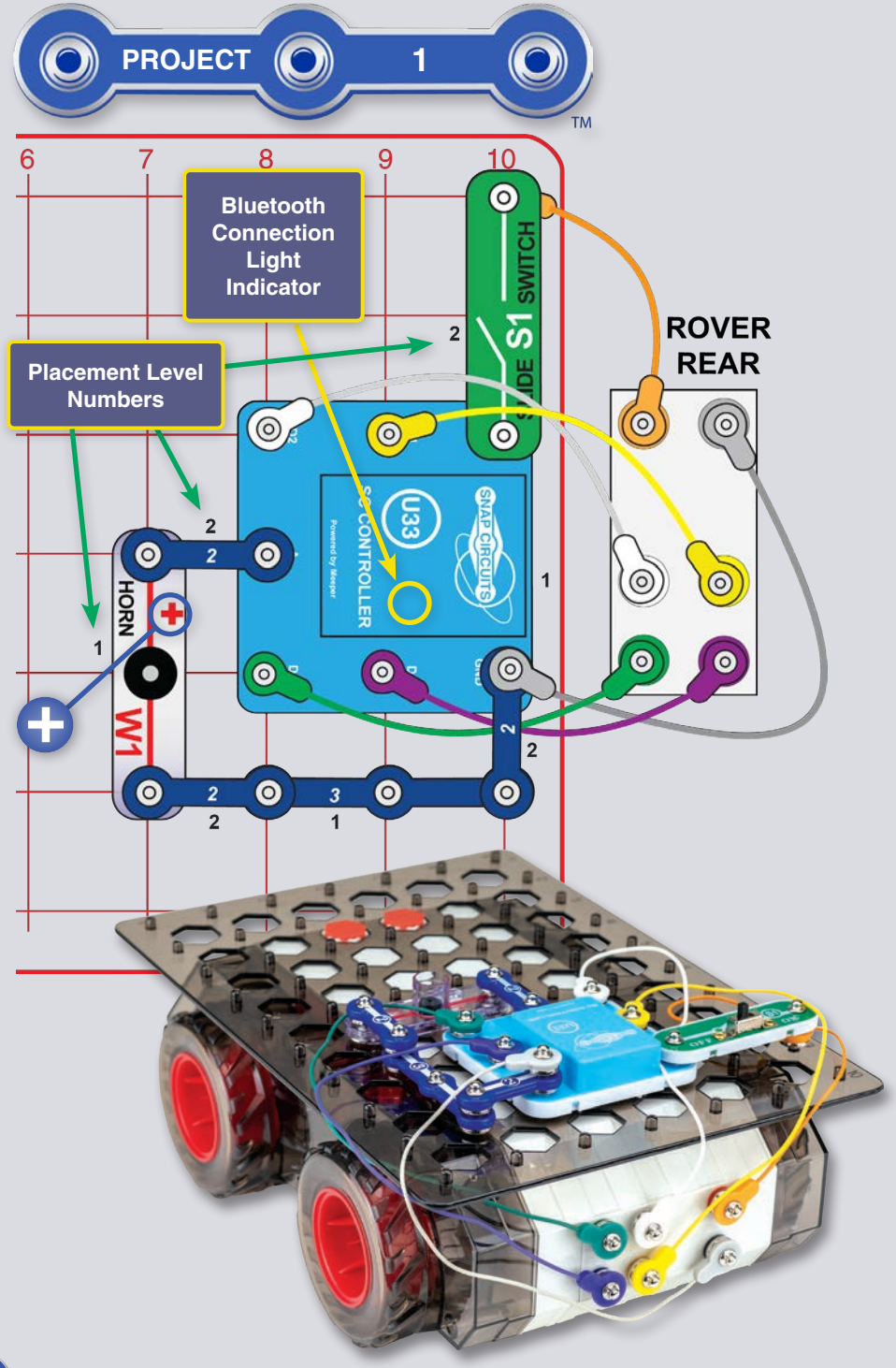




# Project Listings




ELENCO®

150 Carpenter Avenue Wheeling, IL 60090 | Phone: (847) 541-3800
| E-mail: help@elenco.com | www.elenco.com



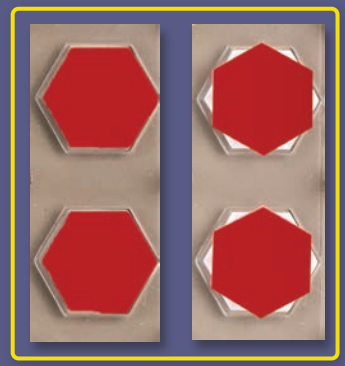

# MEET SNAP ROVER®

## (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. For more detailed app instructions, see page 29-38. To learn more about Snap Circuits® see pages 39-46.**

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

Install six (6) "AA" batteries into the bottom of the Rover body. **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.** Place the base grid on the Rover body; you may lock it into position by turning the hexagonal alignment posts (shown here), if desired.



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**. Be sure to place the horn (W1) with its (+) side oriented as shown. Connect the colored jumper wires to the rear of the Rover body as shown (the colors are interchangeable).

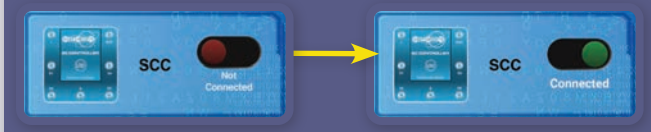
1. Turn on the slide switch (S1). A blue light on the SC Controller (U33) should be flashing, indicating that the module is waiting for a Bluetooth connection to a device.

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, which is best for non-vehicle circuits. 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 so can control the horn (W1) but cannot control the Rover wheel motors. Use the app controls to turn the Rover motors and the horn on and off.

**Control Screen Mode**


5. Vehicles like Snap Rover® are best controlled using Drive mode, so switch to Drive mode using the landscape icon.

**Changing Control Screen Mode**

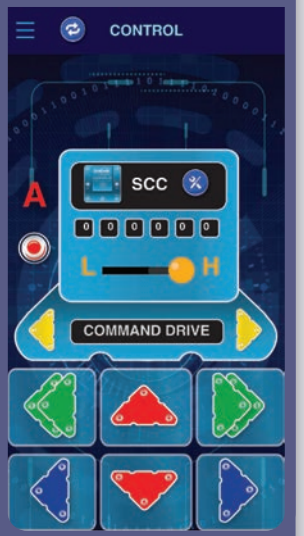

6. There are 3 different Drive modes. You can experiment by having these control the Snap Rover® motors.

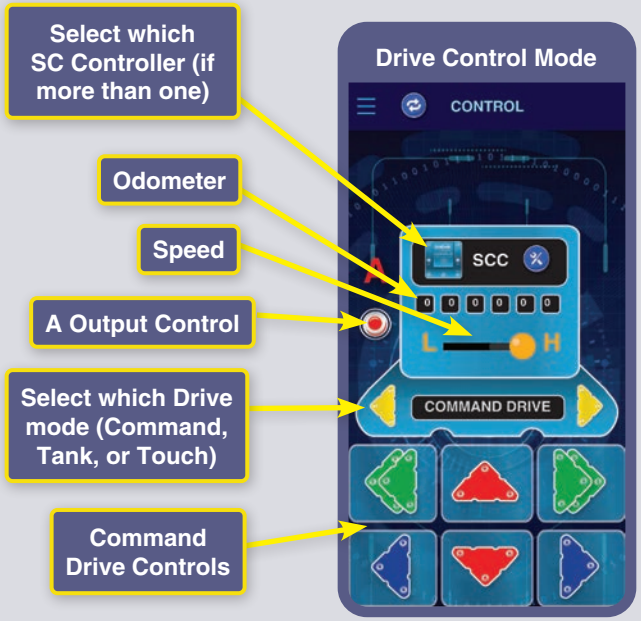
a. Command Drive, is the easiest mode. Great to get started.
b. Tank Drive, a two-handed drive control which gives you direct control over each of the back motors.
c. Touch Drive, a super-responsive, joystick-like controller which lets you touch and drag where you want the vehicle to go (touch the center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

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 the horn.

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

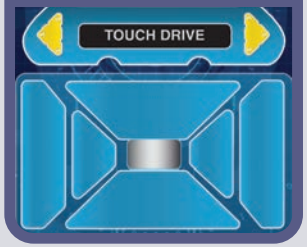
**Drive Control Mode**



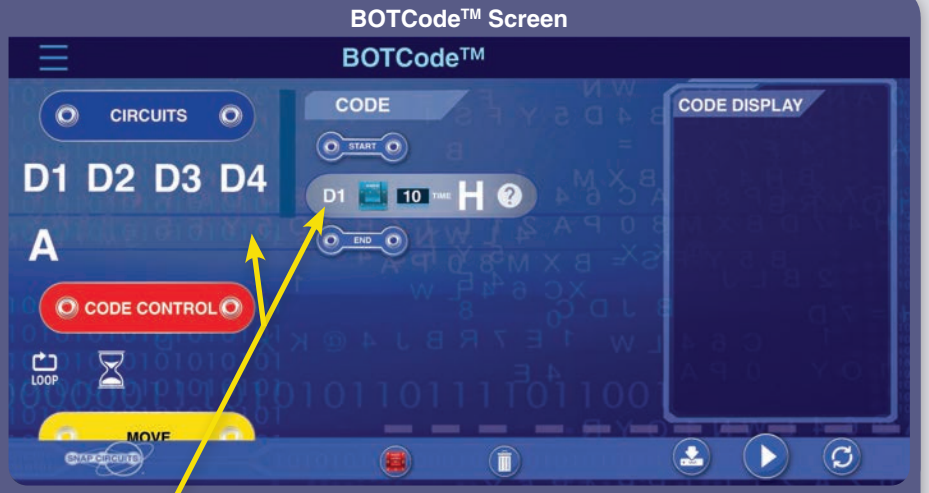



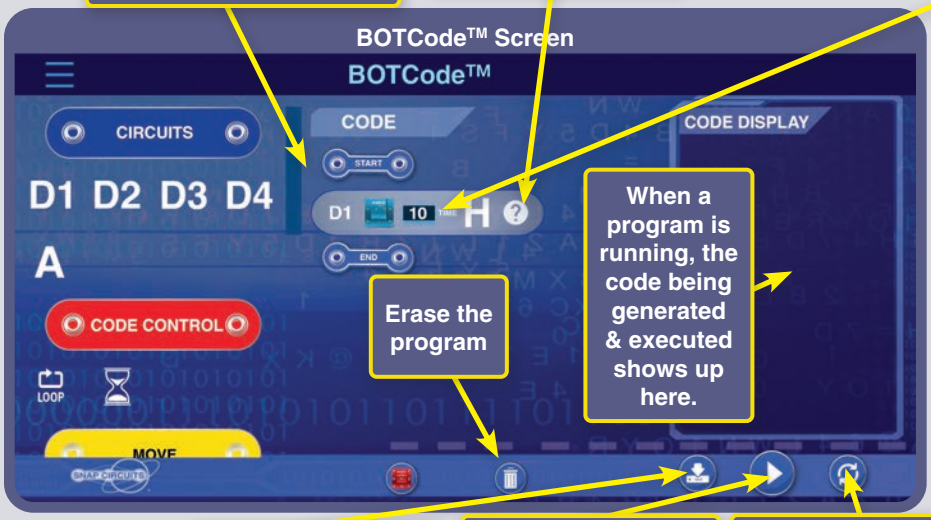

**Tank Drive Controls**

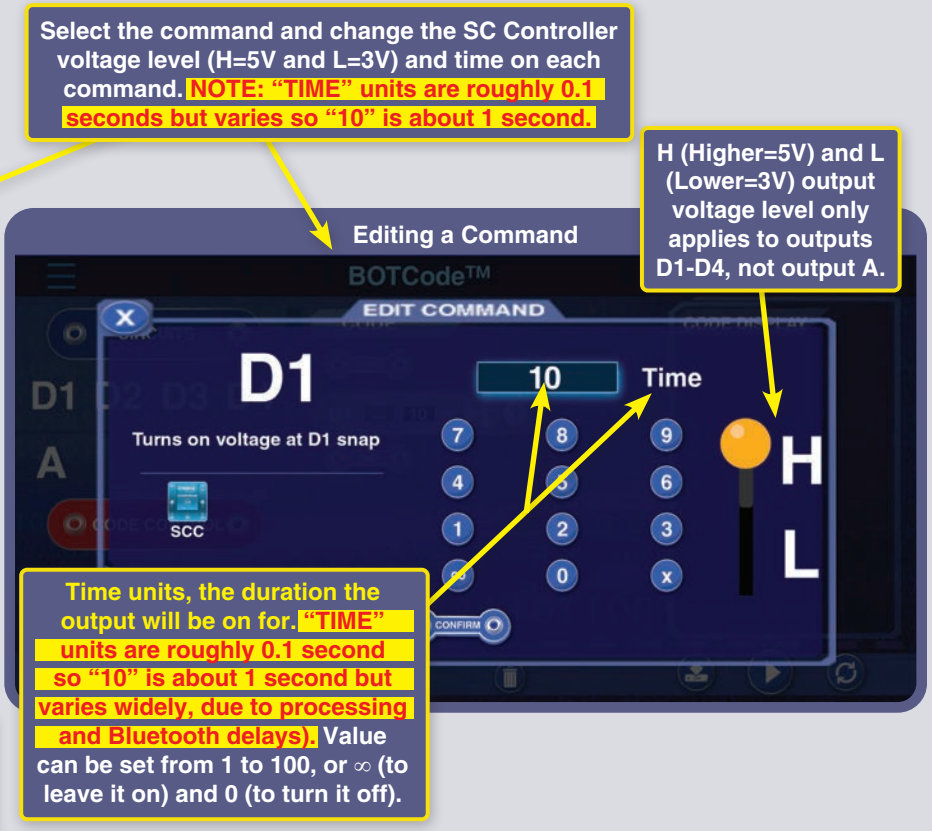

**Touch Drive Controls**



7. Go to the BOTCode™ screen using the app menu. Drag commands from the list at left to the program area in the center. Circuits commands are first, followed by Code Control, Move, and Turn.



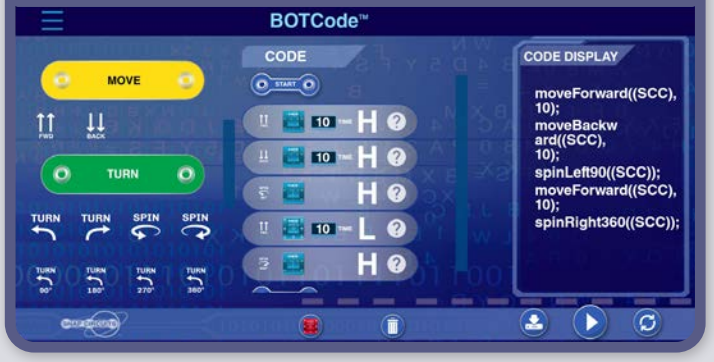



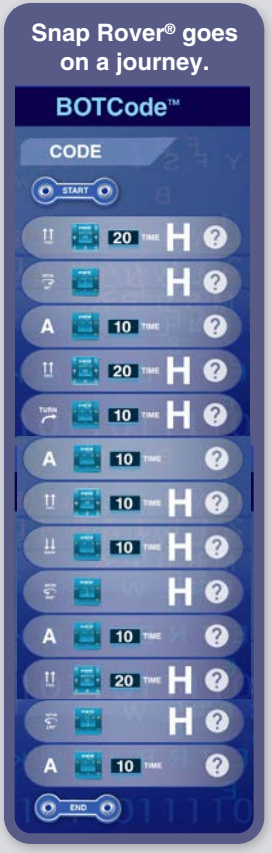
Now that you know the basics of BOTCode™, program the SC Controller to drive Snap Rover® on routes you select, and sounding the horn at times you select. Here are some programming examples: drag-n-drop the commands into the program area, edit the time and voltage levels, and then run the program once or continuously.

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

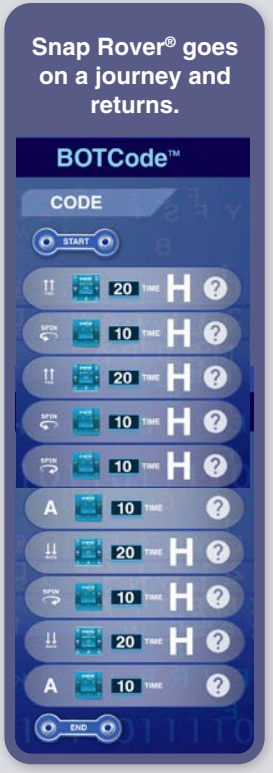
**BOTCode™ Screen: Snap Rover® does a short dance.**




**Snap Rover® goes on a journey.**




**Snap Rover® goes on a journey and returns.**




**Snap Rover® extra journey.**


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.

