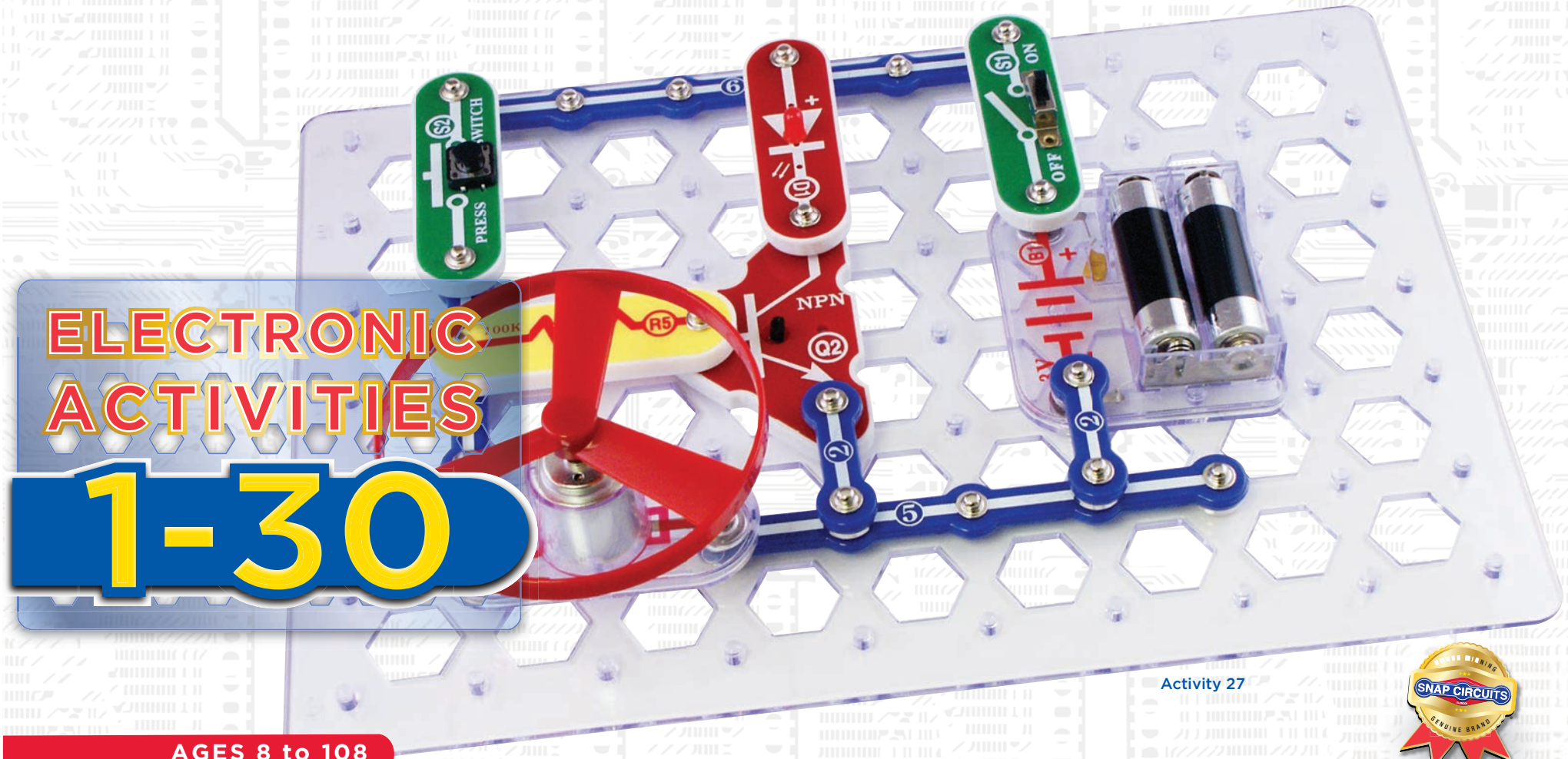
SNAP CIRCUITS®

SNAP CIRCUITS® HOME LEARNING KIT

Instruction Manual



ELECTRONIC ACTIVITIES 1-30

Activity 27

AGES 8 to 108

Two (2) "AA" batteries required

ELENCO®
Learn by doing.®

753043
REV-A

Table of Contents

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

Conforms to ASTM F963-96A

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.

Meets academic standards for elementary science.

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.

Snap Circuits® Home Learning is a tool for opening the exciting world of electronics. Following the Learn by Doing® concept, electronics will be easy to understand by building circuits as you learn about them. This book emphasizes the practical applications of electronics, without bogging down in mathematics. This book is as much about science as about electronics. It will take about 3 hours to complete this book.

Why should you learn about electronics? Electronics plays an important and increasing role in our everyday lives, and so some basic knowledge of it is good for everyone. Learning about it teaches how to do scientific investigation, and the activities develop basic skills needed in today's world.

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.
5. If the motor spins but does not balance the fan, check the black plastic piece with three prongs on the motor shaft. Be sure that it is at the top of the shaft.

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

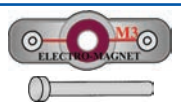
Note: If you suspect you have damaged parts, you can follow the Advanced Troubleshooting procedure on page 6 to determine which ones need replacing.

⚠ 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 alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- Do not mix old and new batteries.
- Remove batteries when they are used up.
- Do not short circuit the battery terminals.
- Never throw batteries in a fire or attempt to open its outer casing.
- Batteries are harmful if swallowed, so keep away from small children.

Parts List (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.

Qty.	ID	Name	Symbol	Part #	Qty.	ID	Name	Symbol	Part #
❒ 1		Base Grid (11.0" x 7.7")		6SCBG	❒ 1	D1	Red Light Emitting Diode (LED)		6SCD1
❒ 2	2	2-Snap Wire		6SC02	❒ 1	L1	Lamp, 2.5V or 3V		6SCL1
❒ 2	3	3-Snap Wire		6SC03	❒ 1	B1	Battery Holder - uses 2 1.5V type AA (not included)		6SCB1
❒ 1	4	4-Snap Wire		6SC04	❒ 1	SP	Speaker		6SCSP
❒ 1	5	5-Snap Wire		6SC05	❒ 1	U1	Music Integrated Circuit		6SCU1
❒ 1	6	6-Snap Wire		6SC06	❒ 1	Q2	NPN Transistor		6SCQ2
❒ 1 ❒ 1	M1	Motor Fan		6SCM1 6SCM1F	❒ 1	R1	100Ω Resistor		6SCR1
❒ 1 ❒ 1	M3	Electromagnet Iron Core Rod		6SCM3 6SCM3B	❒ 1	R5	100kΩ Resistor		6SCR5
❒ 1	S1	Slide Switch		6SCS1	❒ 1		Jumper Wire (Black)		6SCJ1
❒ 1	S2	Press Switch		6SCS2	❒ 1		Jumper Wire (Red)		6SCJ2
❒ 1	RP	Photoresistor		6SCRP	**You may order additional / replacement parts at our website: www.elenco.com/replacement-parts**				

How to Use It

The Electronic Snap Circuits® Home Learning Kit has 30 projects. They are simple to build and understand.

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

For Example:

This is the switch block which is green and has the marking (S1) on it as shown in the drawings.

Please note that the drawing doesn't reflect the real switch block exactly (it is missing the ON and OFF markings), but gives you the general idea of which part is being used in the circuit.

This is a wire block which is blue and comes in different wire lengths.
This one has the number (2), (3), (4), (5), or (6) on it depending on the length of the wire connection required.

To build each circuit, you have a power source block number (B1) that needs two (2) "AA" batteries (not included with the Snap Circuits® kit).

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

Next to each part in every circuit drawing is a small number in black. This tells you which level the component is placed at. Place all parts on level 1 first, then all of the parts on level 2, then all of the parts on level 3, etc.

Place the fan on the motor (M1) whenever that part is used, unless the project you are building says not to use it.

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

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.

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, lamp, 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 IC using configuration given in the projects, incorrectly doing so may damage it. **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 the speaker, lamp, electromagnet, music IC (which must be connected properly), motor, photoresistor, or resistor.

ALWAYS use the LED and switches in conjunction with other components that will limit the current through them. Failure to do so will create a short circuit and/or damage those parts.

ALWAYS disconnect your batteries immediately and check your wiring if something appears to be getting hot.

ALWAYS check your wiring before turning on a circuit.

ALWAYS connect the music IC using configurations given in the projects or as per the connection descriptions for it.

NEVER connect to an electrical outlet in your home in any way.

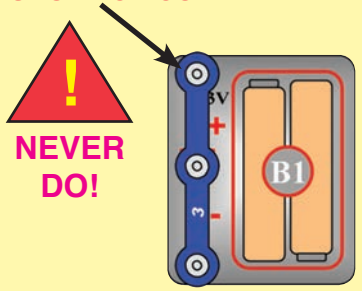
NEVER leave a circuit unattended when it is turned on.

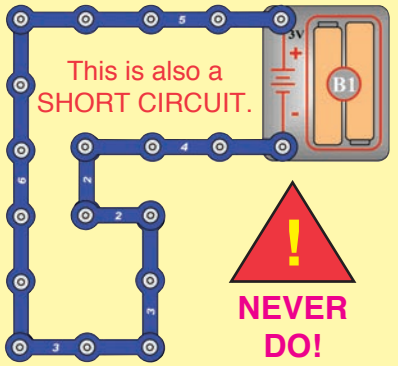
NEVER touch the motor when it is spinning at high speed.