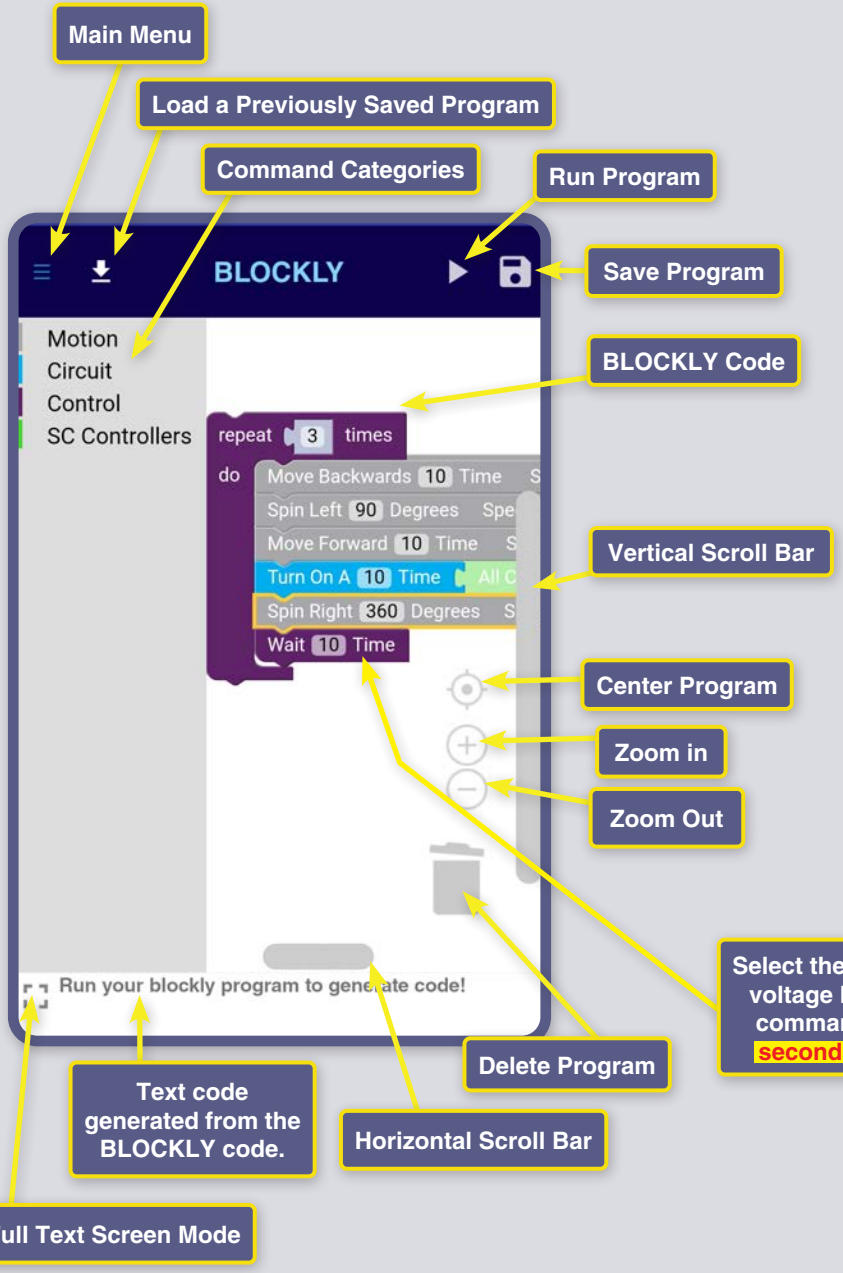
Also, the A output on the SC Controller can only supply low currents, so it cannot be used to control the Rover body motors directly.

## CHALLENGES

- Code a route for Snap Rover® to follow.
- Code a "dance" routine for Snap Rover®.
- Make Snap Rover® spin right for several seconds, then left for several seconds.

PART II

Turn on the LEDs, alternately between yellow and red.


## 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.

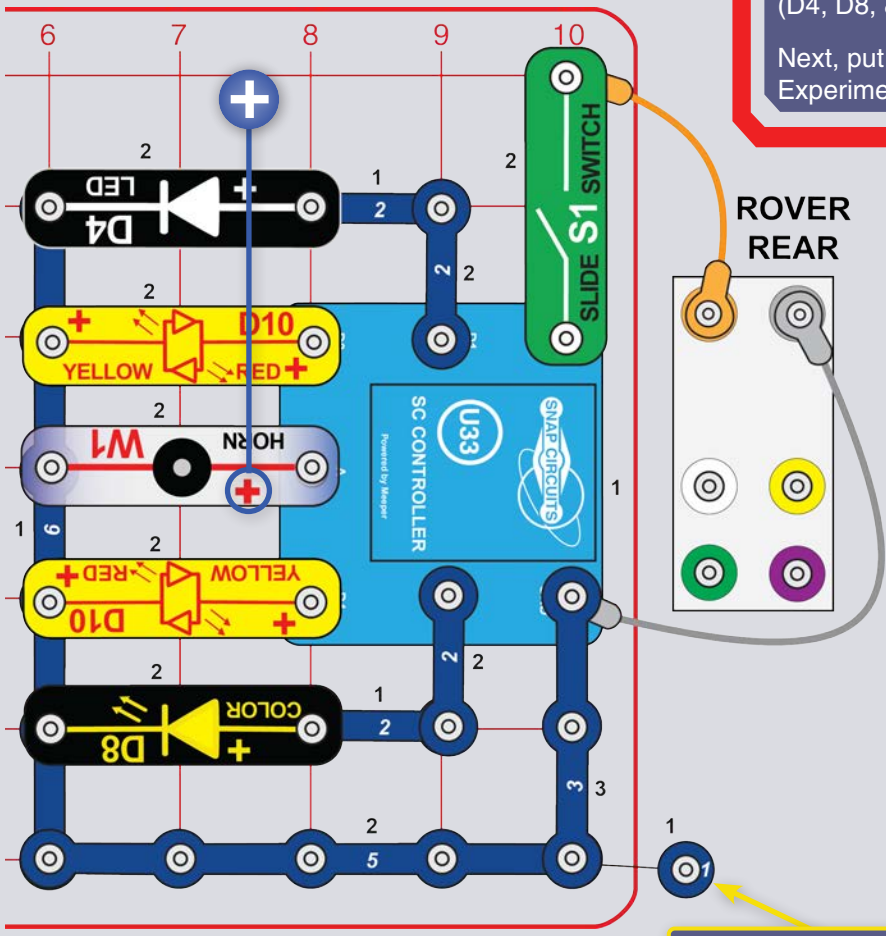
To enter the program, get the D1-D4 and A commands from the Circuit category, and the Delay and Forever command from the Control category. Select the category, click on the command to bring it into your program area, then drag it to attach to the other commands in your program. Put the Forever command 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.

PROJECT 2

# CODE 5

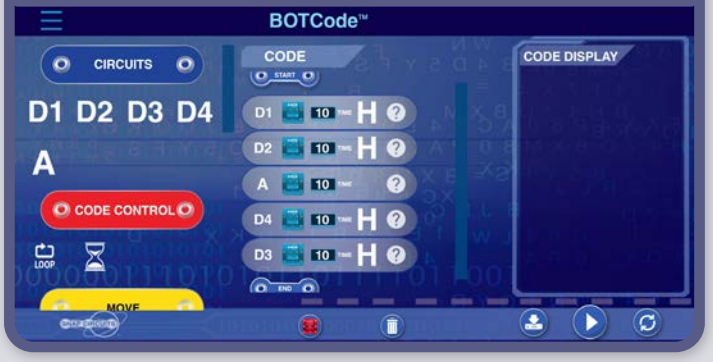
Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode to turn on the LEDs (D4, D8, & D10) and horn (W1). See project 1 and pages 29-38 to review how to use the app.

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



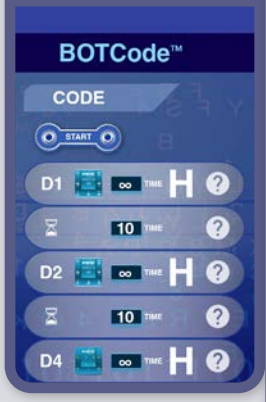

**Control Screen in Circuit Mode**

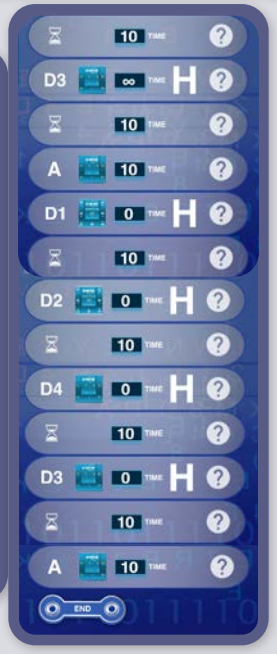

**BOTCode™ Screen: Turn on the 4 LEDs and the horn, one at a time.**




**Turn on white LED then red LED, low brightness then high brightness.**


**Turn on LEDs one at a time until all are on, sound horn, then turn LEDs off one at a time.**

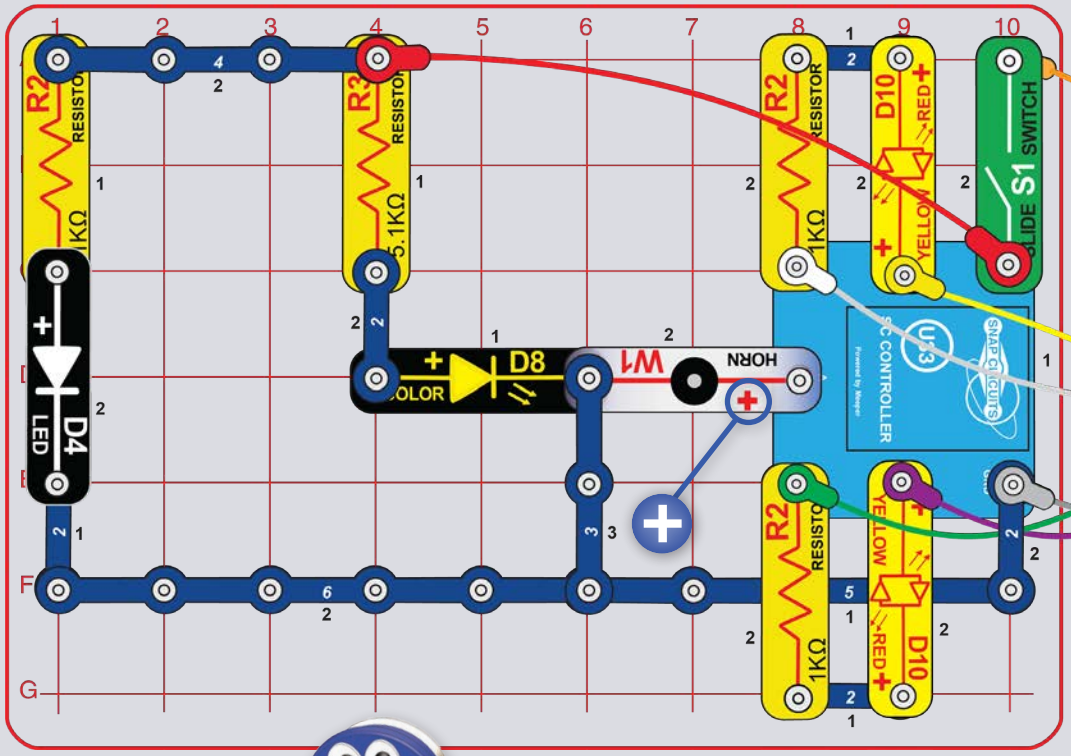



## CHALLENGES

- Make an LED turn on for several seconds, then off for a much shorter time.
- Make an LED flash every 20 seconds.
- Try to get the lights blinking in a pattern like a beat to a song.

PROJECT 3



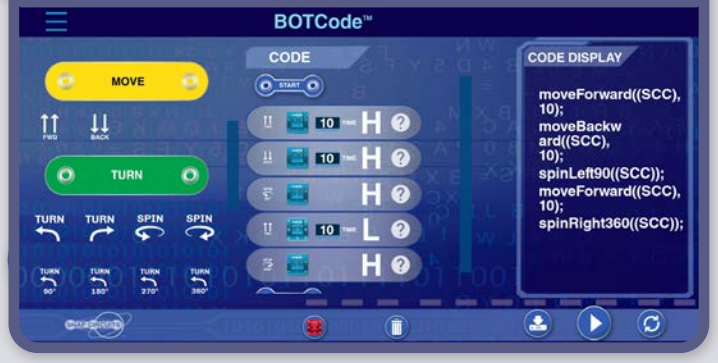

# SNAP ROVER®

Build the circuit shown here and turn on the switch (S1). The white and color LEDs (D4 & D8) are on. Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around and sound the horn. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and sound the horn. Experiment with changing parameters for commands, such as the time duration.

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.

**BOTCode™ Screen: Snap Rover® does a short dance.**

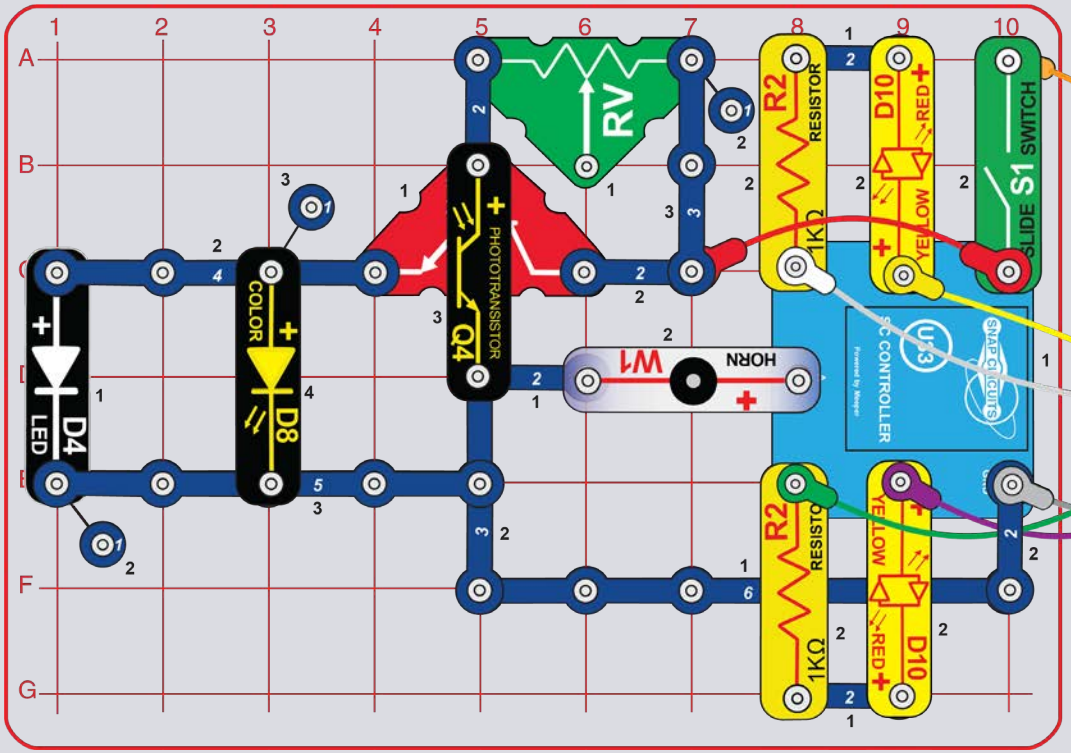



**Control Screen in Circuit Mode**


**Drive Control Mode**


**Snap Rover® goes on a journey and returns.**

PROJECT 4




# SNAP ROVER® WITH NIGHT LIGHT

Build the circuit shown here and turn on the switch (S1). The white and color LEDs (D4 & D8) are on unless there is bright light on the phototransistor (Q4). Shine a bright light on the phototransistor or cover it to turn D4 & D8 on or off.

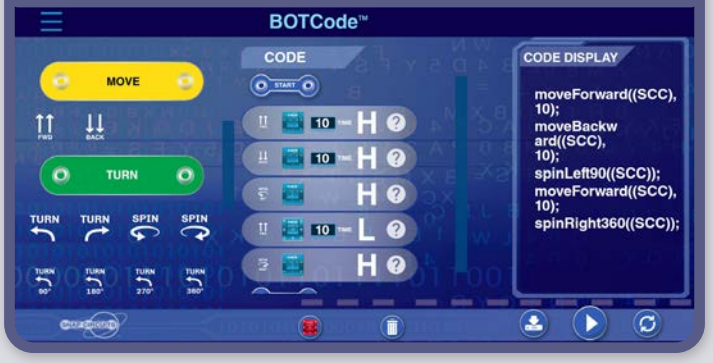
Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around and sound the horn. See project 1 and pages 29-38 to review how to use the app. The D4 & D8 lights turn on whenever the room lighting is not bright.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and sound the horn. Experiment with changing parameters for commands, such as the time duration.

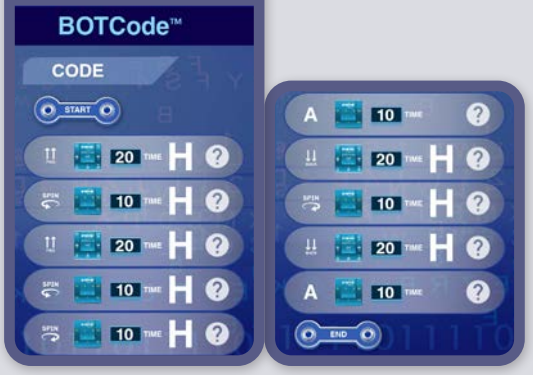
**Control Screen in Circuit Mode**


**Drive Control Mode**


**BOTCode™ Screen: Snap Rover® does a short dance.**




**Snap Rover® goes on a journey and returns.**



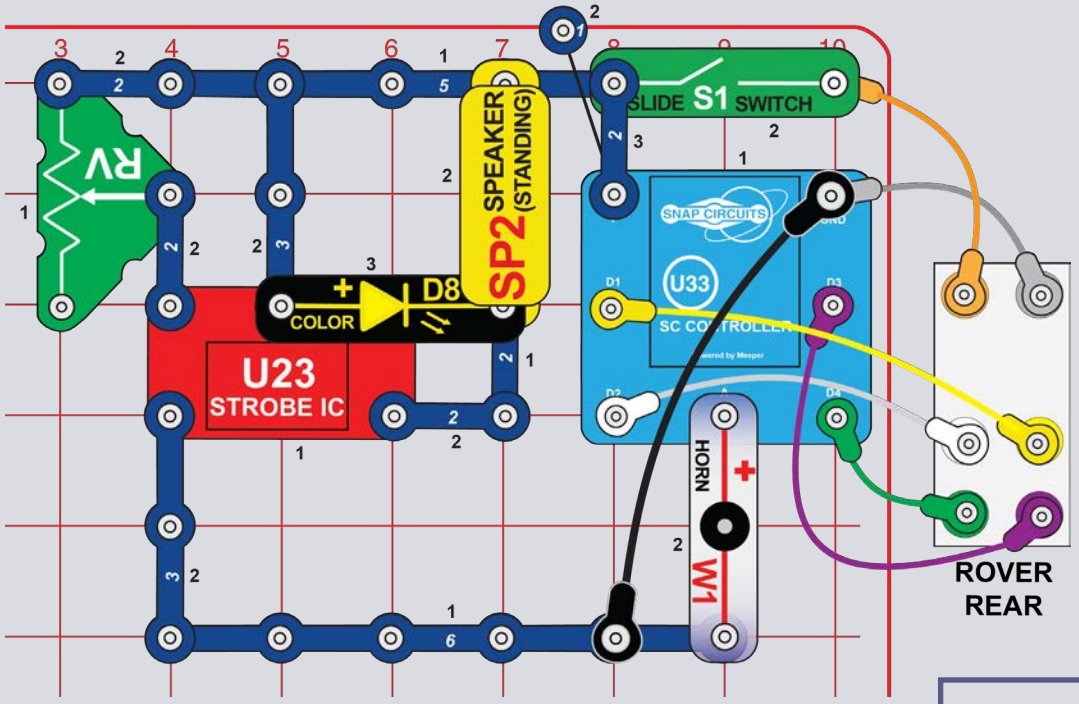
PROJECT 5

# SOUND ROVER

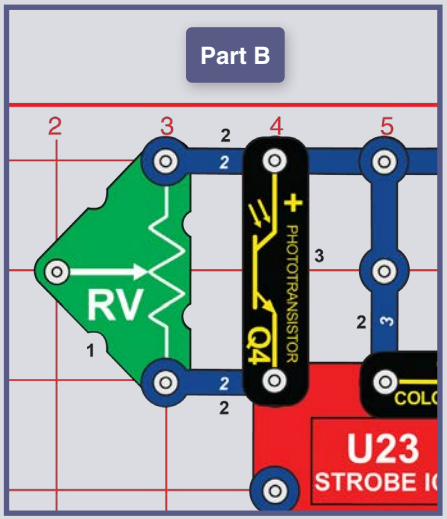
Build the circuit shown here and turn on the switch (S1). Move the lever on the adjustable resistor (RV) to change the sound.

Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around and sound the horn. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and sound the horn. You can use the programs from project 1 or create your own.

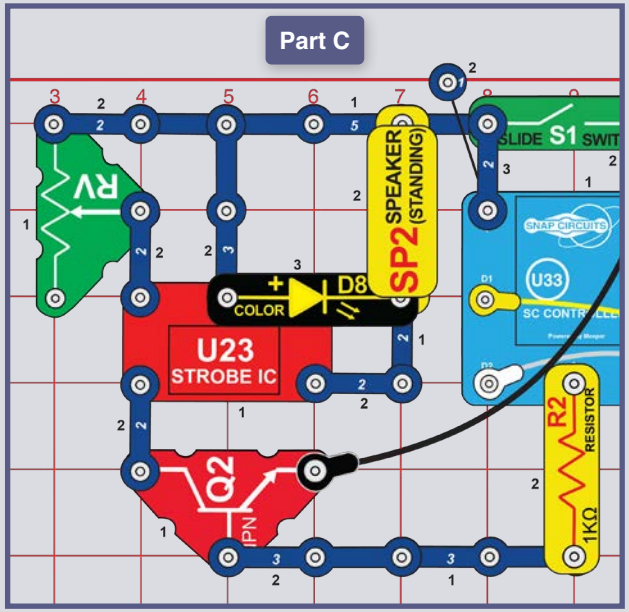



Part B




**Part B, Light Controlled Sound:** Re-arrange the adjustable resistor (RV) and add the phototransistor (Q4) as shown. Vary the amount of light shining on the phototransistor to change the sound. Moving the lever on RV will not change the sound, and once the light is dim the sound will not change (RV is used here as a fixed resistor so there is always some sound). Drive Snap Rover® around between bright and dim areas and see the sound change automatically.

Part C



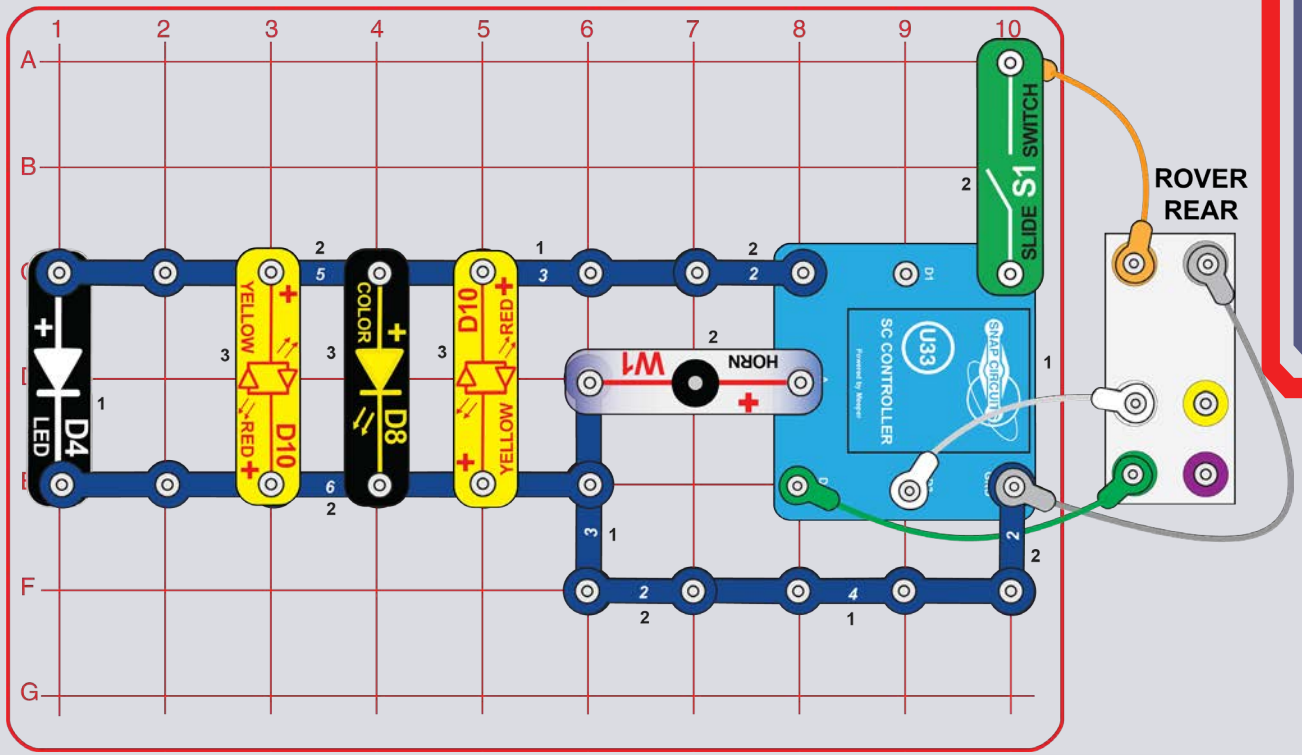

**Part C, Adjustable Controlled Sound:** Return the adjustable resistor (RV) to its original position and add the NPN transistor (Q2) and 1kΩ resistor (R2) as shown. Activate sound by turning on the A output on the SC Controller using the Snap Circuits® Coding app (Circuit Mode, Drive Mode, or BOTCode™ mode). The lever on the adjustable resistor changes the sound played. Drive Snap Rover® around and turn on the sound when desired.

PROJECT 6™

# LIGHT SHOW

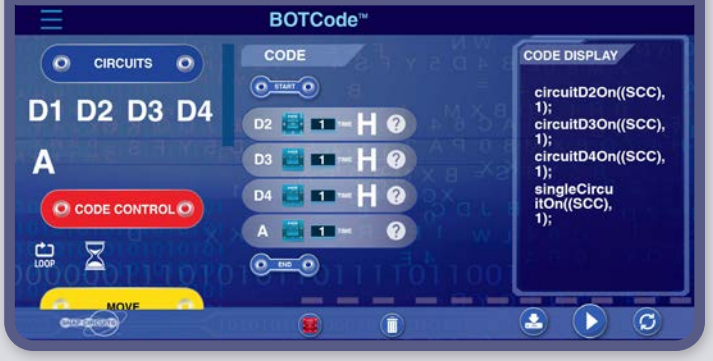
Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode to turn on lights or sound the horn. See project 1 and pages 44-53 to review how to use the app. Output D1 on the SC Controller is not used.

Next, put the app in BOTCode™ mode and create some code to turn on the lights in a sequence like a light show.




**Control Screen in Circuit Mode**


**BOTCode™ Screen: Snap Rover® light show.**




## CHALLENGES

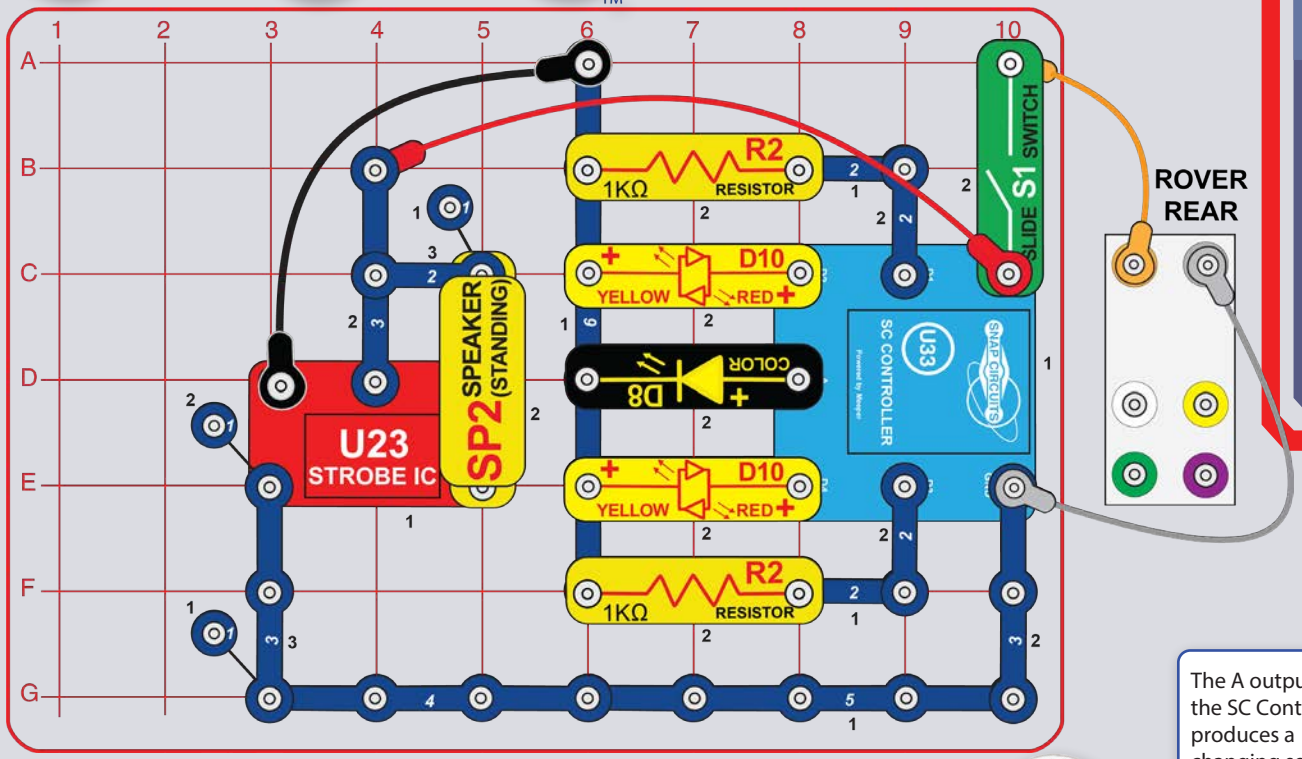
- Make the LEDs light up in different patterns.

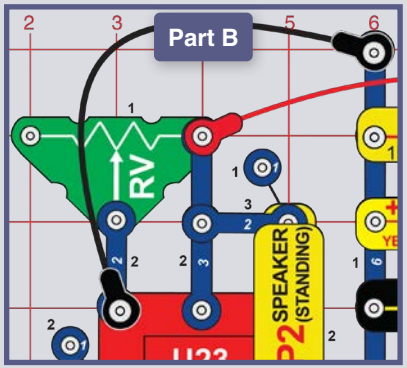
PROJECT 7

# ELECTRONIC KEYBOARD

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode to hear different sounds by activating any of the D1-D4 or A outputs. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to turn on the sounds in a sequence.




**Part B:** Add the adjustable resistor (RV) and re-arrange the connections near it as shown. The circuit works the same but the sounds are higher in pitch.

## CHALLENGES

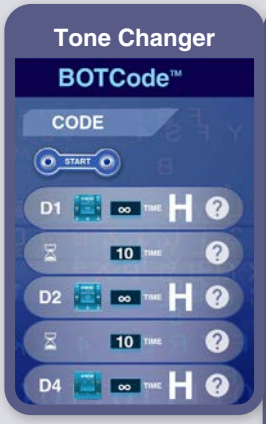
- See if you can play a familiar song on this "keyboard".

**Control Screen in Circuit Mode**

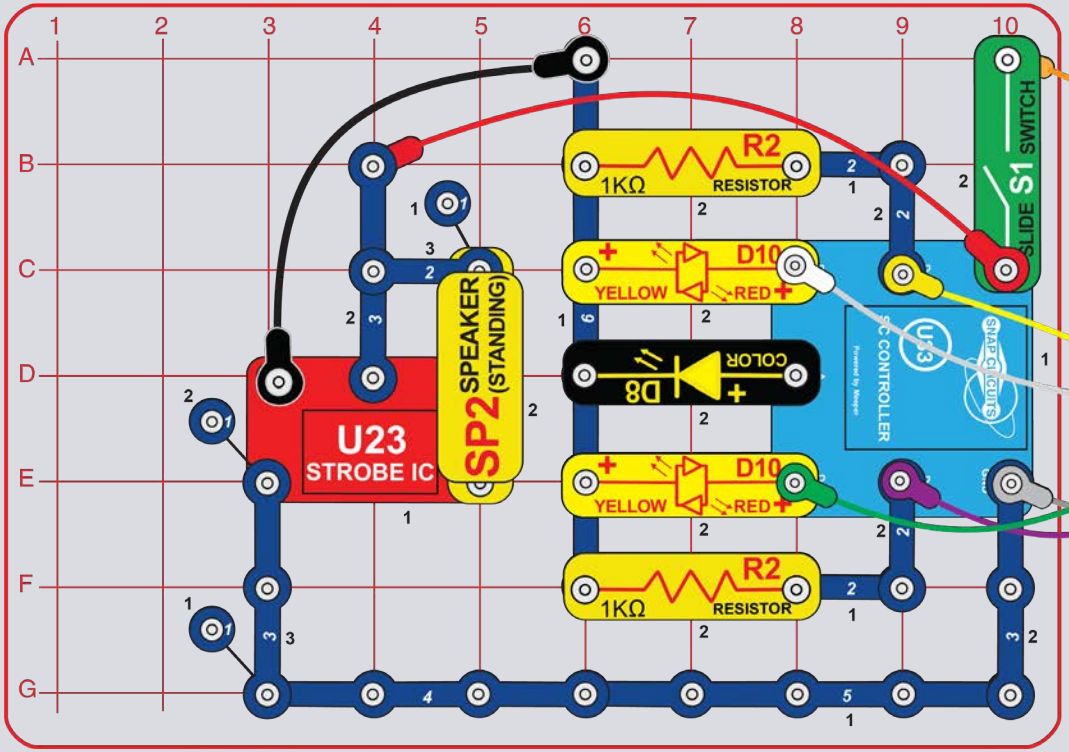

The A output on the SC Controller produces a changing sound as the color LED (D8) changes colors.

**BOTCode™ Screen: Keyboard tones**


**Tone Changer**




PROJECT 8

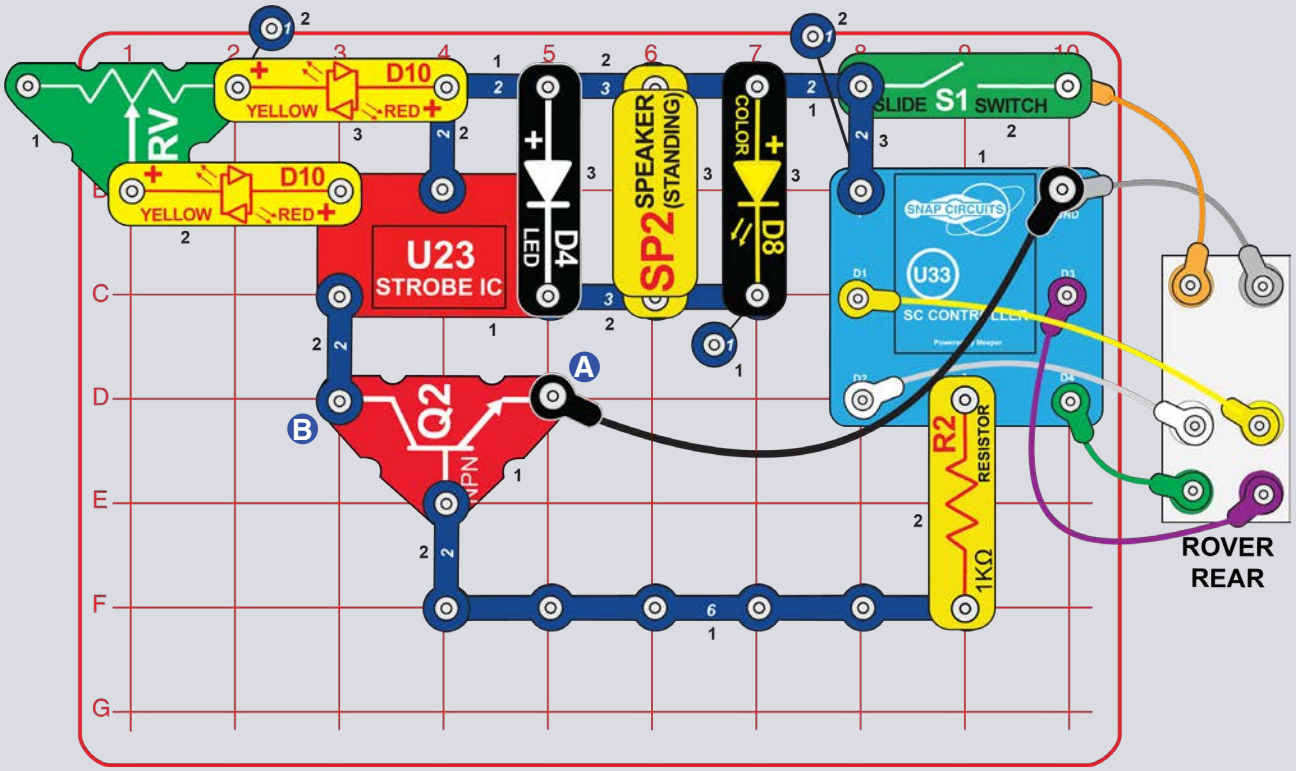



# MOBILE ELECTRONIC KEYBOARD

Use the preceding circuit but add the white, yellow, green and purple jumper wires to connect the motors in the Rover body. Turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around while activating different tones. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around while activating different tones. You can use the programs from project 1 or create your own.