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

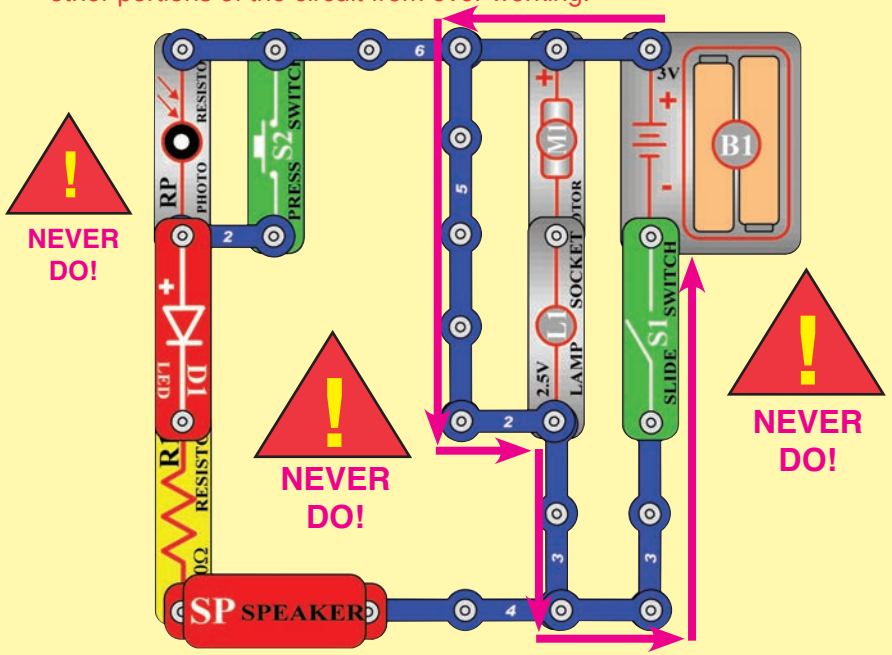
Examples of SHORT CIRCUITS - NEVER DO THESE!!!

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





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



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

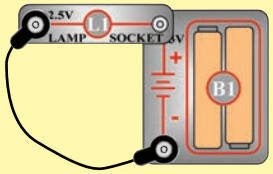
Advanced Troubleshooting (Adult supervision recommended)

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

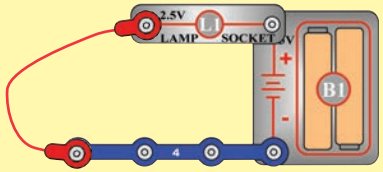
If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:

1. **Lamp (L1), motor (M1), speaker (SP), and battery holder (B1):** Place batteries in holder. Place the lamp directly across the battery holder, it should light. Do the same with the motor (motor + to battery +), it should spin to the right at high speed. "Tap" the speaker across the battery holder contacts, you should hear static as it touches. If none work then replace your batteries and repeat, if still bad then the battery holder is damaged.

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



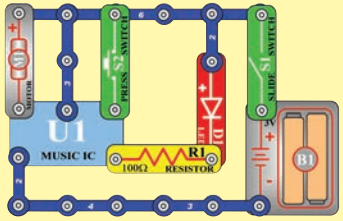
3. **Snap wires:** Use this mini-circuit to test each of the snap wires, one at a time. The lamp should light.



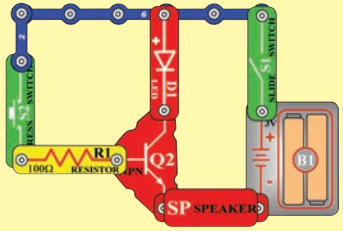
4. **Slide switch (S1) and Press switch (S2):** Build activity 1, if the lamp (L1) doesn't light then the slide switch is bad. Replace the slide switch with the press switch to test it.

5. **100Ω resistor (R1) and LED (D1):** Build activity 6 except initially use the speaker (SP) in place of the LED, you will hear static if the resistor is good. Then replace the speaker with the LED and see that it lights.

6. **Music IC (U1):** Build the circuit shown here. Turn it on and the LED (D1) flickers for a while and stops, it should resume if you spin the motor (M1) or push the press switch (S2).



7. **NPN transistor (Q2), 100kΩ resistor (R5), and Photoresistor (RP):** Build the mini-circuit shown here. The LED (D2) should only be on if the press switch (S2) is pressed; if otherwise then the NPN is damaged.



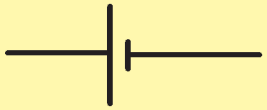
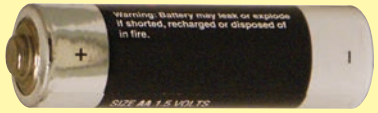
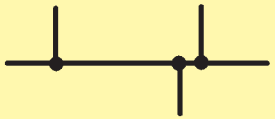
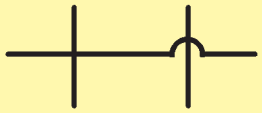
- Replace the 100Ω resistor (R1) with the 100kΩ resistor (R5). The LED should light when the press switch is pressed; otherwise the 100kΩ resistor is damaged.
- Replace the 100kΩ resistor with the photoresistor. The LED should light when the press switch is pressed and there is light on the photoresistor; otherwise the photoresistor is damaged.

8. **Electromagnet (M3):** Use the circuit for activity 18, and place the iron core rod in the electromagnet. When you push the press switch (S2), a metal paperclip or small iron nail should be attracted to the iron core rod; if no attraction then the electromagnet is damaged.

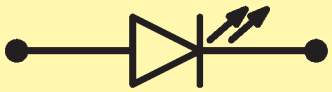
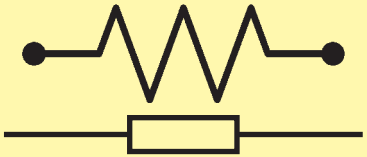
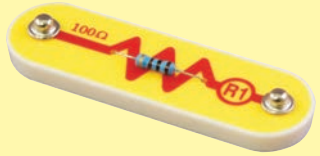
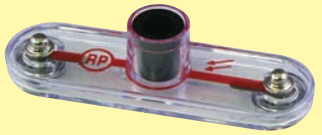
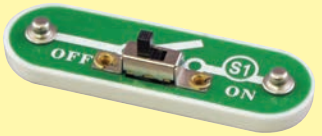
ELENCO®
150 Carpenter Avenue
Wheeling, IL 60090 U.S.A.
Phone: (847) 541-3800 • Fax: (847) 520-0085
e-mail: help@elenco.com • Website: www.elenco.com

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

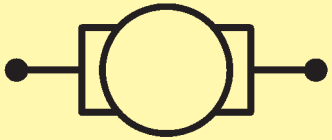
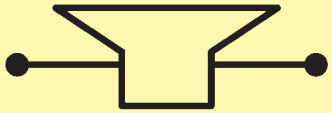
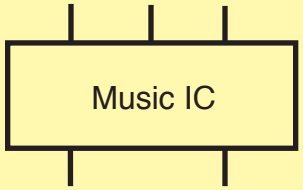
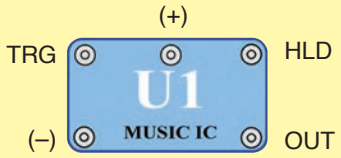
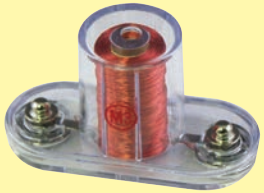
Summary of Parts & Circuit Diagram Symbols

Dry Cell		Produces electrical energy using a chemical reaction. The larger terminal (on the left) is positive (+). A single cell is often called a battery, but strictly a battery is two or more cells joined together. 
2 Cell Battery (B1)		Batteries supply electrical energy. A battery is more than one cell. 
Wire (2, 3, 4, 5, & 6 snap wires, red and black jumper wires)		Used to pass current very easily from one part of a circuit to another. A 3-snap wire is shown here. 
Wires joined		A ‘blob’ should be drawn where wires are connected (joined), but it is sometimes omitted. Wires connected at ‘crossroads’ should be staggered slightly to form two T-junctions, as shown on the right.
Wires not joined		In complex diagrams it is often necessary to draw wires crossing even though they are not connected. Often the ‘bridge’ symbol shown on the right is used because the simple crossing on the left may be misread as a join where you have forgotten to add a ‘blob’!

Summary of Parts & Circuit Diagram Symbols

Lamp (L1)		A transducer that converts electrical energy to light. It contains a special wire that glows bright when a large electric current passes through it. The upper symbol is used for a lamp providing illumination, for example a car headlamp or flashlight bulb. 
LED (D1) Light Emitting Diode		A transducer that converts electrical energy to light. 
Resistor (R1 100Ω and R5 100kΩ)		A resistor restricts the flow of current through a circuit. 
Photoresistor (RP)		A resistor whose value changes as light shines on it. 
On-Off Switch (S1)		A mechanical switch that allows current to flow only when it is in the closed (on) position. 
Push Switch (push-to-connect S2)		A push switch allows current to flow only when the button is pressed. 