PROJECT 9



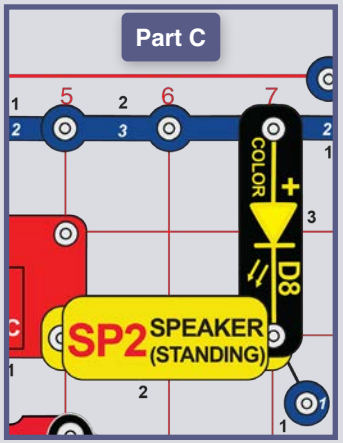

## STROBE LIGHT

Build the circuit shown, set the lever on the adjustable resistor (RV) to the left, and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around, while using output A control to activate a strobe light and beeping. See project 1 and pages 29-38 to review how to use the app.

Move the lever on RV to the right to increase the rate of the strobe and sound. Moving RV's lever all the way to the right makes the strobe LEDs (D4 & D8) on continuously and makes the sound into a continuous tone.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and activate the strobe light and sound. You can use the programs from project 1 or create your own.

**Part B:** Move the end of the black jumper wire from the point labeled A to point B. Now the strobe light and sound are on whenever the switch (S1) is on, instead of being activated by the SC Controller.

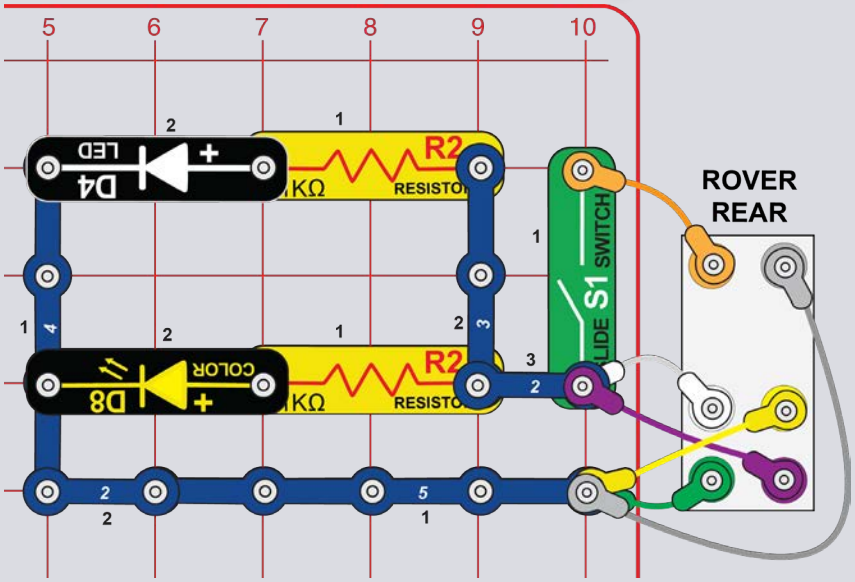



**Part C:** Use the original or Part B circuit but re-arrange the speaker and LEDs at the output of the strobe IC (U23) as shown. Now the strobe light is not as bright and the sound is not as loud. You can replace the color LED with the white LED if desired.

## CHALLENGES

- Make the lights flash in short bursts.

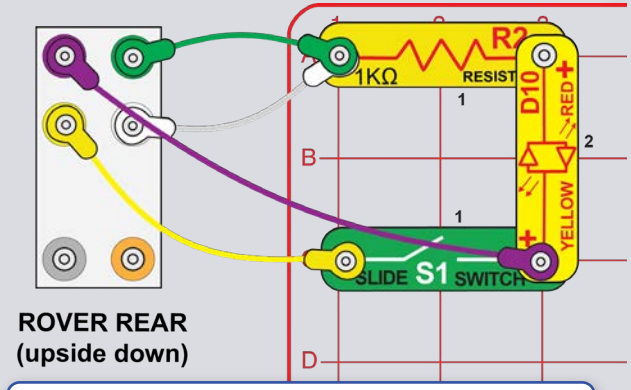
PROJECT 10




## LIGHTHOUSE

Build the circuit shown, place it in the middle of a dimly lit room, and turn on the switch (S1). The light will shine around the room as Snap Rover® spins.

PROJECT 11




ROVER REAR
(upside down)

Notice that the smaller gears are spinning faster than the larger gears and wheels. The smallest gears (on the motor) are actually spinning 128 times faster than the wheels. See page 43 for more information about the gears.

## GENERATOR

**WARNING:** Do not use excessive force to spin the wheels at abnormally high speeds. This may burn out the motors or LEDs.

Flip the Rover body so it is upside down and connect the jumper wires to the body and circuit as shown. Turn off the slide switch (S1) for the time being.

Spin the right wheels with your hands. The red/yellow LED (D10) should light.

Now turn on the slide switch (S1) and spin the right wheels again. The wheels now take more effort to spin, and cause the left wheels to also spin.

Spinning the right wheels makes all the inter-connected gears spin, and spins the shaft on the right motor. The spinning motor shaft creates electricity using magnetism (opposite to how electricity through the motor spins the shaft), which powers the LED. With the switch on, the electricity created in the right motor also powers the left motor, which spins the left wheels. The wheels are harder to spin now because magnetic fields in both motors must be overcome. No batteries are used.

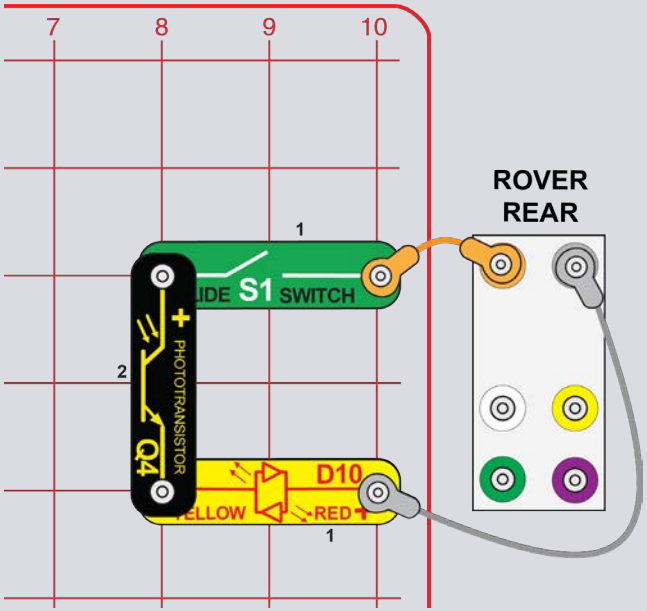
PROJECT 12

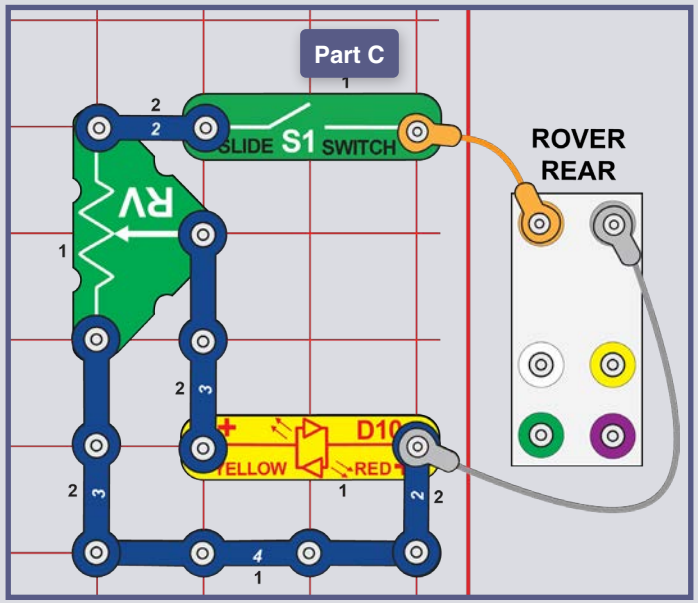
# LED FUN

**Part A:** Build the circuit shown and turn on the slide switch (S1). Vary the amount of light shining on the phototransistor (Q4) to change the brightness of the red/yellow LED (D10). You may want to hold the circuit near a bright light or flashlight and then partially block the light with your hand.

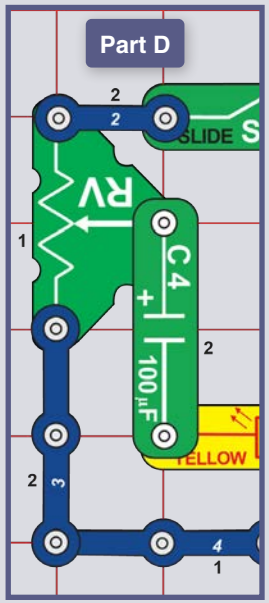
You can replace the phototransistor with the 5.1kΩ resistor (R3) to compare the phototransistor's resistance to it.

**Part B:** With the phototransistor in the circuit, dim the room lights so the LED is off. Take a TV/stereo/DVD infrared remote control from your home then point it directly into the phototransistor, and press any button to turn on the LED. (Infrared light is light, so can change the phototransistor's resistance just like visible light does.)



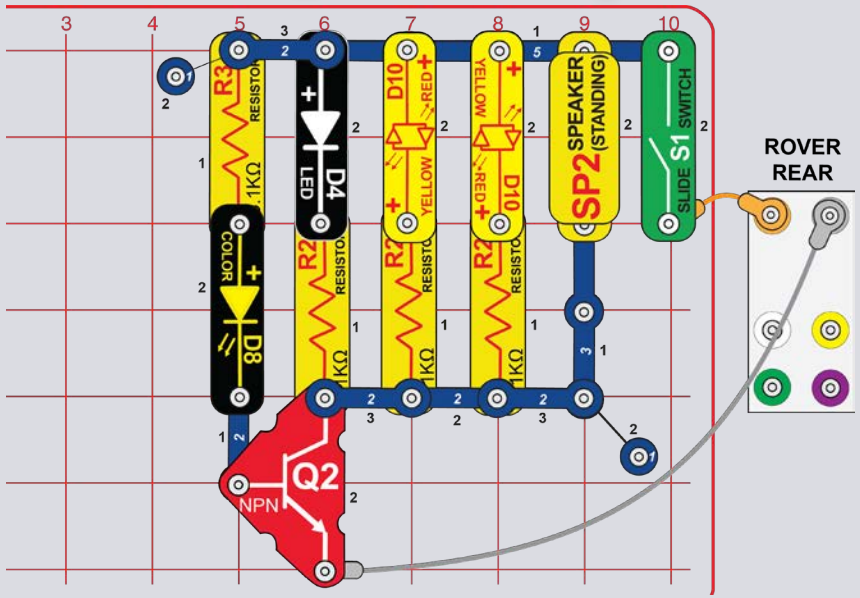




**Part C:** Re-arrange the circuit and add the adjustable resistor (RV) as shown here. Move the lever on RV to vary the LED brightness. (RV is a 50kΩ resistor, with a center tap that is adjustable from 200Ω to 50kΩ.)




**Part D:** Replace a 3-snap wire with the 100µF capacitor (C4). Move the lever on RV back and forth several times. (Moving RV's lever changes the voltage to the capacitor and LED, making the capacitor charge up and discharge. The LED is yellow when the capacitor is charging and red when the capacitor is discharging.)

PROJECT 13

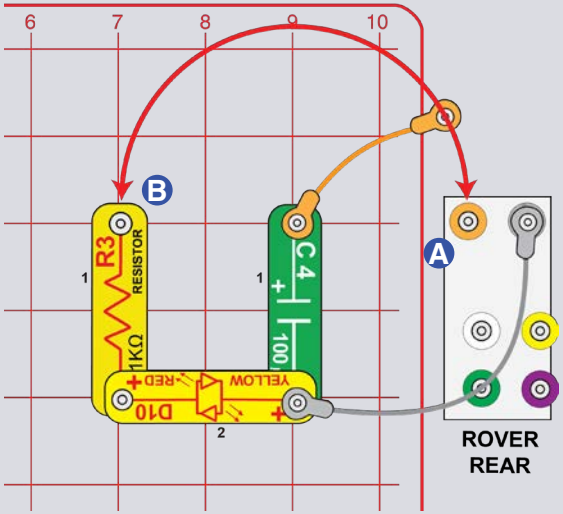



# FUNKY LIGHT & SOUND

Build the circuit and turn on the slide switch (S1). The white & red/yellow LEDs (D4 & D10) flash and the speaker (SP2) makes sound in sync with the color LED (D8) as it changes.

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 D8 and R2, controlling a larger current into Q2 through D4, both D10s, and SP2. This control allows the color LED to control the other LEDs and the speaker.

PROJECT 14




# ELECTRICITY TANK

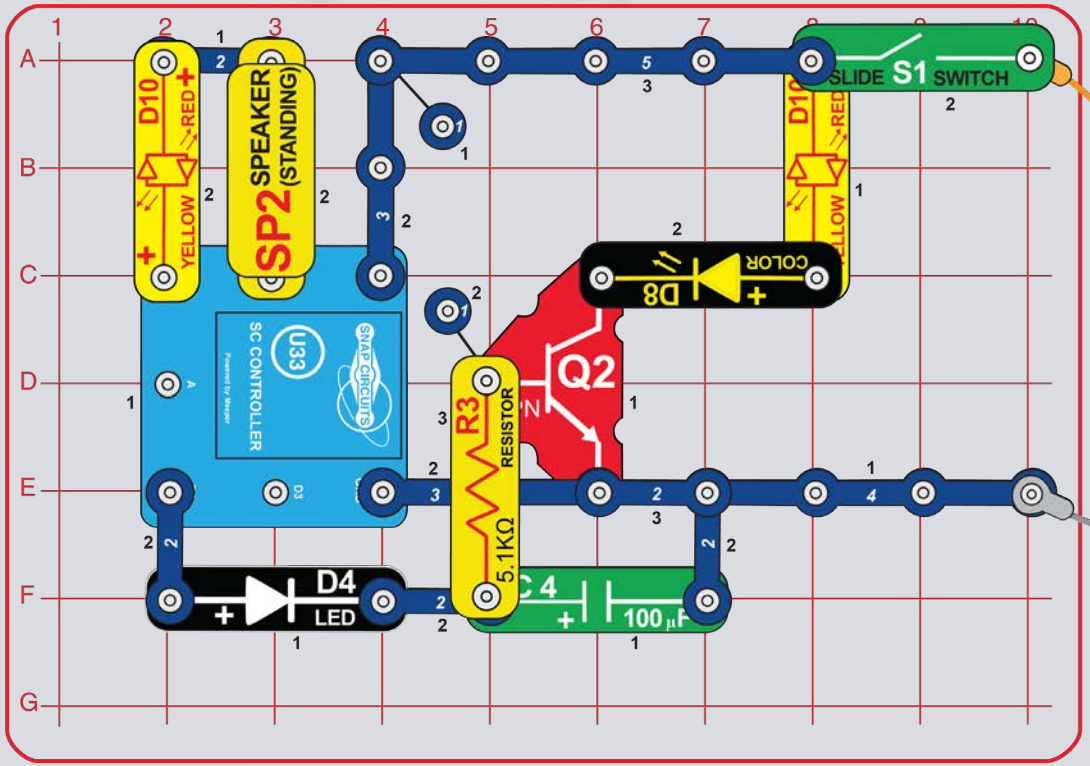
Build the circuit and connect the jumper wires, leaving one end of the orange jumper off as shown. Touch the loose end of the orange jumper to point A on the Rover rear for a moment. This fills up the 100μF capacitor (C4) with electricity.

Now move the orange jumper from point A to point B on the 5.1kΩ resistor (R3). The red/yellow LED (D10) lights red for a few seconds using the electricity stored in the capacitor. Move the orange jumper back to point A to refill with electricity, and then to point B several times.

If you replace the 5.1kΩ resistor (R3) with the 1kΩ resistor (R2) then the LED will turn off faster but be brighter.

Notice that a capacitor is not very efficient at storing electricity - compare how long the capacitor kept the LED lit for with how your batteries run all of your projects! That is because capacitors store electrical energy while a battery stores chemical energy.

PROJECT 15™




# FADING LIGHTS + BEEPER

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode to turn SC Controller output D4 on and off. See project 1 and pages 29-38 to review how to use the app.

Turning on output D4 turns on the white LED (D4), charges the 100µF capacitor (C4), and turns on the color LED (D8) and a red LED (D10). Turning off output D4 turns off the white LED and lets the capacitor slowly discharge into the 5.1kΩ resistor (R3) and NPN transistor (Q2), which slowly turns off the color and red LEDs.

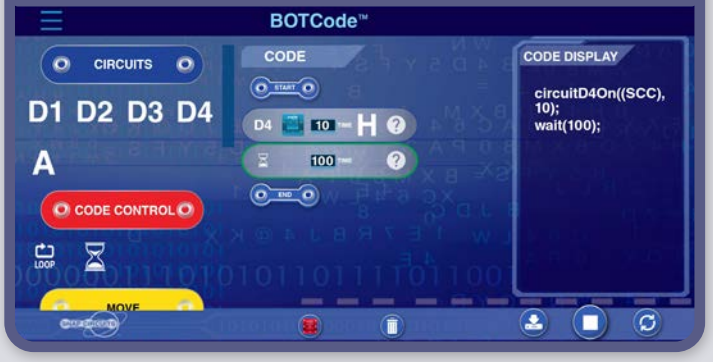
Next, put the app in BOTCode™ mode and control SC Controller output D4 repeatedly using BOTCode™.

Variants:

- Speed up the color LED fading rate by replacing the 5.1kΩ resistor (R3) with 1kΩ resistor (R2).
- Remove the 100µF capacitor (C4) and compare how quickly the color LED turns off.

**Control Screen in Circuit Mode**

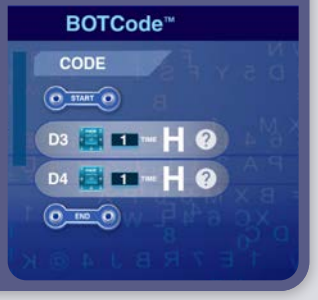

**BOTCode™ Screen: Fading Lights, run continuously.**



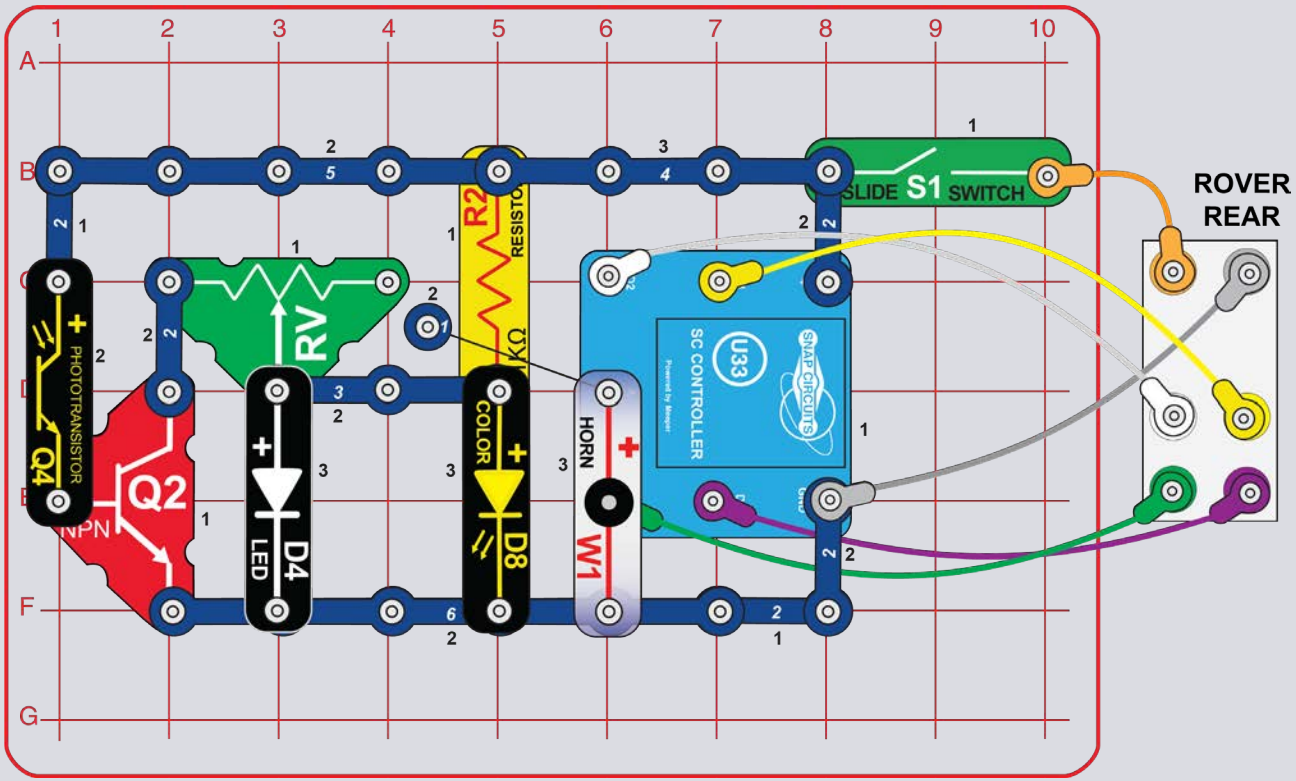

**Part B, Beeper:** Now use Circuit Control mode to turn SC Controller outputs D1 & D2 on and off.

Next, put the app in BOTCode™ mode and control SC Controller outputs D1 & D2 repeatedly using BOTCode™.

**Beep & flash. Run this program continuously.**



PROJECT 16




# AUTOMATIC LIGHT

Build the circuit shown and turn on the switch (S1). Set the lever on the adjustable resistor (RV) to the left. If the room lighting is dim then the white and color LEDs (D4 & D8) will be on, otherwise they will be off. Vary the amount of light shining on the phototransistor (Q4) to turn the LEDs on and off. Move the lever on RV a little to the right to make the LEDs come on more easily.

Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around, while using output A control to change the sound. The white & color LEDs will come on if the room lighting is dim, to help Snap Rover® find its way. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and change the sound. You can use the programs from project 1 or create your own.

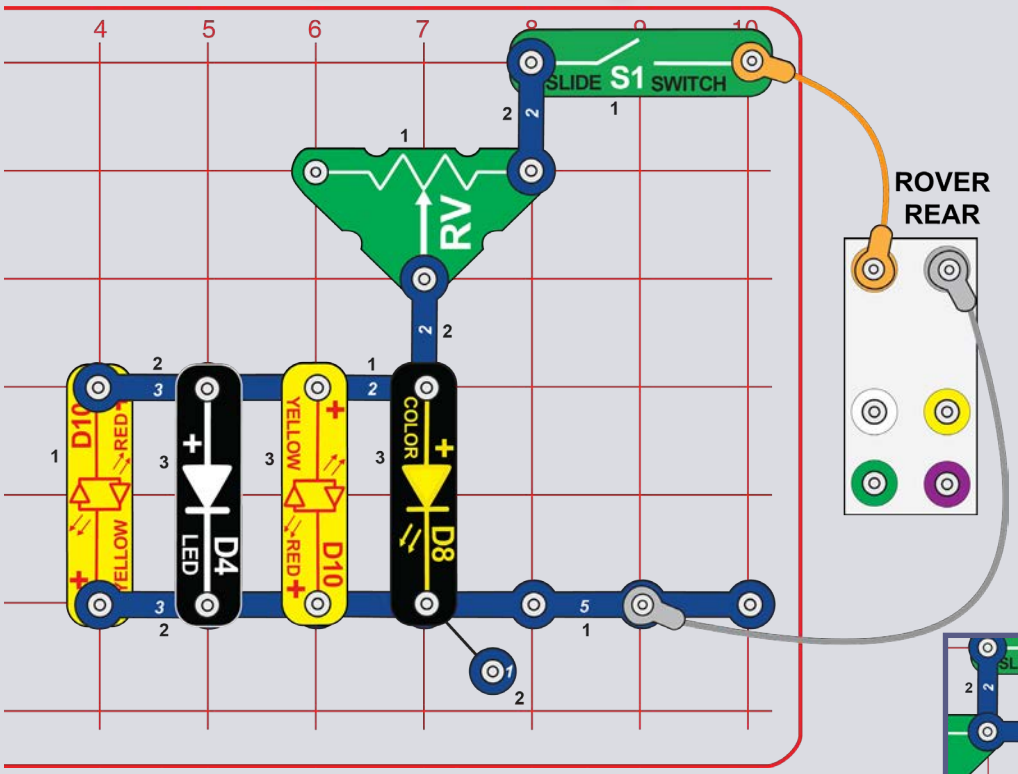
## CHALLENGES

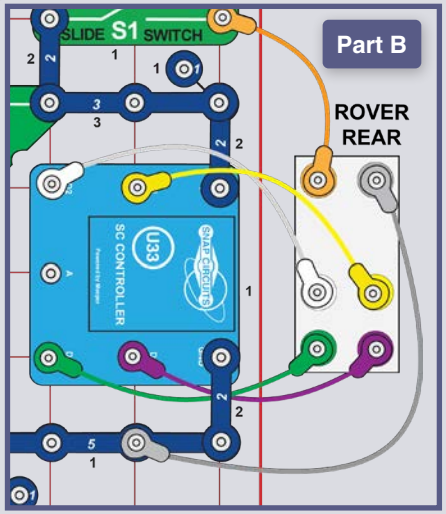
- Make Snap Rover® follow a route or do a dance.

PROJECT 17

# LIGHT THEM UP

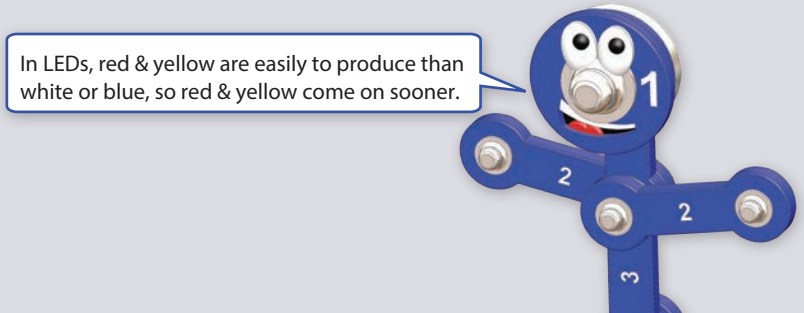
Build the circuit shown here and turn on the switch (S1). Move the lever on the adjustable resistor (RV) to the right to increase the brightness of the LEDs. If you move the lever slowly as it nears the right side, you can see that some LED colors come on before others.



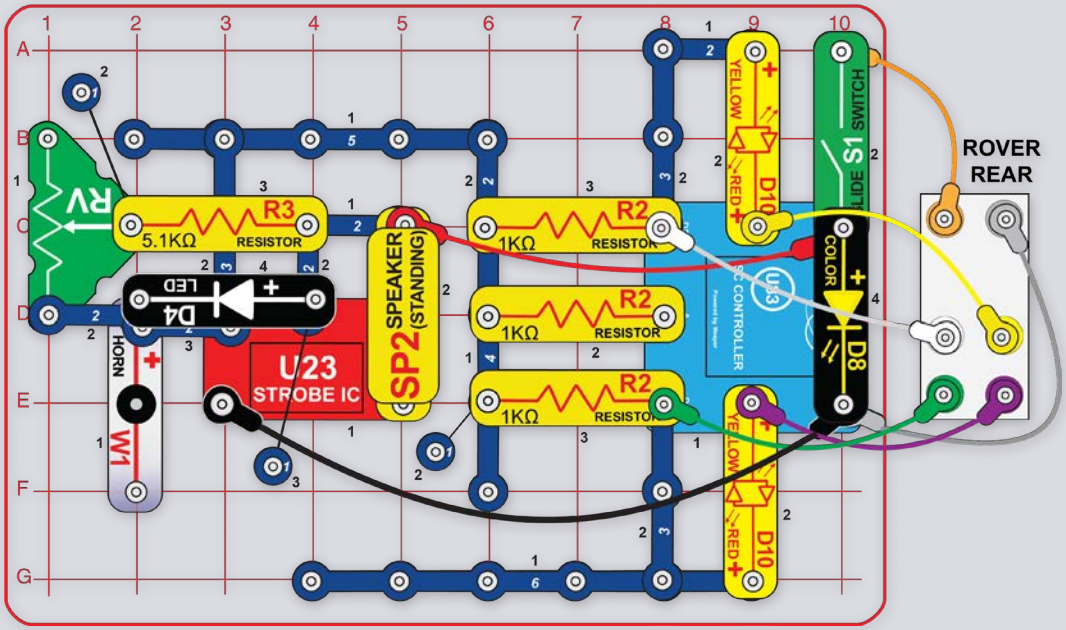




**Part B, Light Controlled Sound:** Add the SC Controller (U33) and other connecting parts to the circuit as shown. Turn on the switch. Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around with the LEDs on. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around. You can use the programs from project 1 or create your own.



PROJECT 18




# BOX COVER CIRCUIT

Build the circuit shown here and turn on the switch (S1). Move the lever on the adjustable resistor (RV) to change the sound. Open the Snap Circuits® Coding app, connect to the SC Controller, and use Circuit Control mode or Drive Control mode to move Snap Rover® and to change the sound. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around while changing the sound. Experiment with changing parameters for commands, such as the time duration.

The horn (W1) will not make sound, it is only used here as a spacer.

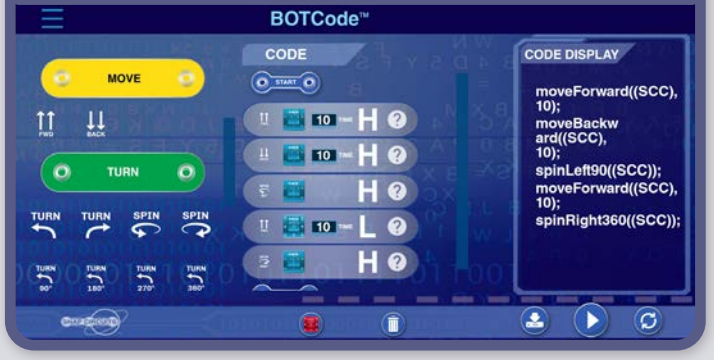
## CHALLENGES

- Make your own dance or route for Snap Rover®.

**Control Screen in Circuit Mode**

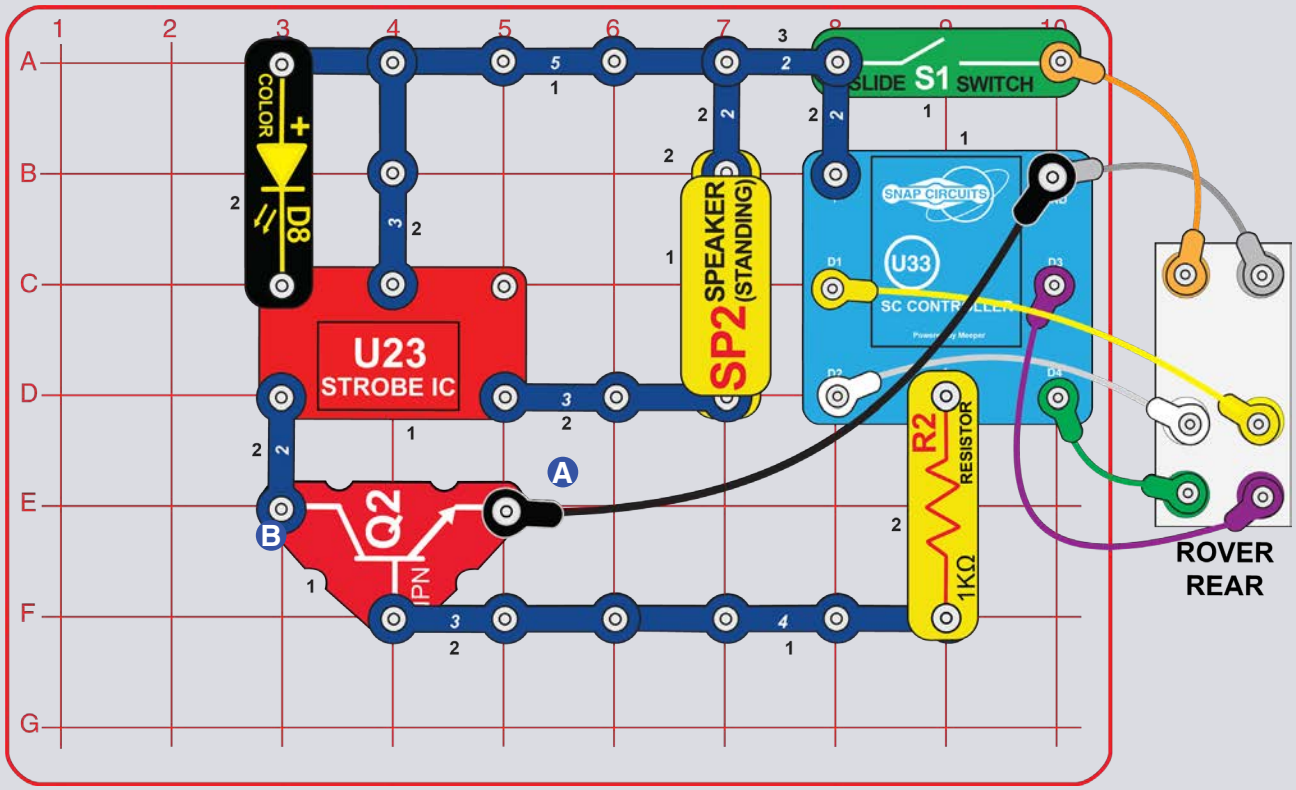

**Drive Control Mode**


**BOTCode™ Screen: Snap Rover® does a short dance.**




**Snap Rover® goes on a journey and returns.**

PROJECT 19




## FUNKY SOUND ROVER

Build the circuit shown and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around, while using output A control to activate a funky sound. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and activate the funky sound. You can use the programs from project 1 or create your own.

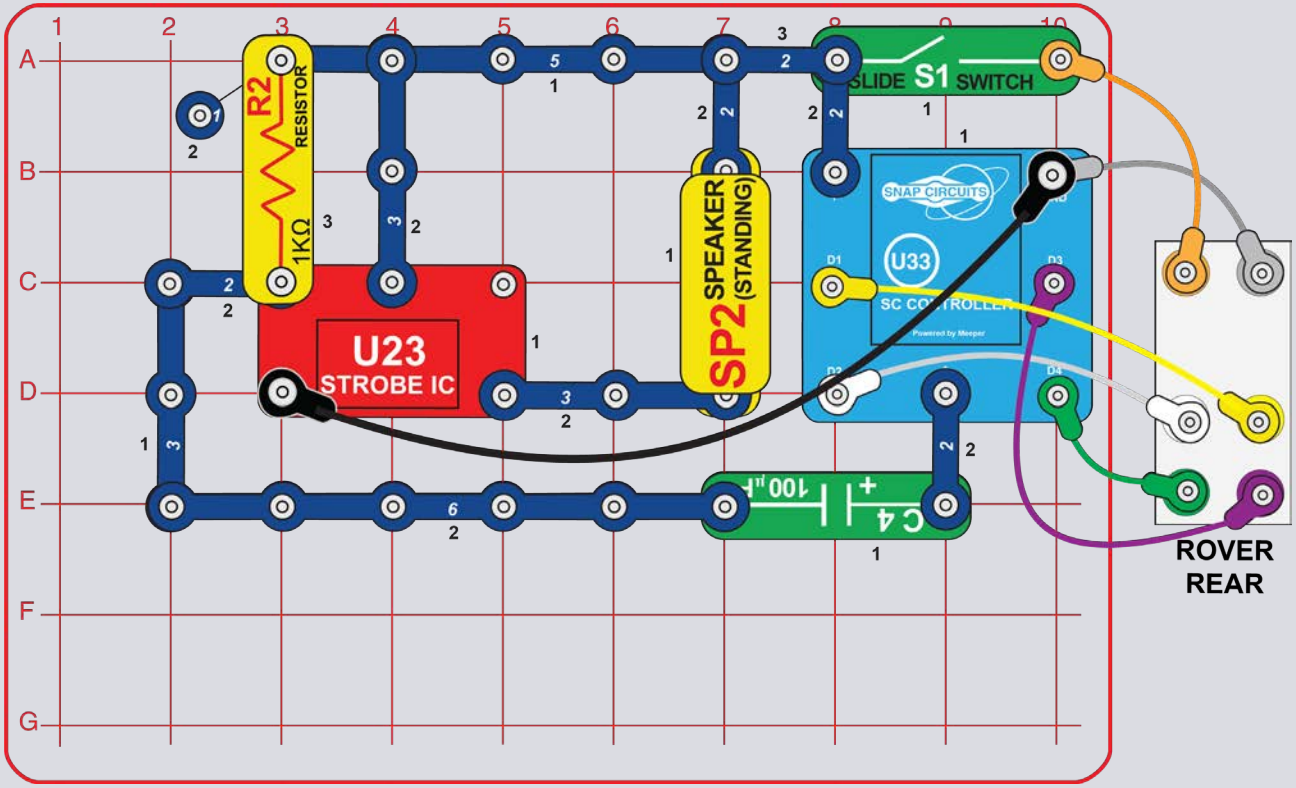
**Part B:** Move the end of the black jumper wire from the point labeled A to point B. Now the strobe light and sound are on whenever the switch (S1) is on, instead of being activated by the SC Controller.