Summary of Parts & Circuit Diagram Symbols

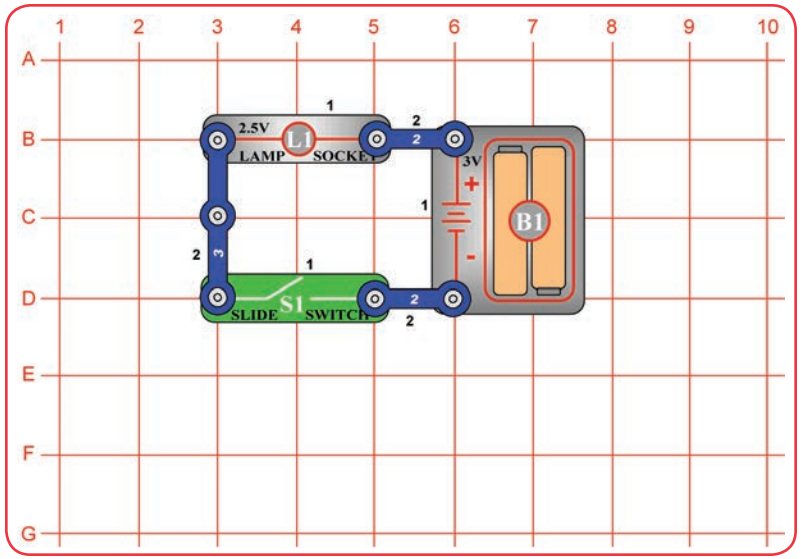
Motor (M1)		A transducer that converts electrical energy to kinetic energy (motion). 
Speaker (SP)		A transducer that converts electrical energy to sound. An electrical signal creates mechanical vibrations, which create variations in air pressure, which travel across the room to your ears. 
Music Integrated Circuit (U1)		A module that converts electrical energy to Music. It contains a specialized sound-generation circuit with resistors, capacitors, and transistors. The descriptions for the music IC module is given here for those interested, see the projects for connection examples:   **Music IC:** (+) - power from batteries (–) - power return to batteries OUT - output connection HLD - hold control input TRG - trigger control input Music for ~20 sec on power-up, then hold HLD to (+) power or touch TRG to (+) power to resume music.
Electromagnet (M3) with Iron Core Rod		A coil of wire, which acts like a magnet when an electric current flows through it. Placing an iron bar inside increases the magnetic effects.  
NPN Transistor (Q2)		A device that switches or amplifies electrical current. 

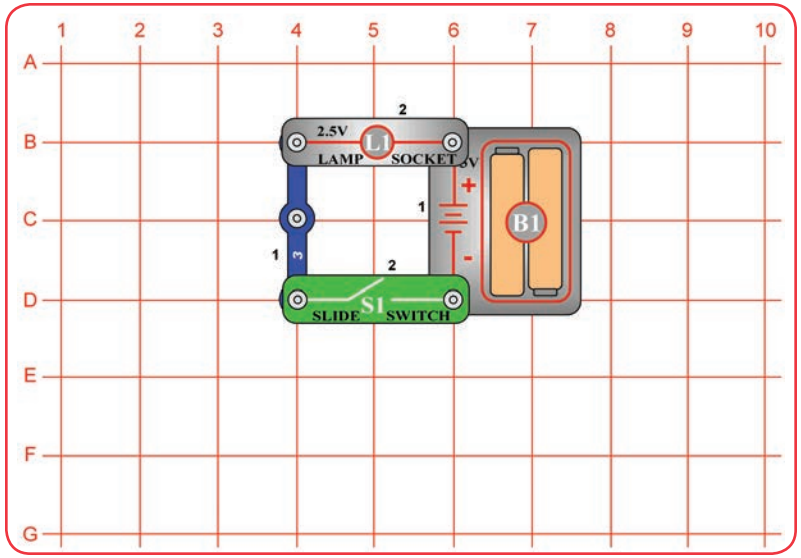
Activities Listing

Objectives: As a result of completion of activities 1 - 30 in this kit, students will:

- Understand basic information about electricity as a form of energy
- Control the flow of electricity through a number of circuits and devices
- Identify the path of electricity through a circuit
- Identify the parts of a circuit
- Repair a non-functioning circuit
- Transform electrical energy into light, sound, and motion
- Identify series and parallel circuits
- Determine if materials are conductors of electricity or insulators
- Observe the effect of resistance on the brightness of a bulb or LED
- Study the motion of a motor
- Produce and study sound from a speaker
- Draw and label circuit diagrams
- Build a Morse Code sender (telegraph using light instead of sound)
- Send and receive messages in Morse code, and decode messages received
- Observe the effect of fluorescent light on a spinning disc
- Observe the effect of electricity on a temporary magnet (electromagnet)
- Use a transistor to switch devices on or off
- Make a circuit that detects the presence of water
- Have a better understanding of the scientific method of investigation

Activity 1
Electric Light and Switch





Materials List

Quantity	Description
2	2-Snap Wires
1	3-Snap Wire
1	Battery Holder (B1) with 2 AA batteries (not included)
1	Lamp (L1), 2.5V or 3V
1	Slide Switch (S1)

Build the circuit shown on the left by placing the parts with a black **1** next to them on the board first. Then add the parts with a **2**. Install two AA type batteries (not included) in the holder (B1).

What happens when you close the switch? _____

What happens when you open the switch? _____

Now build this circuit with some of the same parts.

What do the two circuits have in common?

_____

How can you tell when electricity is flowing through the circuit?

_____

Explain how the switch works. _____

_____

What could you do to open and close this circuit without a switch?

_____

Give two examples of switches used in everyday life.

1. _____

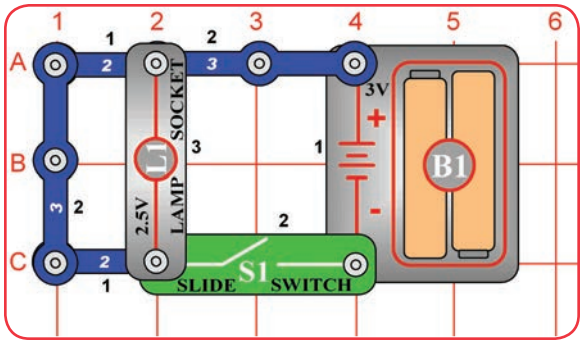
2. _____

Use the circuit diagram symbols to draw the two circuits you have made on the previous page.

Diagram 1	Diagram 2

Tell why these three circuits will not light the bulb, then explain a way to fix the circuits.

A.



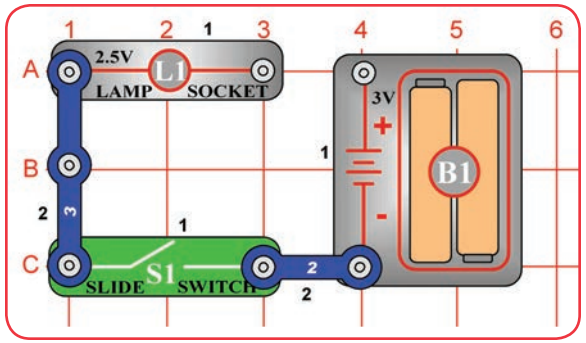
Circuit A will not light the bulb because

_____

Repair by:

_____

B.



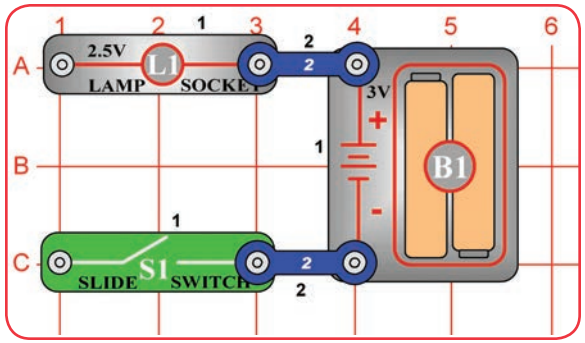
Circuit B will not light the bulb because

_____

Repair by:

_____

C.



Circuit C will not light the bulb because

_____

Repair by:

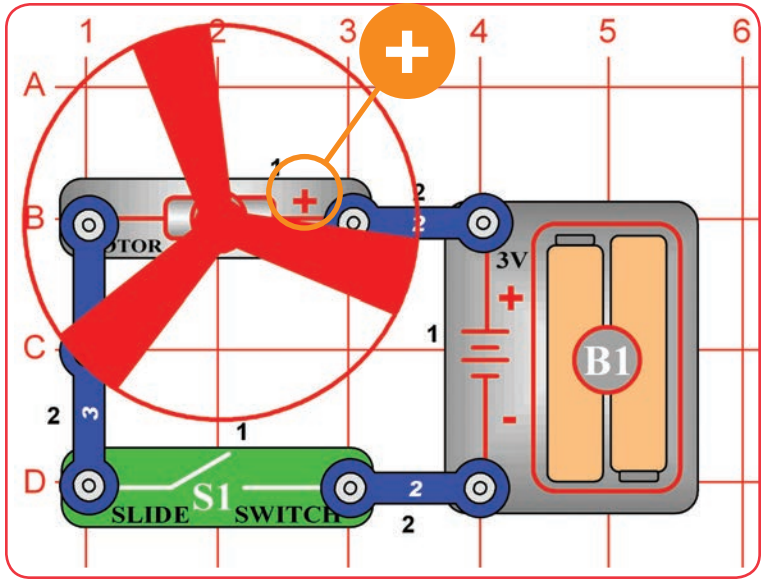
_____

Answers are at www.elenco.com/product/snap-circuits-home-learning/

Activity 2
Motor and Switch

Use the circuit diagram symbols to draw the circuit shown below.

Circuit Diagram



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

WARNING: Do not lean over the motor.

Materials List

Quantity	Description
2	2-Snap Wires
1	3-Snap Wire
1	Battery Holder (B1)
1	Motor (M1) and Fan Blade
1	Slide Switch (S1)

Build the circuit pictured on the left by placing all parts with a black **1** next to them on the board first. Then assemble the parts with a black **2**. Place the motor (M1) with the "+" side as shown.

What happens when you close the switch? _____

What happens when you open the switch? _____

What is the electrical energy changed into? _____

How is this circuit similar to the lamp circuit in Activity 1?

_____

_____

Think of several examples of tools or toys powered by a motor.