If the sound seems too loud then replace the 3-snap wire between U23 and SP2 with the red/yellow LED (D10) or the 1kΩ resistor (R2).

### CHALLENGES

- Make Snap Rover® follow a route or do a dance.
- Make Snap Rover® follow a short zig-zag route.

PROJECT 20




# CRAZY SOUND ROVER

Build the circuit shown and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around, while using output A control to change the sound. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around and change the sound. You can use the programs from project 1 or create your own.

**Part B:** Replace the 5.1kΩ resistor (R3) with the 1kΩ resistor (R2). The sound is different now.

If the sound seems too loud then replace the 3-snap wire between U23 and SP2 with the red/yellow LED (D10) or the 1kΩ resistor (R2).

## CHALLENGES

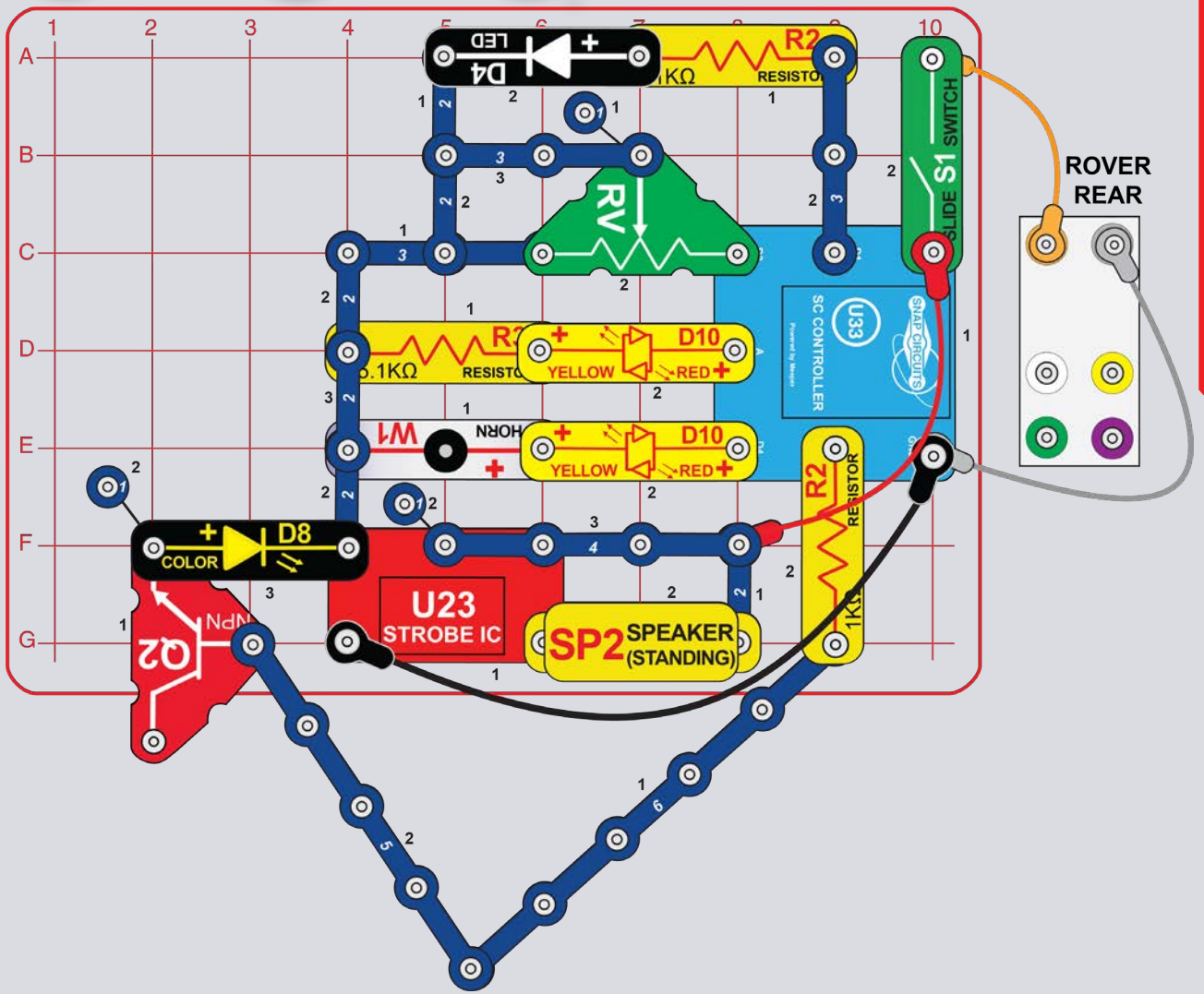
- Make Snap Rover® follow a route, making a sound after every turn.

PROJECT 21

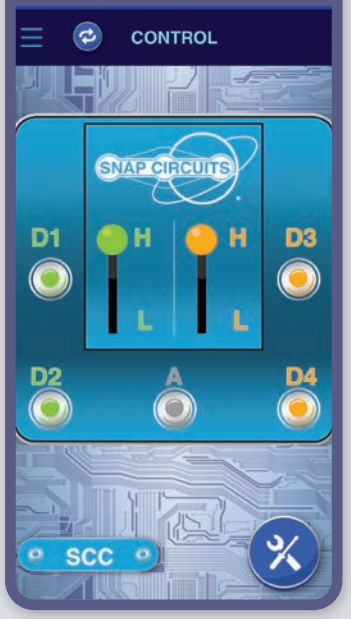
# CRAZY KEYBOARD

Build the circuit shown here and turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode to hear different sounds by activating any of the D1-D4 or A outputs. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to turn on the sounds in a sequence.



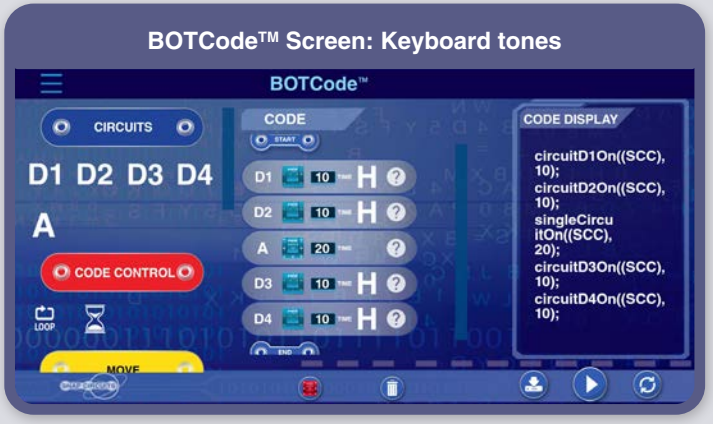

**Control Screen in Circuit Mode**

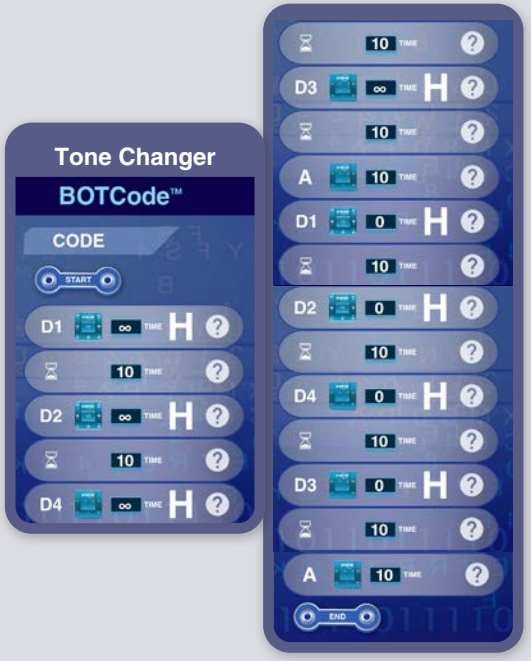



## CHALLENGES

- Make an interesting sequence of sounds.

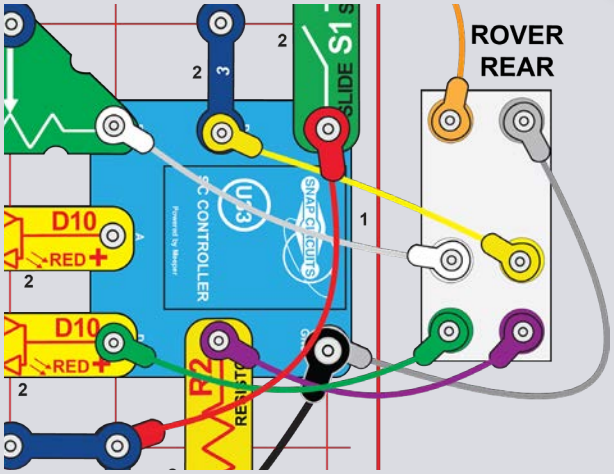
The NPN transistor (Q2) is only connected in two places. Q2 is used here as a one-way diode to isolate some of the circuits from each other.




PROJECT 22

TM




## CHALLENGES

- Make your own dance or route for Snap Rover®.

# MOBILE CRAZY KEYBOARD

Use the preceding circuit but add the white, yellow, green and purple jumper wires to connect the motors in the Rover body. Turn on the switch (S1). Open the Snap Circuits® Coding app, connect to the SC Controller (U33), and use Circuit Control mode or one of the Drive Control modes to drive Snap Rover® around while activating different tones. See project 1 and pages 29-38 to review how to use the app.

Next, put the app in BOTCode™ mode and create some code to drive Snap Rover® around while activating different tones. You can use the programs from project 1 or create your own.

# 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

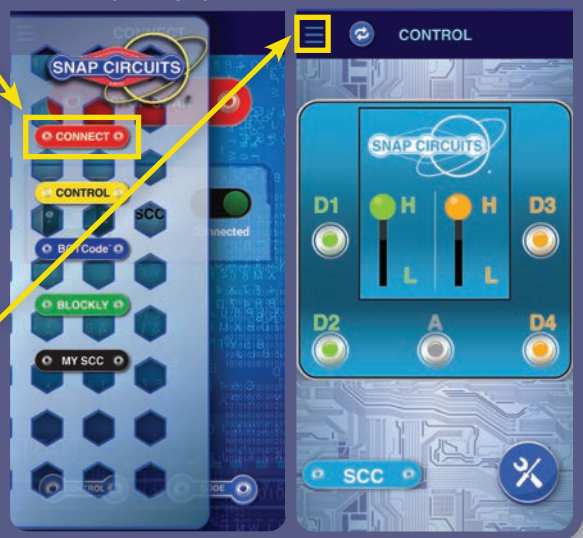
Download on the App Store

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.

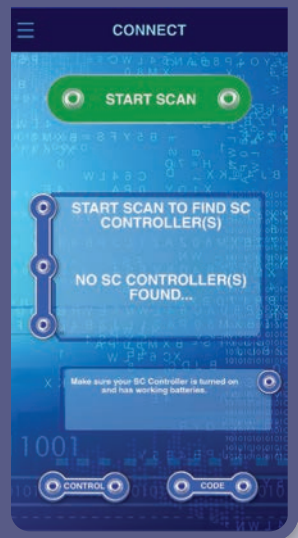
# CONNECT TO THE SNAP CIRCUITS® CODING APP

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.)




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


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.




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

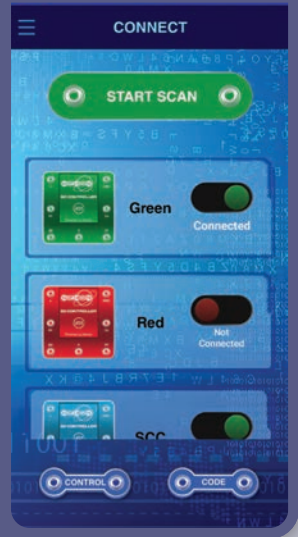
5. Tap on the red "Not Connected" dot to connect the app to your SC Controller. The red dot on the app should turn green, indicating your SC Controller module is now connected to the app. The Bluetooth indicator light on your SC Controller will now be a solid blue, indicating it is connected. You are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


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 35 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.



# CONTROL

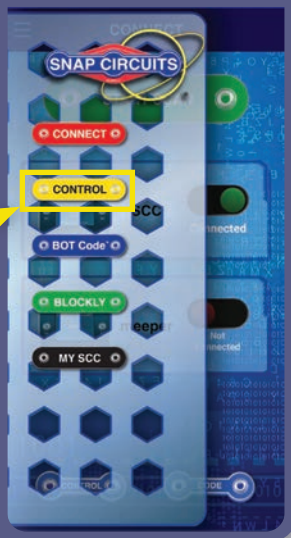
The easiest way to use your SC Controller is with Control mode, which uses your device as a remote control.

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 30.

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

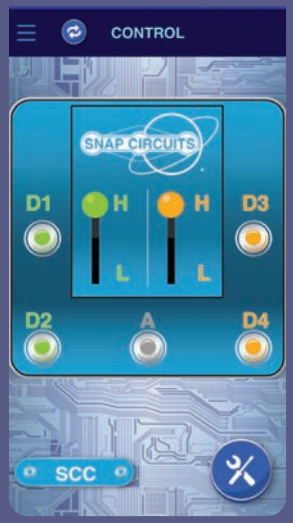

Main Menu




3. The Control screen begins in Circuit mode, you can switch to Drive mode using the mode icon. Drive Control mode is described on page 36.

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

Control Screen In Circuit Mode

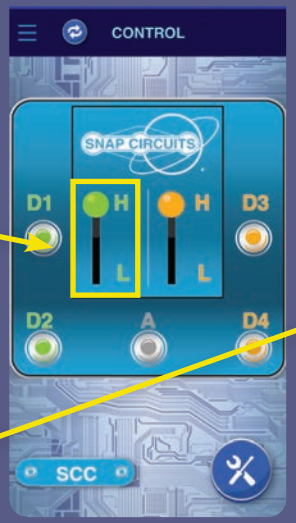



Changing Control Screen Mode

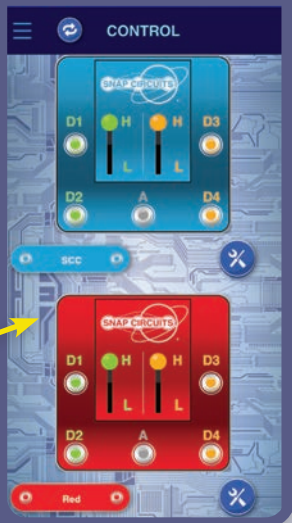

**CIRCUIT MODE FEATURES:**

- 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

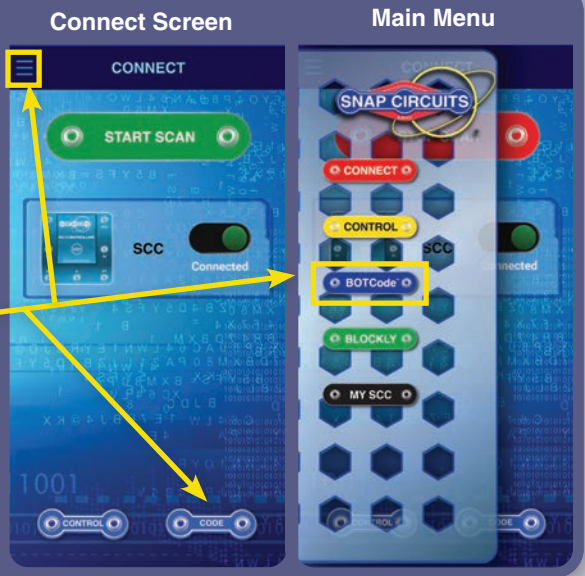


# CREATE BOTCODE™

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!

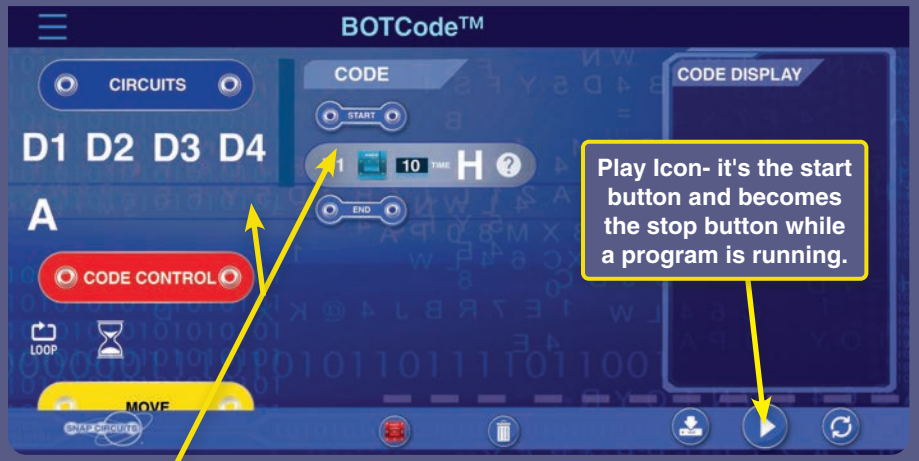
5. Now, tap the Button with the Play icon in the lower right hand corner. The SC Controller activates the LEDs in this circuit as per the program you entered.

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.

**BOTCode™ Screen**




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

# 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.

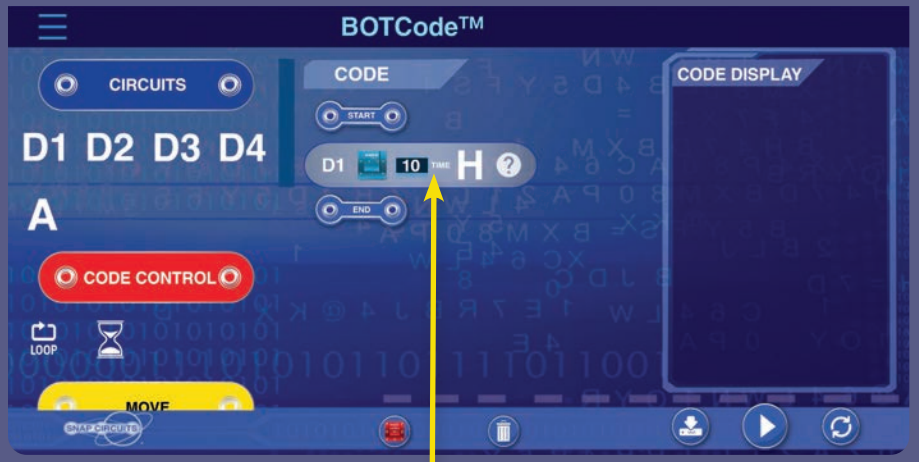
3. The Edit Command screen will appear.

   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.

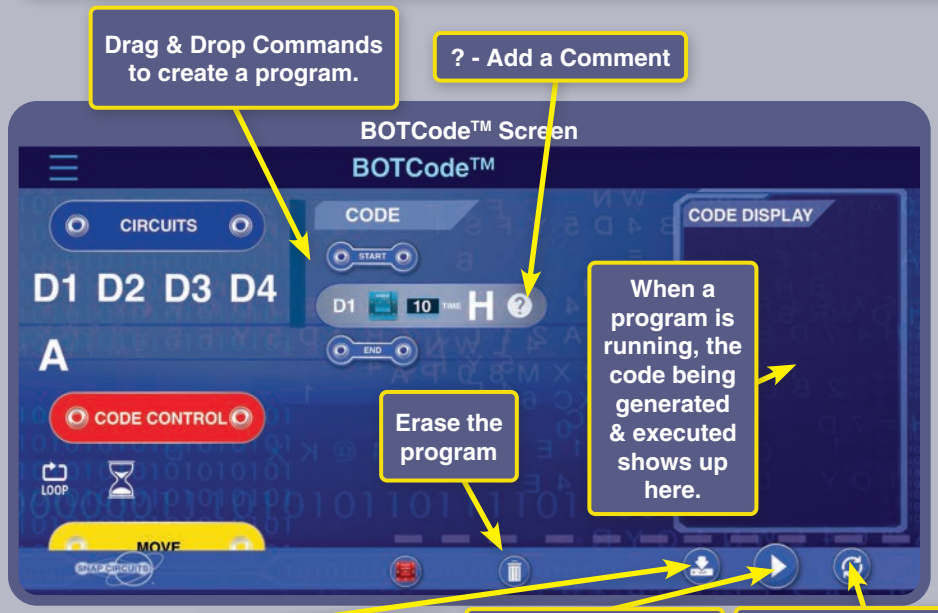
8. Run your code.

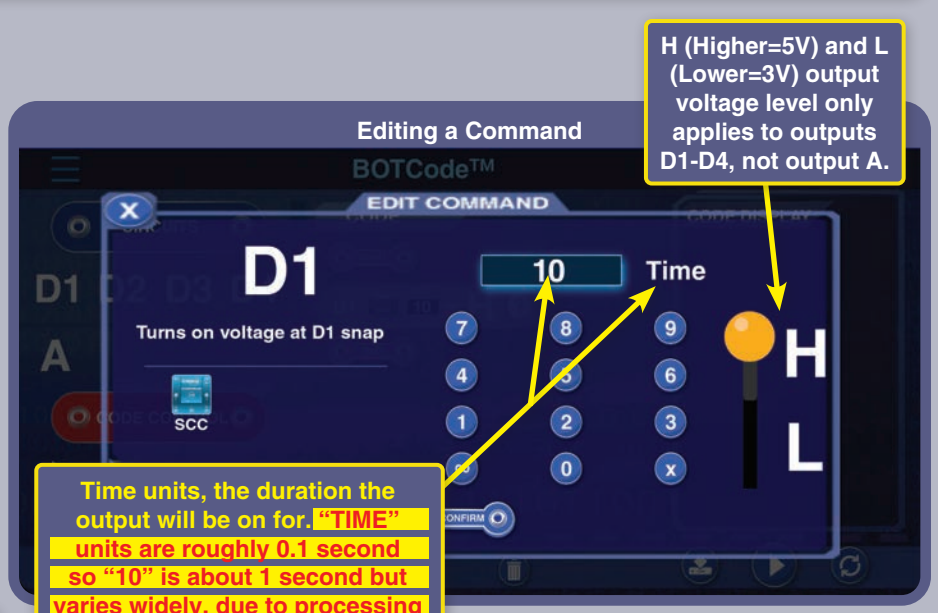
**Note:** You must be connected to your SC Controller in order to program it with commands.

**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.

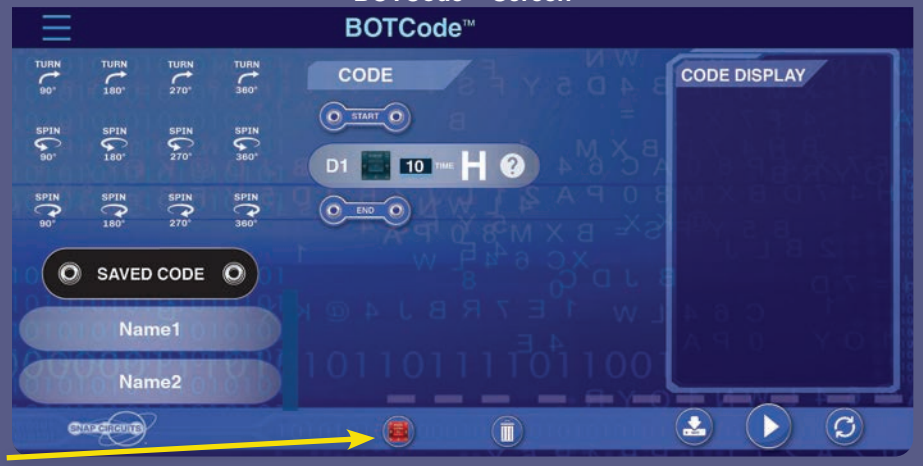
2. To find your newly saved masterpiece, go to the bottom of the commands menu (where you drag commands from). Your program will appear under the ‘Saved Code’ banner.

**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 BOTCode™ 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.

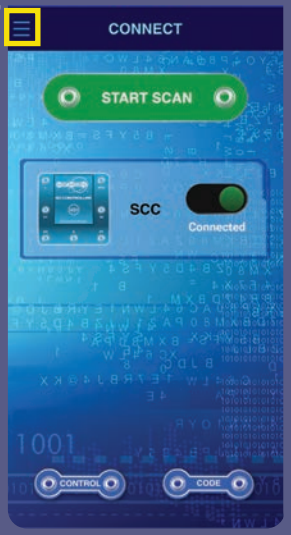
# PERSONALIZING YOUR SC CONTROLLER

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.

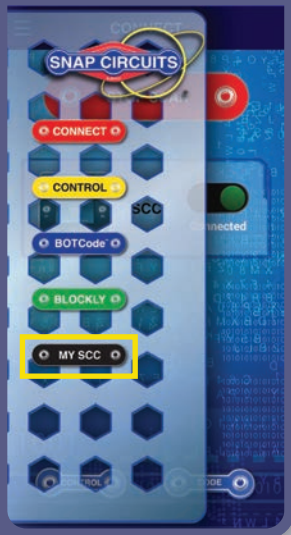
1. Open Snap Circuits Coding app and connect your SC Controller module. (NOTE: in order to personalize any SC Controller you must be connected to it.

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

**Connect Screen**




**Main Menu**



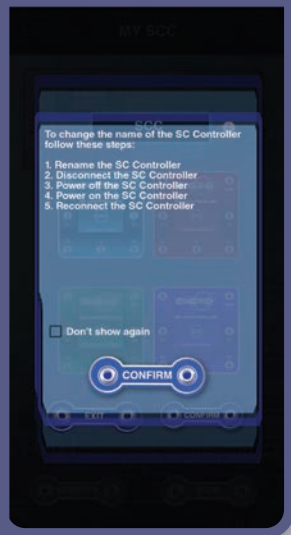

3. Your SC Controller should show up with an icon and name. If several SC Controllers are connected then all will be shown.

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.

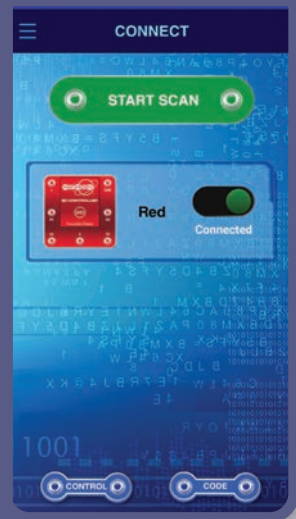
8. To ensure that the changes were saved, disconnect the SC Controller, then turn off the SC Controller, then turn on the SC Controller, and then reconnect the SC Controller.

**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

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

**Changing Control Screen Mode**

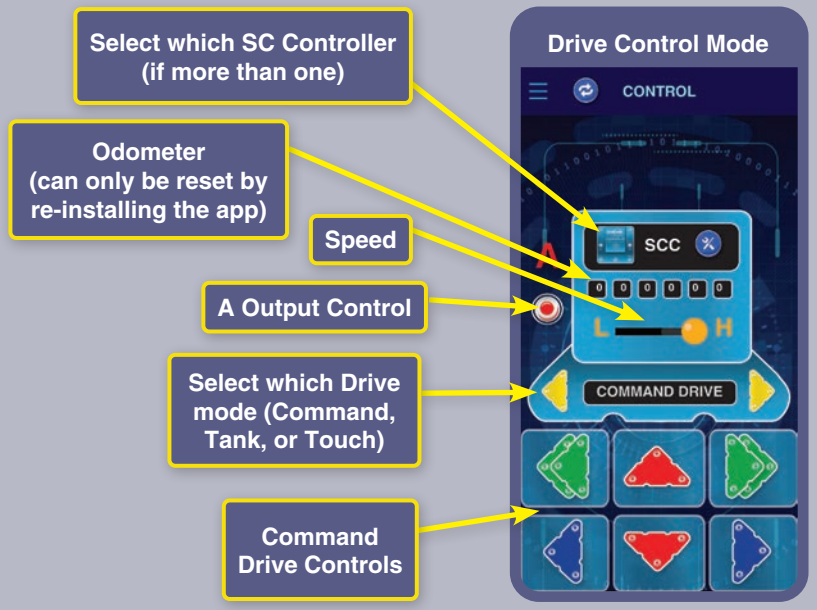

2. There are 3 different Drive modes:

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.

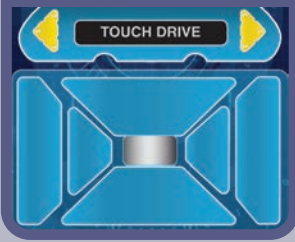
**Drive Control Mode**


**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.

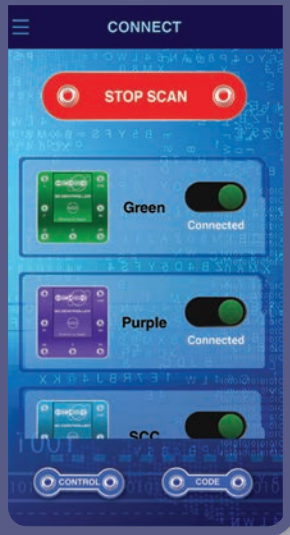
The app should be open to the Code screen, with some commands entered, and the app connected to your SC Controllers.

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.

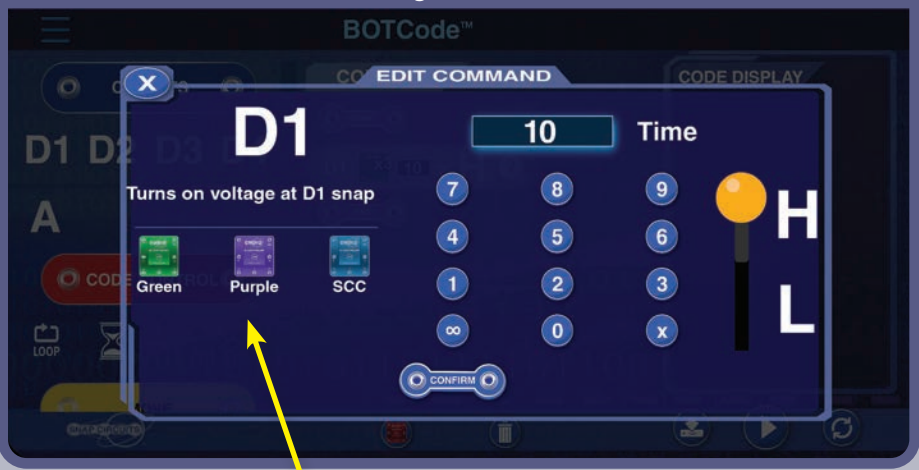
2. Assign one command to one SC Controller and another to your other SC Controller – tap their portrait to choose which SC Controllers execute the command.

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

**Multiple SC Controllers Connected**




**Editing a Command**



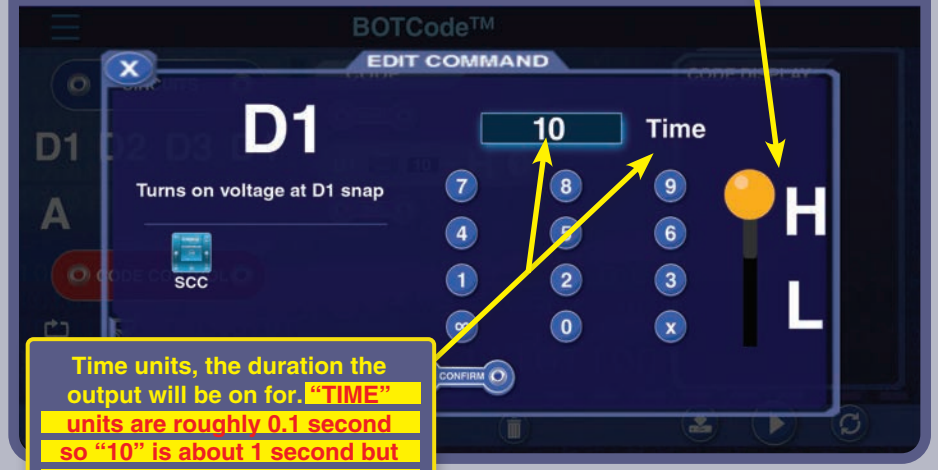

**Select which SC Controllers to command, up to 8 may be controlled at once**

# 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.

# 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 # |
|---|---|---|---|---|
| ❒ 3 | 1 | 1- Snap Wire |  | 6SC01 |
| ❒ 6 | 2 | 2- Snap Wire |  | 6SC02 |
| ❒ 3 | 3 | 3- Snap Wire |  | 6SC03 |
| ❒ 1 | 4 | 4- Snap Wire |  | 6SC04 |
| ❒ 1 | 5 | 5- Snap Wire |  | 6SC05 |
| ❒ 1 | 6 | 6- Snap Wire |  | 6SC06 |
| ❒ 1 | | Base Grid (11.0" x 7.7") Black Tint |  | 6SCBGBK |
| ❒ 1 | C4 | 100µF Capacitor |   | 6SCC4 |
| ❒ 1 | D4 | White LED 90º |   | 6SCD4 |
| ❒ 1 | D8 | Color LED |   | 6SCD8 |
| ❒ 2 | D10 | Red/Yellow Bi-Color LED |   | 6SCD10 |
| ❒ 1 | | Jumper Wire, Black |  | 6SCJ1 |
| ❒ 1 | | Jumper Wire, Red |  | 6SCJ2 |
| ❒ 1 | | Jumper Wire, Orange |  | 6SCJ3A |
| ❒ 1 | | Jumper Wire, Yellow |  | 6SCJ3B |

| Qty. | ID | Name | Symbol | Part # |
|---|---|---|---|---|
| ❒ 1 | | Jumper Wire, Green |  | 6SCJ3C |
| ❒ 1 | | Jumper Wire, Purple |  | 6SCJ3D |
| ❒ 1 | | Jumper Wire, Gray |  | 6SCJ3E |
| ❒ 1 | | Jumper Wire, White |  | 6SCJ3F |
| ❒ 1 | Q2 | NPN transistor |   | 6SCQ2 |
| ❒ 1 | Q4 | Phototransistor |   | 6SCQ4 |
| ❒ 3 | R2 | 1k ohms Resistor |   | 6SCR2 |
| ❒ 1 | R3 | 5.1k ohms Resistor |   | 6SCR3 |
| ❒ 1 | | Rover Body, Light Gray | | 6SCRB2 |
| ❒ 1 | RV | Adjustable Resistor |   | 6SCRV |
| ❒ 1 | S1 | Slide Switch |   | 6SCS1 |
| ❒ 1 | SP2 | Speaker |   | 6SCSP2 |
| ❒ 1 | U23 | Strobe IC |   | 6SCU23 |
| ❒ 1 | U33 | SC Controller |  | 6SCU33 |
| ❒ 1 | W1 | Horn |   | 6SCW1 |

# 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).

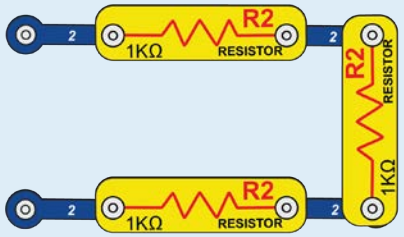
The "**power**" of electricity is a measure of how fast energy is moving through a wire. It is a combination of the voltage and current (Power = Voltage x Current). It is expressed in **watts** (W).