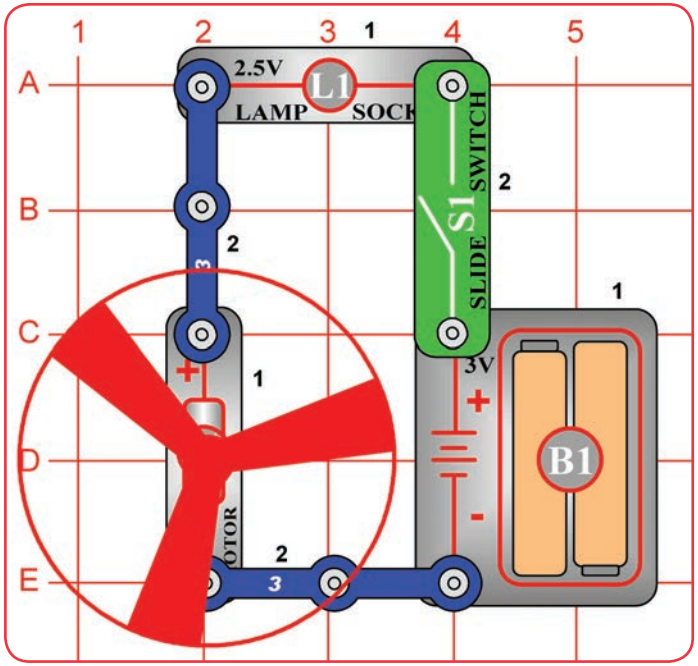
_____

_____

Activity 3
Lamp and Fan in Series

Use the circuit diagram symbols to draw the circuit shown below.

Circuit Diagram



Materials List

Quantity	Description
2	3-Snap Wires
1	Battery Holder (B1)
1	Lamp (L1)
1	Motor (M1) and Fan Blade
1	Slide Switch (S1)

Build the circuit pictured on the left. Place all the parts with the black **1** next to them on the board first, then the parts with the black **2**.

What happens when you close the switch?

_____

What happens when you open the switch?

_____

Open the switch. Take the fan off the motor. Close the switch. Describe What happens.

_____

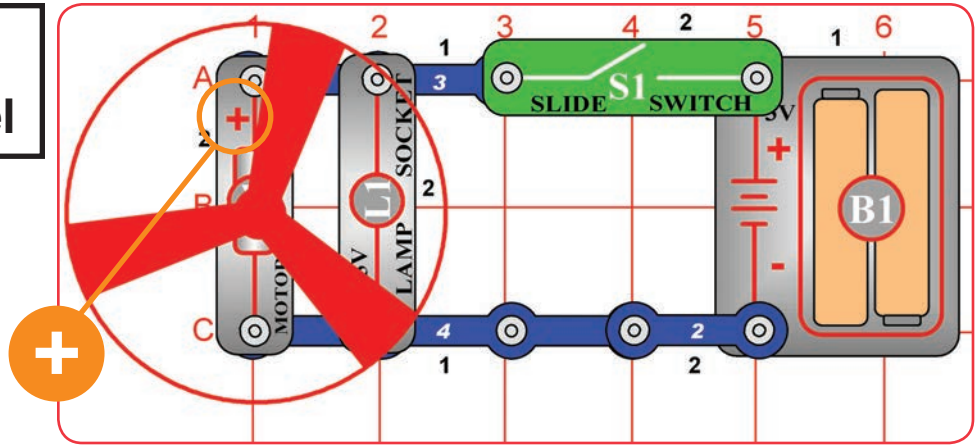
_____

The circuits in Activity 1, 2, and 3 were series circuits. In a series circuit all of the parts are placed on the board one after the other.

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

WARNING: Do not lean over the motor.

Activity 4
Lamp and Fan in Parallel



Build the circuit shown on the left. Place the motor (M1) with the "+" side as shown.

Materials List

1 2-Snap Wire
1 3-Snap Wire
1 4-Snap Wire
1 Battery Holder (B1)
1 Lamp (L1)
1 Motor (M1) and Fan Blade
1 Slide Switch (S1)

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

WARNING: Do not lean over the motor.

Use the circuit diagram symbols to draw the circuit here.

What happens when you close the switch? _____

What happens when you open the switch? _____

Unscrew the lamp. What happens to the motor? _____

Screw the lamp back in. Open the switch. Remove the fan blade from the motor. Close the switch. What happens to the lamp?

_____

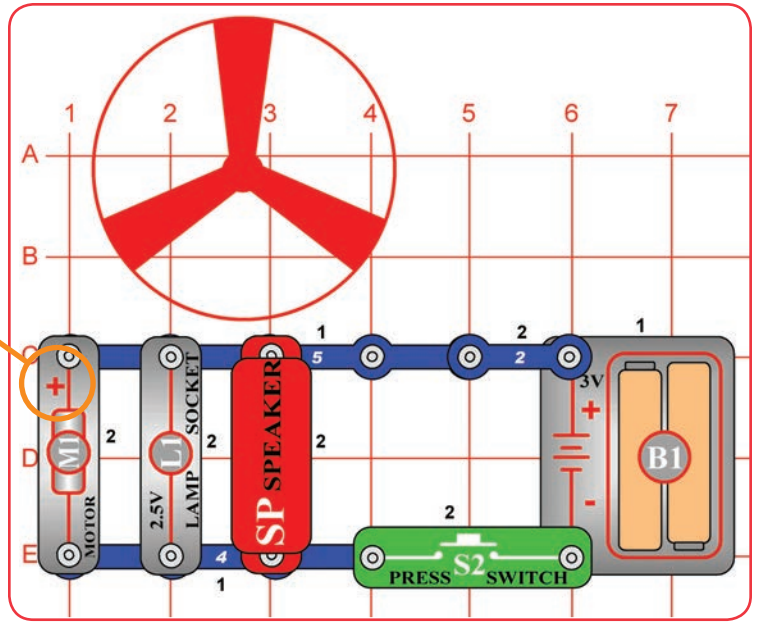
How is a parallel circuit different from a series circuit? _____

_____

Activity 5
Lamp, Speaker, and Fan in Parallel

Materials List

1 2-Snap wire
1 4-snap wire
1 5-snap wire
1 Battery Holder (B1)
1 Press Switch (S2)
1 Lamp (L1)
1 DC motor (M1) & Fan Blade
1 Speaker (SP)



Build the circuit shown on the left. Place the motor (M1) with the "+" side as shown.

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

WARNING: Do not lean over the motor.

Use the circuit diagram symbols to draw the circuit here.

What happens when you press the switch S2? _____

Circle the number of paths that exist for the electric current to follow? 1 2 3 4 5 6

Put the fan on the motor when the motor stops spinning. Press the switch. What changes do you notice?

_____

What is the purpose of the speaker in the circuit? _____

Remove the speaker from the circuit. What changes do you notice? _____

Unscrew the lamp. Press the switch. What effect does this have on the motor? _____

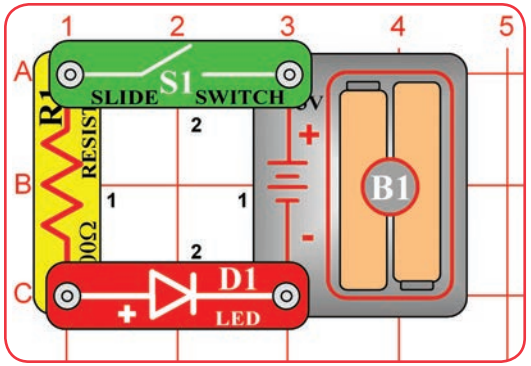
—

Don't leave the circuit on too long or it will drain the batteries.
Do you think the lights in your home are wired in series or parallel? _____

Activity 6
Light Emitting Diode

Materials List

1 Battery Holder (B1)
1 LED (Light Emitting Diode, D1)
1 100Ω Resistor (R1)
1 Slide Switch (S1)



Build the circuit pictured on the left.

Draw the circuit using the circuit diagram symbols.

Is this a series or parallel circuit? How do you know? _____

_____

What happens when you close the switch? _____

How is this circuit like the circuit in Activity 1? How is it different? _____

_____

What is the function of the resistor? _____

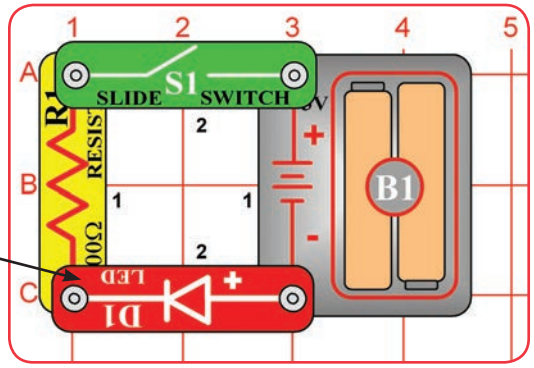
List several devices you have seen that use LEDs in them. _____

Why are LEDs used instead of a incandescent light bulbs in these devices? _____

_____

Activity 7
One Direction for the LED

Rebuild the circuit used in Activity 6, but put the LED facing in the opposite direction as shown here.



What happens when you close the switch?

_____

What path is the electric current following?

_____

What effect did turning the LED around have on the flow of electric current? _____

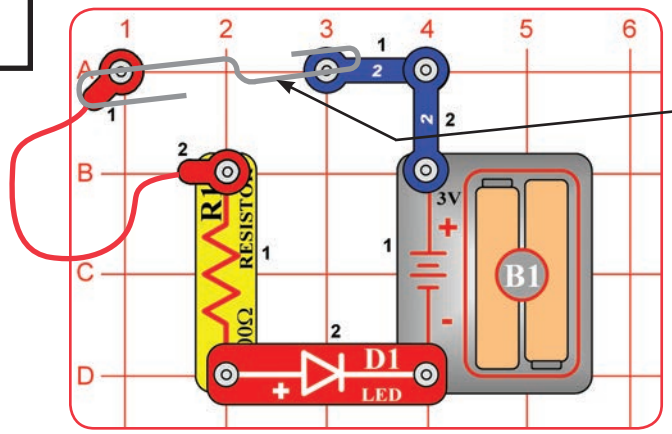
_____

Activity 8
Conduction Detector

Materials List

2 2-Snap Wires
1 Battery Holder (B1)
1 LED (D1)
1 100 Ohm Resistor (R1)
1 Red Jumper Wire
1 Paper clip (uncoated)

Build the circuit as shown.