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).

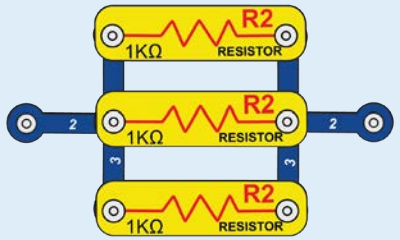
Nearly all of the electricity used in our world is produced at enormous generators driven by steam or water pressure. Wires are used to efficiently transport this energy to homes and businesses where it is used. Motors convert the electricity back into mechanical form to drive machinery and appliances.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

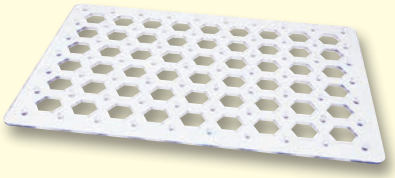
Placing components in series increases the resistance; highest value dominates. Placing components in parallel decreases the resistance; lowest value dominates.

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.

# About Your Snap Circuits® Parts

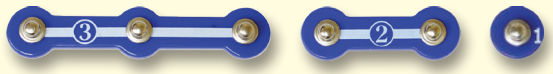
## BASE GRID

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 colored **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).***

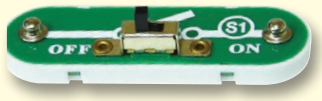
## BATTERY HOLDER

The batteries in the Rover body 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.

**Batteries in the Rover body**

## SWITCHES

The **slide switches (S1)** connects ("ON") or disconnects ("OFF") the wires in a circuit. When ON it has no effect on circuit performance. Switches turn on electricity just like a faucet turns on water from a pipe.




**Slide Switch(S1)**

## TRANSISTORS

The **NPN transistor (Q2)** is a component that uses a small electric current to control a large current, and is used in switching, amplifier, and buffering applications. Transistors are easy to miniaturize, and are the main building blocks of integrated circuits including the microprocessor and memory circuits in computers.


**NPN Transistor (Q2)**

The **phototransistor (Q4)** is a transistor that uses light to control electric current.


**Phototransistor (Q4)**

## 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)**

# About Your Snap Circuits® Parts

## LEDs

The **white, color, and red/yellow LEDs (D4, D8, & 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 about 1.5V for red and yellow, about 2.0V for green, and about 3.0V for blue and white; 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).


**White, Color, & Red/Yellow LEDs (D4, D8, & 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 **1kΩ (R2) and 5.1kΩ (R3) resistors** ("k" symbolizes 1,000, so R2 is really 1,000Ω). 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 (R2 & R3)**

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


**Adjustable Resistor (RV)**

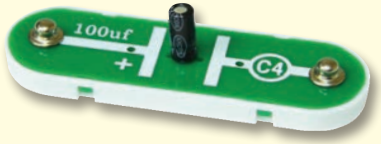
## HORN

The horn (W1) converts electricity into sound by making mechanical vibrations. These vibrations create variations in air pressure, which travel across the room. You "hear" sound when your ears feel these air pressure variations.


**Horn (W1)**

## CAPACITORS

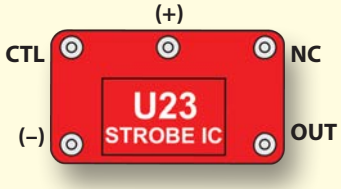
The **100µF capacitor (C4)** can store electrical pressure (voltage) for periods of time. This storage ability allows it to block stable voltage signals and pass changing ones. Capacitors are used for filtering, delay/timing, and oscillator circuits.




**Capacitor (C4)**

## ELECTRONIC MODULES

The strobe IC (U23) contains resistors, capacitors, and transistors that are needed to make a strobe light circuit. A schematic for it is available at www.elenco.com/faqs




**Connections:**
**(+) - power from batteries**
**(–) - power return to batteries**
**OUT - output connection**
**CTL - strobe speed control**
**NC - not used**

See project 5 for example of proper connections.

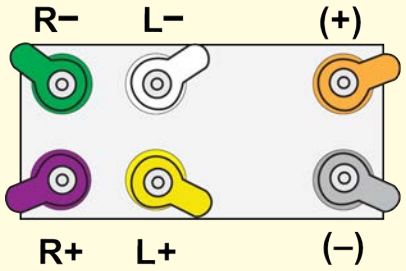
The **SC Controller (U33)** lets you control Snap Circuits® parts using Bluetooth. Its functions and use are described in project 1 and page 29.

# About Your Snap Circuits® Parts

## MOTORS

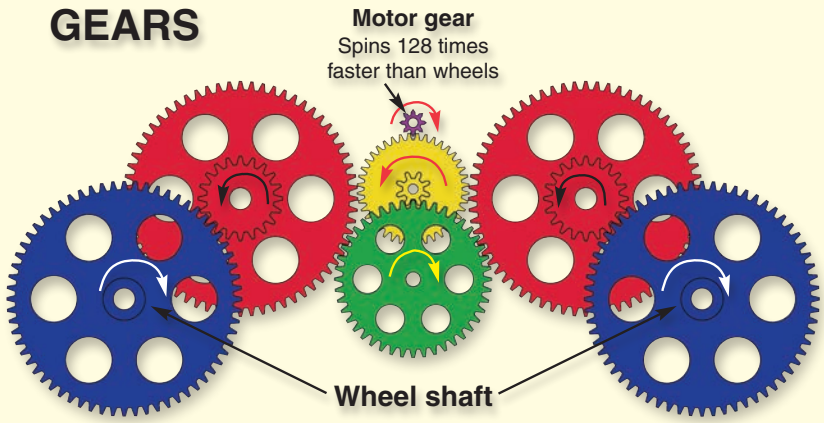
The motors (in the Rover body) convert electricity into mechanical motion. Electricity is closely related to magnetism, and an electric current flowing in a wire has a magnetic field similar to that of a very, very tiny magnet. Inside the motor is a coil of wire with many loops wrapped around metal plates. 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 coil, it magnetizes the metal plates and they repel from the magnet on the motor shell - spinning the shaft. A small gear is on the end of the shaft and spins with it.

**Rover Rear:**
(+) - power from batteries
(–) - power return to batteries
L+ - left forward motor drive
L – - left backward motor drive
R+ - right forward motor drive
R – - right backward motor drive




**WARNING:** Only connect this part as shown in the projects!

**Rover Drive Mechanism:**
The small gear on the Motor drives a larger gear, which drives a larger gear, which drives two larger gears (one on each side), which drive larger gears. The last, largest gears are fixed on shafts that are attached to the front and back wheels, making them move. Note that interlocking gears spin in opposite directions. Also notice that in the sets of interlocking gears between the Motor and the gears on the wheel shafts, the number of "teeth" is increased each time (40-8, 44-8, 64-44, and 64-20), for 128:1 gear ratio overall. This means the Motor must rotate 128 times to rotate the wheels once. The reason for this is that if the Motor were to drive the wheels directly then the Rover would be so fast that it would be impossible to control. Using the gears to reduce the speed also makes the wheels move with much greater force, preventing the Rover from getting stuck in rough terrain and allowing it to carry heavy loads uphill.




*(Part designs are subject to change without notice).*

# 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 book. 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 45 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 modules using configurations given in the projects, incorrectly doing so may damage them. **Elenco® is not responsible for parts damaged due to incorrect wiring.**

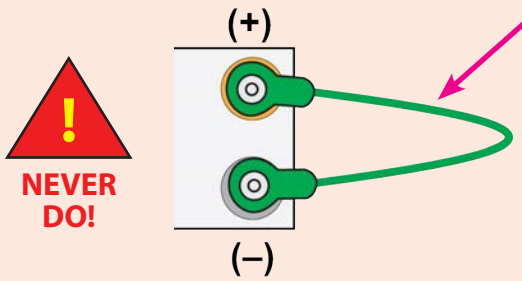
### *Here are some important guidelines:*

| | |
|---|---|
| ***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 motor, resistor, IC, or 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*** | connect the strobe IC using configurations given in the projects. |
| ***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. |

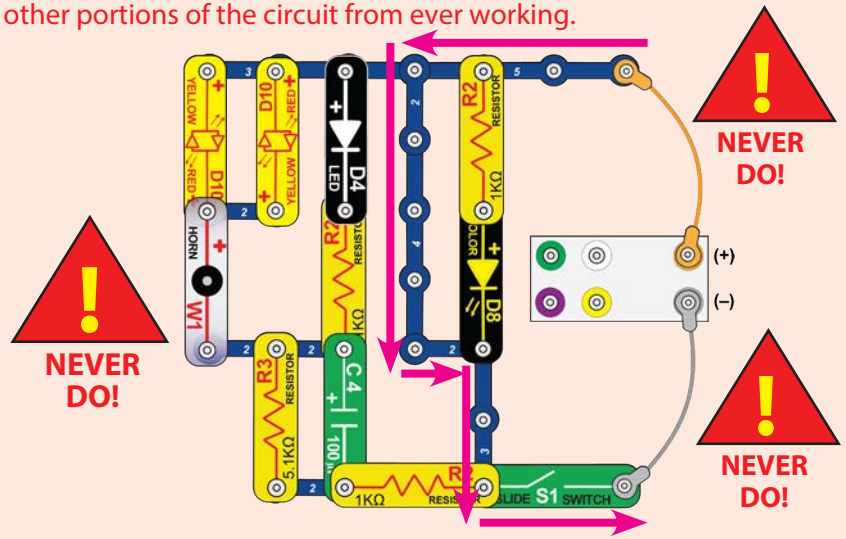
For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

**Warning to Snap Circuits® Owners:** Do not connect additional voltage sources from other sets, or you may damage your parts. Do not connect parts from other Snap Circuits® sets with the Rover body unless you are familiar with the limitations of those parts, the Rover body uses higher voltage which could damage those parts. Contact ELENCO® if you have questions or need guidance.

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




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.**

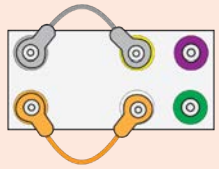
**WARNING: SHOCK HAZARD** - Never connect Snap Circuits® to the electrical outlets in your home in any way!

# Advanced Troubleshooting (Adult supervision recommended)

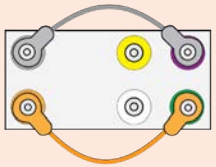
**Elenco® is not responsible for parts damaged due to incorrect wiring.**

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

1. **Rover body and jumper wires:** Flip the Rover body upside down and make sure the wheel mechanisms are clean. Install batteries in the Rover body and connect jumper wires to the Rover rear as shown; two wheels should move. Replace the orange and gray jumper wires with each of the other colors to see if any of the jumpers are damaged. If the wheels don't move for any combination of wires, then the Rover body is damaged. Remove the gray wire; four LEDs on the side should light.

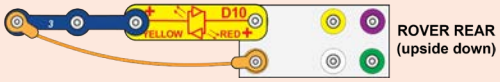



Now move the jumper wires to test the other two wheels, if they don't move then the Rover body is damaged. Remove the gray wire; four LEDs on the side should light.



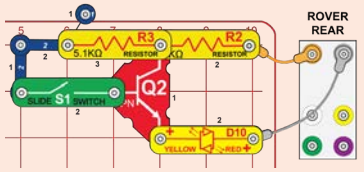

2. **LEDs (D4, D8, & D10) and horn (W1):** With the Rover body still upside down, connect the white LED (D4) as shown ("+" on left), it should light or it is damaged. Replace D4 with D8 and test it in the same way. Replace D8 with each D10 and test in both directions, D10 should be red or yellow depending on its direction. Replace D10 with W1 ("+" on left), it should make sound.


3. **Snap wires:** With the Rover body still upside down, connect each of the blue snap wires (including the 1-snaps) between the red/yellow LED (D10) and orange jumper wire as shown, test them one at a time. The LED should light or the snap wire is damaged.



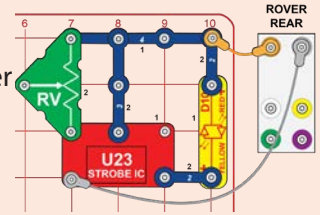

4. **1kΩ & 5.1kΩ resistors (R2 & R3) and slide switch (S1):** Use the preceding circuit but replace the 3-snap wire with S1, when LED should be on when the switch is on and off when the switch is off. Replace the switch with R3, the LED should light but be dimmer. Replace R3 with each R2 (one at a time), the LED should be slightly brighter than with R3.

5. **NPN transistor (Q2):** Use this mini circuit, the red/yellow LED (D10) should only be on when the switch (S1) is on, or the transistor is broken.




6. **Phototransistor (Q4), adjustable resistor (RV), and phototransistor (Q4):** Use the circuit from project 12 (part A); the LED should be on when there is bright light on Q4, or Q4 is broken. Next, use part C; the lever on RV should be able to make the LED bright and off, or RV is broken. Next, use part D; as you move the lever on RV the LED should change brightness more slowly than in part C, or C4 is broken.

7. **Strobe IC (23) and speaker (SP2):** Use this mini circuit, the LED should be flashing quickly or U23 is broken (the lever on RV is not used here). Place SP2 directly over the LED (on level 3), you should hear a buzzing sound or the SP2 is broken.




8. **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 Drive screen of Control mode to drive Snap Rover® around and sound the horn (W1) as described in project 1.

**BOTCode™ NOTE:** If you are using previously entered code then you may need to reassign commands to make that code work, as per page 34.

# NOTES

# NOTES

# CREATE YOUR OWN CHALLENGES

***For Example:***
- Code a route for Snap Rover® using blocks or cones to make obstacles in your path.
- Code a route to another room of your house and have Snap Rover® bring a note to your family member.
- Make an obstacle course and time your route. Play with friends and see who has the best time.
- Code Snap Rover® to “park” under a chair or table.
- Pretend Snap Rover® is on a mission on the moon – have him code an exploration route, then send a light signal to basecamp.
- Play Simon Says: Have Snap Rover® mimic someone’s route or path.

# Welcome to the world of SNAP CIRCUITS®


- SNAP CIRCUITS® makes learning electronics easy and fun!
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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.

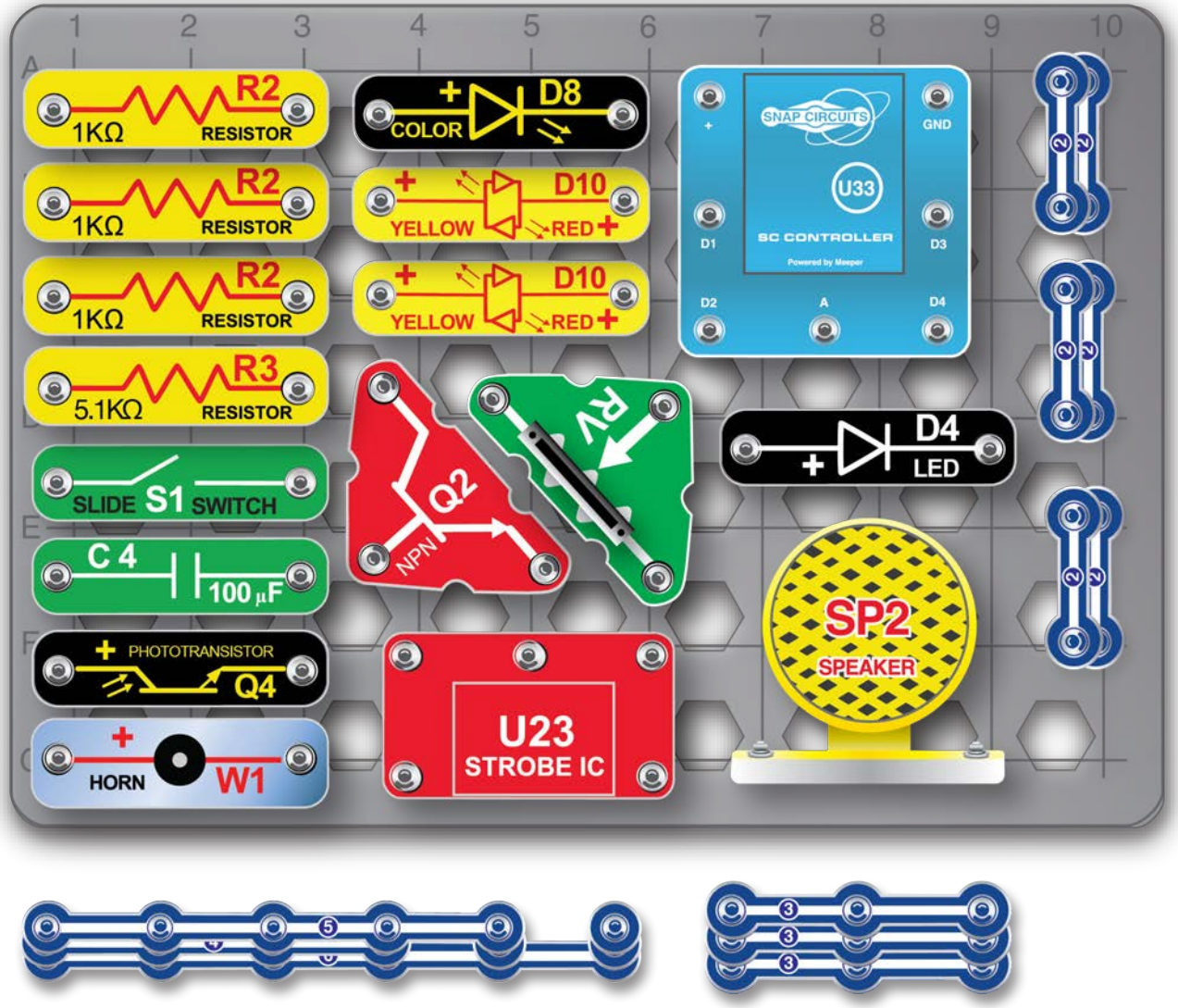
**Customer Service**
150 Carpenter Ave. Wheeling, IL 60090 U.S.A.

**Note:** A complete parts list is on page 39 in this manual.



Powered by Meeper

# SCJ-404 Code Journey Parts Layout





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