To make sure the circuit is working properly, place a paper clip across the opening between the two 2 snap wires as shown here. The LED should light up. When you place the paper clip across the terminals as shown, current flows from the batteries through the resistor, then the LED, then back to the batteries. The paper clip completes the circuit.

Listed below are items that you will place across the terminals one at a time to determine if they are conductors (allow electricity to flow) or insulators (prevents the flow of electricity). Use the jumper wire shown to bridge the gap when testing small items such as a penny. First predict which materials are conductors or insulators by filling in the blue column in the table below.

Material	Prediction	Test Result
Clean steel nail		
Rusty nail		
Piece of chalk		
Rubber eraser		
Plastic straw		
Brass paper fasteners		
Copper penny		
Aluminum foil strip		
Rubber band		

Material	Prediction	Test Result
Key		
Cardboard strip		
Wooden craft stick		
Plastic ruler		
Metal paperclip		
Plastic coated paperclip		
String		
Pencil lead from a mechanical pencil		

Test each item and write the result (conductor or insulator) in the green column.

What do all conductors have in common? _____

List 2 examples of uses for conductors. _____

Which materials are good insulators? _____

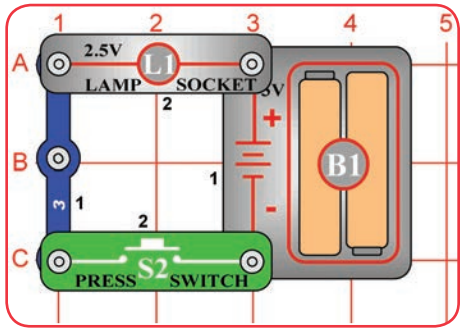
List 2 examples of insulators used in everyday life. _____

Activity 9
Morse Code

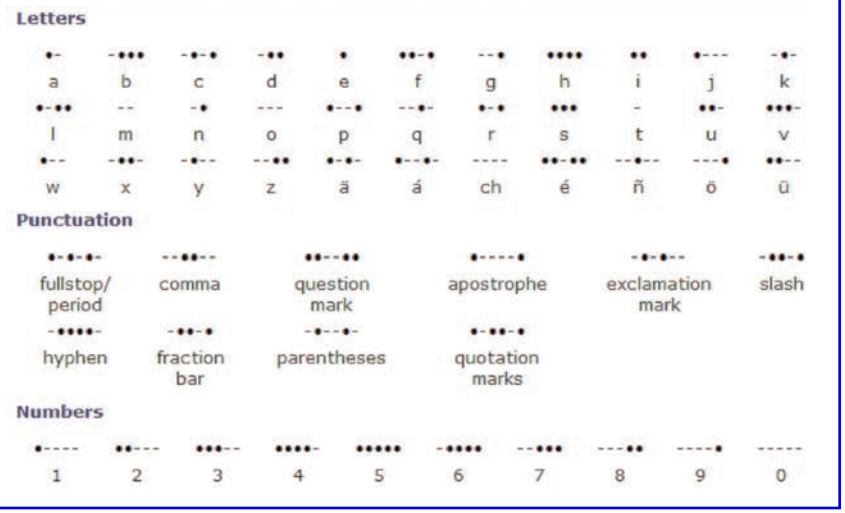
Materials List

1 3-Snap Wire
1 Battery Holder (B1)
1 Lamp (L1)
1 Press Switch (S2)

Build the circuit as shown.



Since December 2003, Morse Code has included the @ symbol: it is a combination of a and c: o--o-o and is the first change to the system since before World War II.



You can send a message to your partner using Morse code shown in the box above. At first you should only use the letters from a to z and the numbers. Morse code is a series of dots and dashes representing the letters of the alphabet. A telegraph sends messages with sound signals. Your sender uses light instead. If you only hold down the press switch for a short time, you get a "dot". If you hold the switch down for a longer time you get a "dash".

Using the code, write a sentence to send to your partner. Remember to pause between words. Since your partner is new to decoding Morse code, try to send your message slowly so your partner has time to write it down. After your partner decodes your message, your partner will write a message to send to you to decode.

How does a telegraph work? _____

How is your telegraph similar to an actual telegraph? _____

How is it different? _____

Why were telegraphs important in the past? _____

Why are telegraphs less important today? _____

Name two devices used for communication over great distances. _____

Activity 10
Flying Saucer

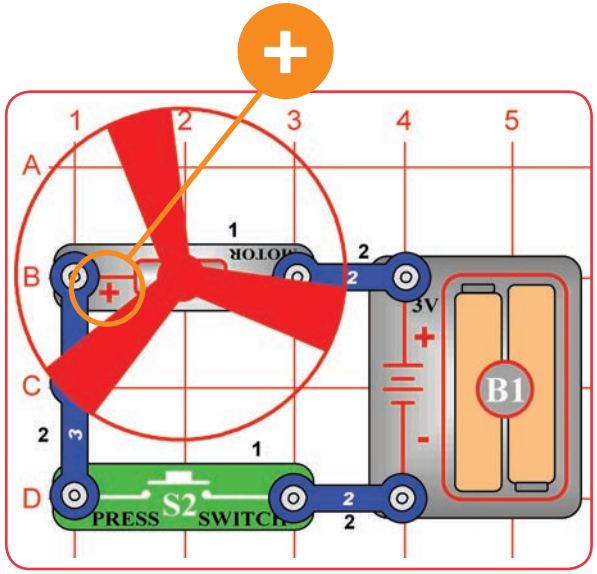
Build the circuit as shown. Place the motor (M1) with the "+" side on the left.

Close the slide switch. Allow the motor to run until it reaches maximum speed, then open the slide switch to turn off the current. Be careful not to look directly down on the fan when it is spinning.

What happens? _____

Why do you think this happened? _____

_____



Note that the polarity of the motor is reversed. The positive terminal of the battery is connected to the negative terminal of the motor.

Materials List

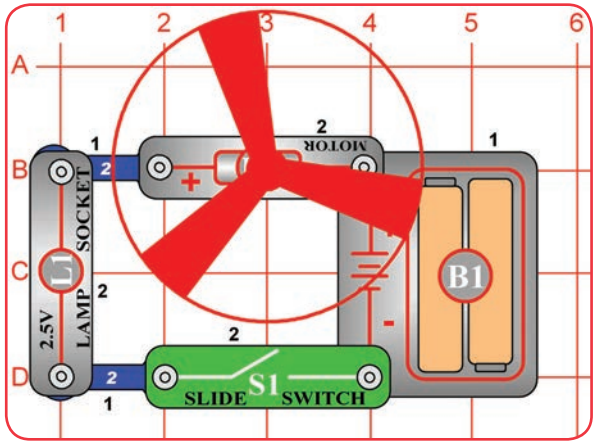
2 2-Snap Wires
1 3-Snap Wire
1 Battery Holder (B1)
1 Motor (M1) and Fan Blade
1 Press Switch (S2)

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

WARNING: Do not lean over the motor.

Activity 11
Decreasing Lift

Build the circuit and slide the switch (S1) to on. Compare this circuit to activity 10.



Materials List

2 2-Snap Wires
1 Battery Holder (B1)
1 Lamp (L1)
1 Motor (M1) and Fan Blade
1 Slide Switch (S1)

What does the lamp do to the motor in the circuit? _____

When the motor has reached maximum speed, slide the switch off. What happens? _____

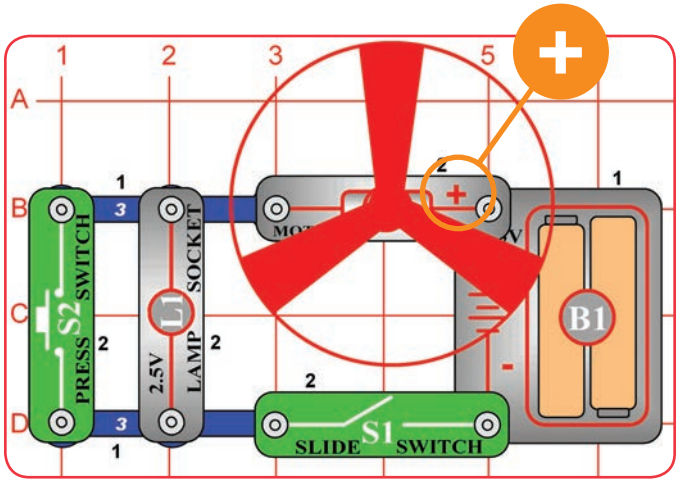
_____

Is this a series circuit or parallel circuit? _____

Activity 12
Two-Speed Fan

Materials List

2 3-Snap Wires
1 Battery Holder (B1)
1 Lamp (L1)
1 Motor (M1) and Fan Blade
1 Slide Switch (S1)
1 Press Switch (S2)



Build the circuit shown on the left. Place the motor (M1) with the "+" side as shown.

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

WARNING: Do not lean over the motor.

What is the path of the current through this circuit when only the slide switch is closed? _____

_____

What happens when you close the press switch? _____

Is this a series or parallel circuit? _____

What is the purpose of the lamp in this circuit? _____

_____

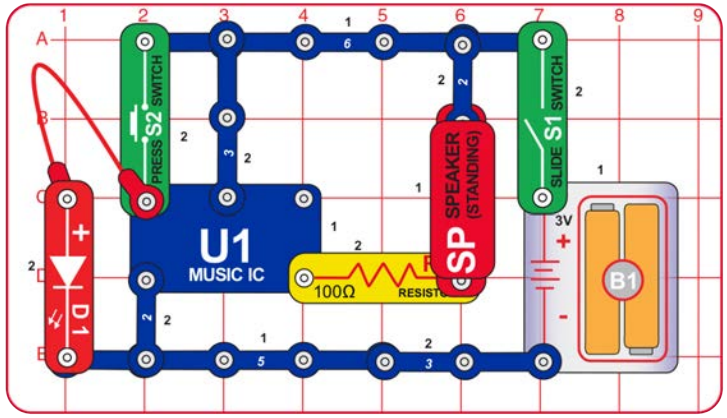
If you have a multiple speed fan at home, how can you increase or decrease the speed? _____

_____

Activity 13
Musical Doorbell

Materials List

2 2-Snap Wires
2 3-Snap Wire
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 100 Ohm Resistor (R1)
1 LED (D1)
1 Slide Switch (S1)
1 Press Switch (S2)
1 Speaker (SP)
1 Music Integrated Circuit (U1)
1 Red Jumper Wire



Build the circuit as shown.

Use the circuit diagram symbols to draw the circuit here.

When you close the slide switch, what happens? _____

To simulate a doorbell, push the button on the press switch.

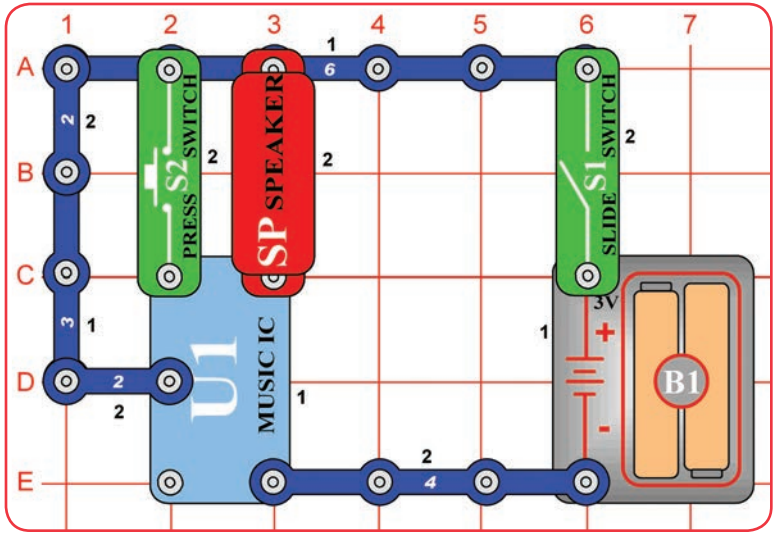
Do you need to hold the button down to keep the music playing? _____

What kinds of toys do you think could have integrated sound circuits? _____

Activity 14
Musical Alarm

Materials List

2 2-Snap Wires
1 3-Snap Wire
1 4-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 Slide Switch (S1)
1 Press Switch (S2)
1 Speaker (SP)
1 Music Integrated Circuit (U1)



Build the circuit as shown.

When you close the slide switch, the music integrated circuit should play one song and then stop.

Is this louder or softer than the music in activity 13? _____ Why? _____

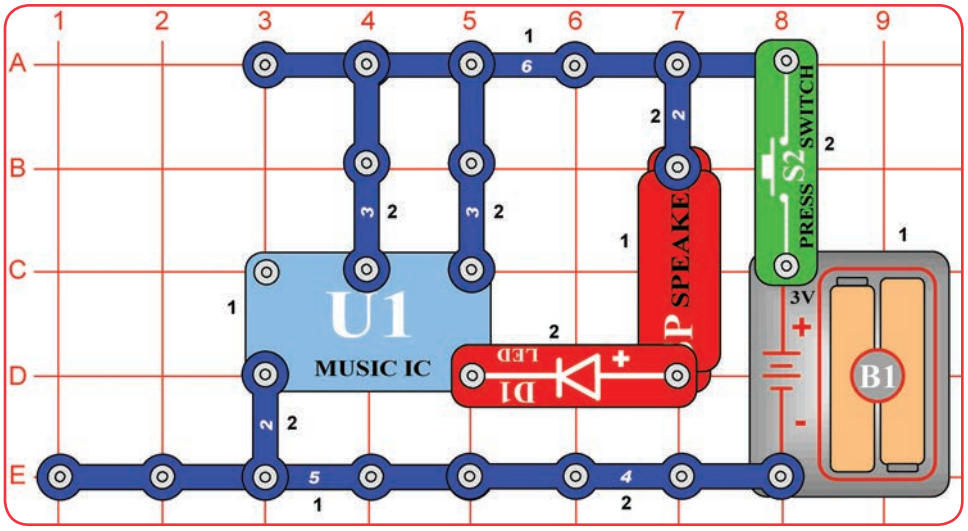
How are the circuits in activity 13 and 14 different? _____

What happens when you hold the press switch down? _____

What happens when you release the press switch? _____

What can you do to keep the song playing? _____

Activity 15
Happy Birthday with Light



Materials List

2 2-Snap Wires
2 3-Snap Wires
1 4-Snap Wire
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 Press Switch (S2)
1 Speaker (SP)
1 Music Integrated Circuit (U1)

Build the circuit as shown.

Use the circuit diagram symbols to draw the circuit here. →

What happens when you push the press switch? _____

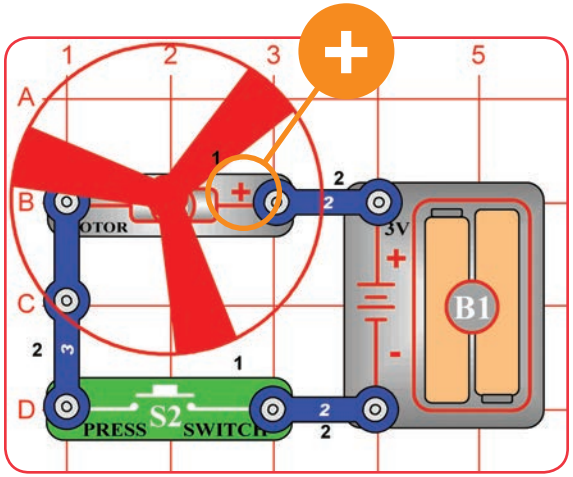
How can you change the length of time the Song & LED stay on? _____

Are the LED and Speaker connected in series or in parallel? _____

Activity 16
Spinning Rings

Materials List

2 2-Snap Wires
1 3-Snap Wire
1 Battery Holder (B1)
1 Motor (M1) with Fan Blade
1 Press Switch (S2)
1 Printed disc cutout



Build the circuit as shown. Place the motor (M1) with the "+" side on the right.

Cut out the disc.

Using Scotch tape, attach the disc to the fan blade with the printed side up.

Place the fan blade and disc on the motor.

Describe what you see when the press switch is pushed.

_____

Is this a series or parallel circuit? _____

Cut this out from page 46

Activity 17
Strobe the House Lights

Use the circuit from activity 16. Place the circuit under a normal house light.
Start the disc spinning and release the press switch.
What do you notice happening with the disc? _____

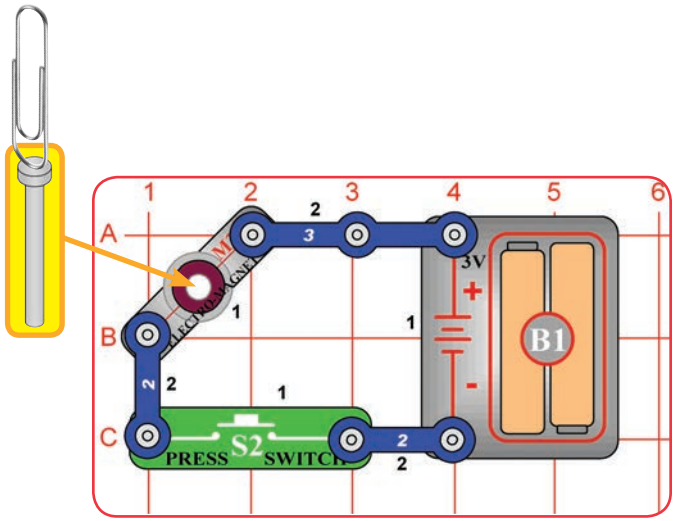
Now, turn off the lights and shine a flashlight on the spinning disc. Release the press switch. How does the disc look under flashlight light?

_____

Normal house lights blink at a rate of 30 times a second. How is this different from the flashlight? _____

_____

Activity 18
The Electromagnet



Materials List

2 2-Snap Wires
1 3-Snap Wire
1 Battery Holder (B1)
1 Electromagnet (M3)
1 Iron Core Rod
1 Press Switch (S2)
1 Paperclip (uncoated)

Build the circuit as shown, and place the iron core rod in the electromagnet (M3). Push the switch (S2) and touch the paper clip to the iron core rod in the electromagnet. Let go off the paper clip so only the magnet holds the paper clip in place. Release the switch (S2) to stop the flow of current.

What happens to the paper clip when the current is turned off? _____

How is an electromagnet like a permanent magnet? _____

How is an electromagnet different than a permanent magnet? _____

_____

How are electromagnets used in real life? _____

_____

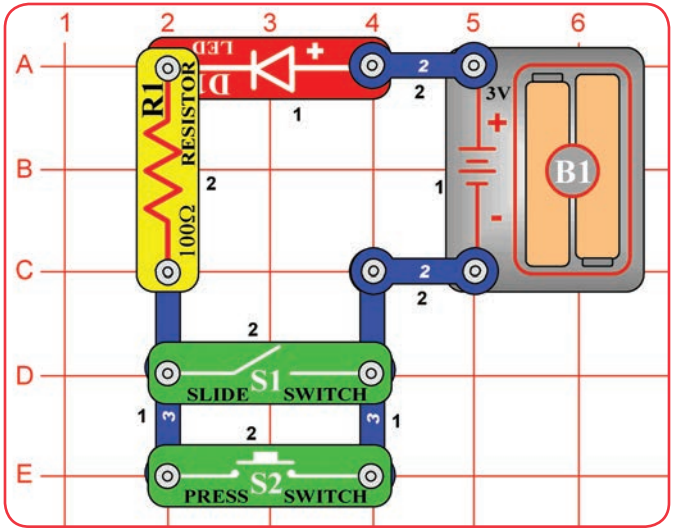
Current flowing in a wire creates a magnetic field around the wire. The field is increased when the wire is made into a coil. If a piece of iron, such as a nail or rod, is inserted into the coil it makes the magnetic field stronger.

Optional activities related to computers and electronic logic.

Activity 19
This OR That OR Both

Materials List

2 2-Snap Wires
2 3-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 100 Ohm Resistor (R1)
1 Slide Switch (S1)
1 Press Switch (S2)



Build the circuit shown on the left.

What are the three positions of the switches that make the LED light up?

Think of all the possible switch positions.

TRUTH TABLE

S1	S2	D1
OFF	OFF	
ON	OFF	
OFF	ON	
ON	ON	

Use the table on the right to determine what happens for each combination. Enter under the heading “D1” the words “ON” or “OFF” for each switch Position shown on the left. This table is called a “Truth Table”.

What do you think the name of a circuit with the same truth table would be called?

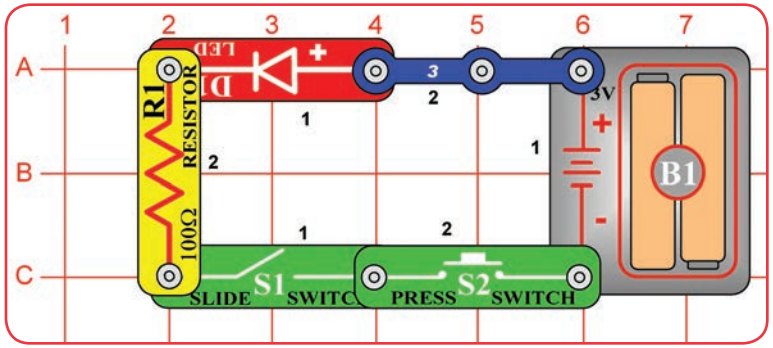
_____ AND Gate _____ OR Gate _____ NOT Circuit _____ IF Gate

This logic is no good for a two way light switch because once one switch is closed the other has no affect on the light. Where would this type of logic be useful in the home? Think about home protection from people that might want to break into your house.

Activity 20
This AND That

Materials List

1 3-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 100 Ohm Resistor (R1)
1 Slide Switch (S1)
1 Press Switch (S2)

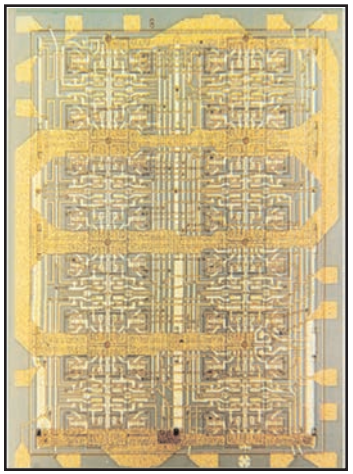


S1	S2	D1
OFF	OFF	
ON	OFF	
OFF	ON	
ON	ON	

Build the circuit as shown. What do you have to do to make the LED light up? Use the Truth Table to help you with your answer. _____

Is this a series or parallel circuit? _____

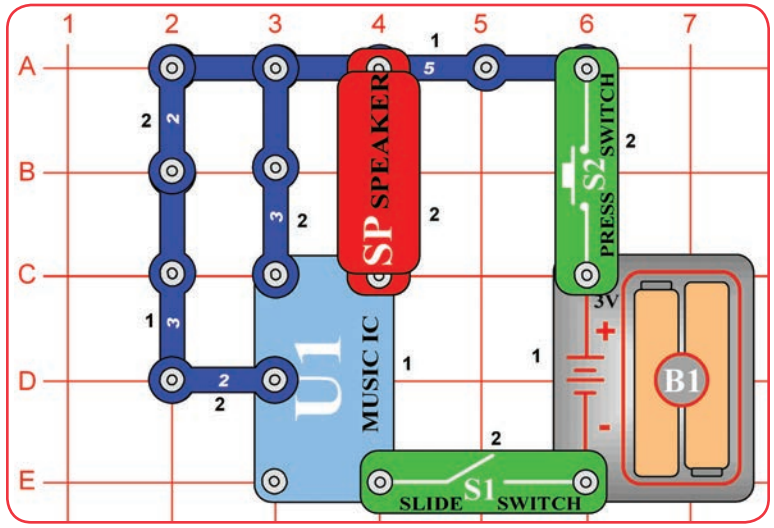
Combinations of Logic Circuits and electronic switches are used to add and multiply numbers together in modern computers. The computer circuits are made of tiny transistors in massive integrated circuits. The integrated circuit shown below has been enlarged many times to show you the circuits. It's actual size is smaller than the head of a pin.



Activity 21
Music AND Gate

Materials List

2 2-Snap Wires
2 3-Snap Wires
1 5-Snap Wire
1 Battery Holder (B1)
1 Slide Switch (S1)
1 Press Switch (S2)
1 Speaker (SP)
1 Music Integrated Circuit (U1)



Build the circuit as shown. What do you need to do to turn on the music? _____

_____

This concept is important in computer logic. If condition X AND condition Y are true, then execute instruction Z.

Let condition X = S1 is ON
Let condition Y = S2 is ON
Let instruction Z = Play Music

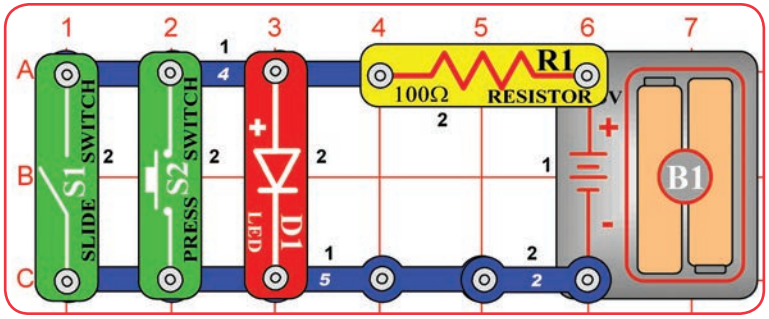
TRUTH TABLE →

S1	S2	SP
OFF	OFF	
ON	OFF	
OFF	ON	
ON	ON	

Activity 22
Neither This NOR That

Materials List

1 2-Snap Wires
1 4-Snap Wire
1 5-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 100 Ohm Resistor (R1)
1 Slide Switch (S1)
1 Press Switch (S2)



Build the circuit as shown.

Test the combinations of the slide switch and press switch.

Fill in,

TRUTH TABLE

S1	S2	D1
OFF	OFF	
ON	OFF	
OFF	ON	
ON	ON	

Which combination makes the LED go on? _____

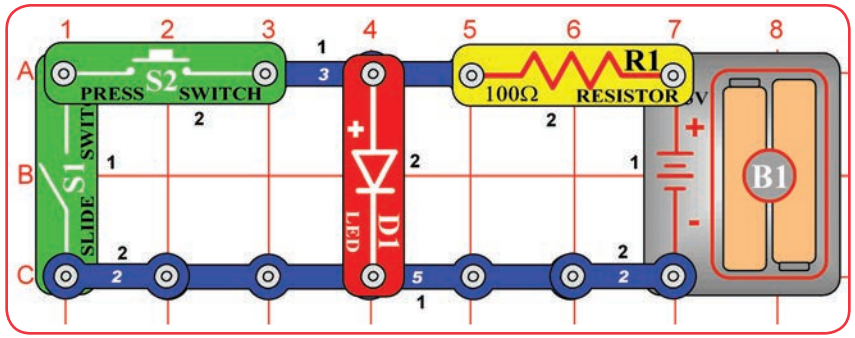
This is called a NOR circuit, which is short for NOT this OR that. Like the OR and AND, it is an important building block in computers.Compare the TRUTH TABLES for the OR and the NOR. What do you notice about the D1 Column?

_____

Activity 23
NOT This AND That

Materials List

2 2-Snap Wires
1 3-Snap Wire
1 5-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 100 Ohm Resistor (R1)
1 Slide Switch (S1)
1 Press Switch (S2)



Build the circuit as shown.

Test the combinations of the slide switch and press switch.

Fill in,

TRUTH TABLE

S1	S2	D1
OFF	OFF	
ON	OFF	
OFF	ON	
ON	ON	

Compare your observations with the AND circuit in activity 22. _____

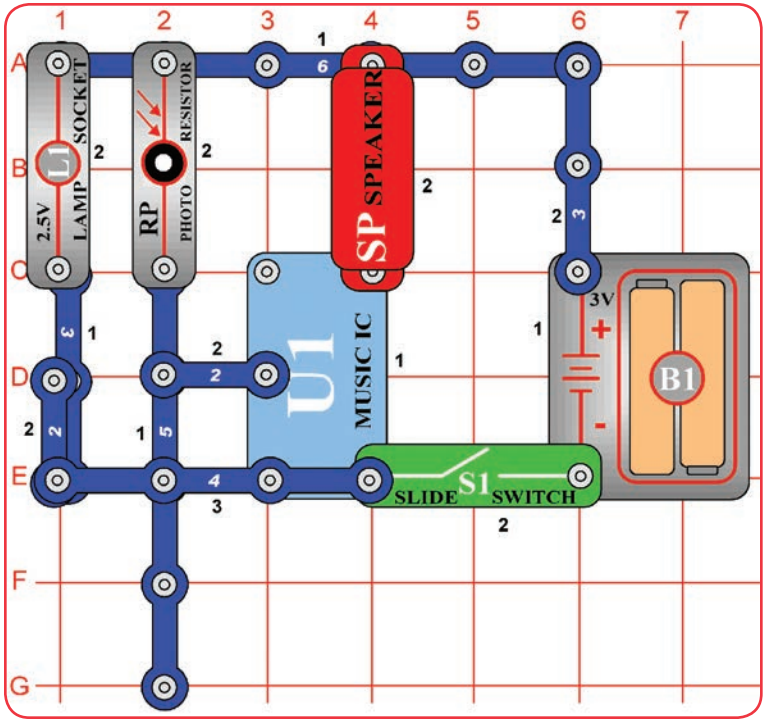
NAND stands for NOT this AND that. This is another important building block in computers.

Optional extension activities.

Activity 24
Reflection Detector

Materials List

2	2-Snap Wires	1	Lamp Socket (L1) with Bulb
2	3-Snap Wires	1	Photoresistor (RP)
1	4-Snap Wire	1	Slide Switch (S1)
1	5-Snap Wire	1	Speaker (SP)
1	6-Snap Wire	1	Music Integrated Circuit (U1)
1	Battery Holder (B1)	1	Small mirror



Build the circuit as shown. Place it where there will be no room light hitting the photoresistor (RP), such as under a piece of paper, or under the table. Turn on the switch.

What happened? _____

Take a small mirror and hold it over the lamp and photoresistor (RP). Try and reflect the light from the bulb into the top RP hole.

What happened? _____

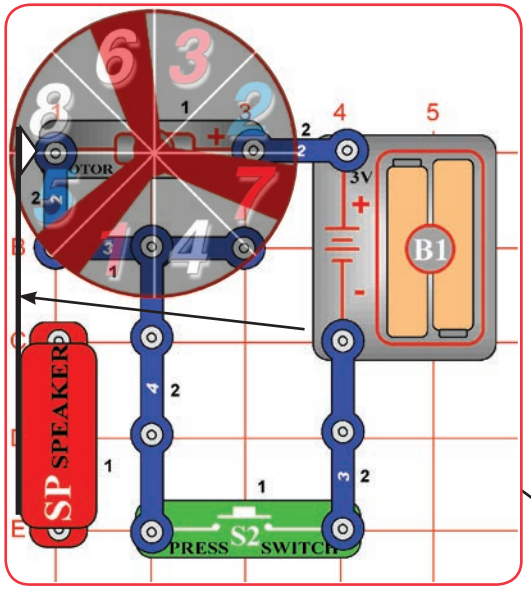
You have made a reflection detector.
What happens as more light is reflected onto the photoresistor? _____

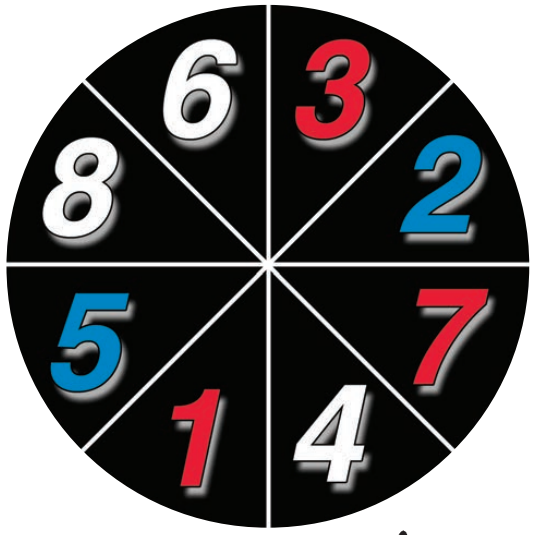
Use a white card or piece of paper to reflect light instead of the mirror. What do you think will happen?

_____

Try the card as a reflector. What happened? _____

Activity 25
Math Game





Cut these out from page 46

POINTER

Materials List

2 2-Snap Wires
2 3-Snap Wire
1 4-Snap Wire
1 Battery Holder (B1)
1 Motor (M1) and Fan Blade
1 Press Switch (S2)
1 Speaker (SP)
1 Math disc cutout
1 Paper pointer cutout

Build the circuit as shown. Place the motor (M1) with the "+" side on the right.

Cut the math disc and paper pointer from page 46.
Attach the math disc to the fan blade.
Bend and attach the pointer to the speaker so it sticks up over the math disc as shown above.

Each player uses a pencil and paper to keep score on a sheet of paper or note pad. Start with all of the players at zero score.

Each player gets a turn to press the switch, which will cause the disc to spin. Release the press switch. When the disc stops turning the paper pointer will be pointing to a wedge with a number on it. In each game below first player to reach or exceed 100 wins.

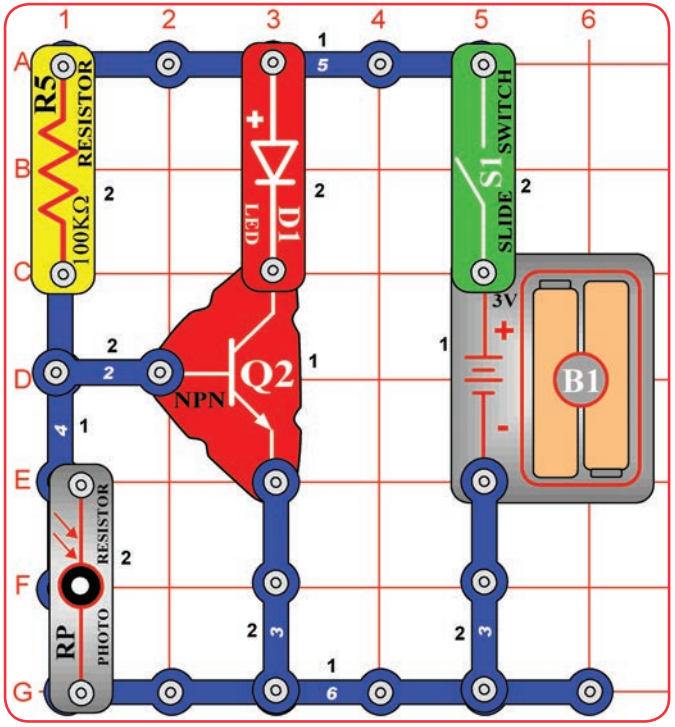
SIMPLE MATH: Add number to your score and the turn moves to the next player.
EASY MATH: Add white and blue numbers to your score but subtract red numbers from your score. Turn ends
MIDDLE MATH: Add white, subtract red, multiply score by blue. Turn ends.
ADVANCED MATH: Add white, multiply by red, divide score by blue. Only keep two decimal places.

If the pointer is pointing to a line instead of a wedge of color, add 9 to your score and spin again.

Activity 26
LED Night Light

Materials List

1 2-Snap Wire
2 3-Snap Wires
1 4-Snap Wire
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 NPN Transistor (Q2)
1 100K Ohm Resistor (R5)
1 Photoresistor (RP)
1 Slide Switch (S1)



Build the circuit as shown. Cover the RP Photo Resistor with a piece of paper. Turn the switch on. What happened?

_____

Remove the paper over RP and place the unit in the light. What happens?

_____

Place the circuit in a dark room. What happens? _____

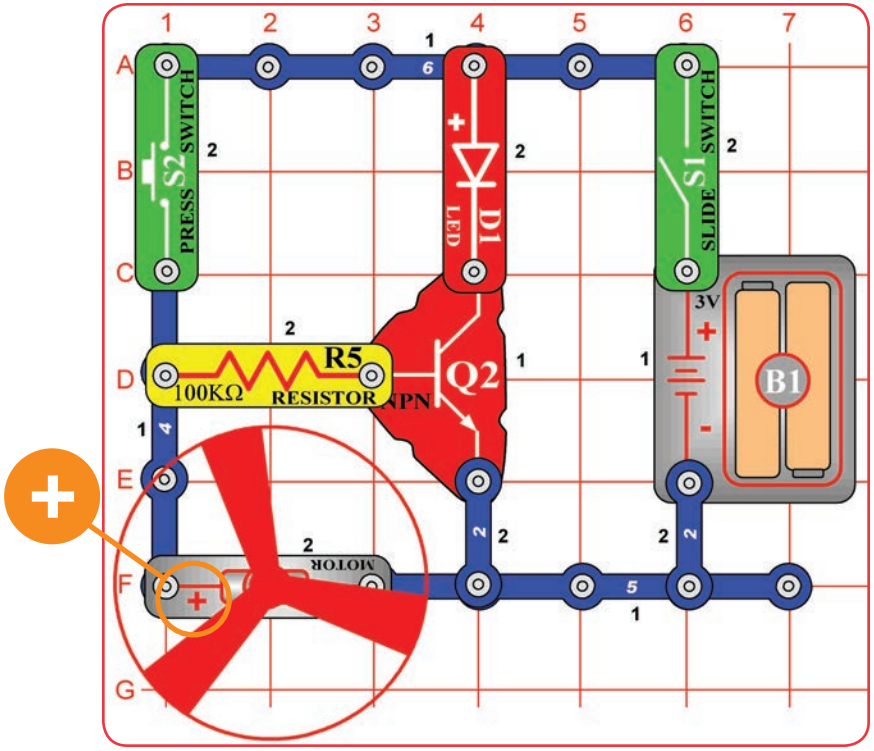
Turn on the room light. What Happens? _____

Is this circuit similar to an automatic night light? _____

Activity 27
Motor Running LED

Materials List

2 2-Snap Wires
1 4-Snap Wire
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 NPN Transistor (Q2)
1 100K Ohm Resistor (R5)
1 Motor (M1) and Fan Blade
1 Slide Switch (S1)
1 Press Switch (S2)



Build the circuit as shown. Place the motor (M1) with the "+" side to the left.

Turn the S1 slide switch on.
Is the LED on? _____ Is the motor running? _____

Push the S2 Push Button Switch.
Is the LED on? _____ Is the motor running? _____

Remove the motor and repeat the experiment. Does the LED act differently? Explain _____

_____

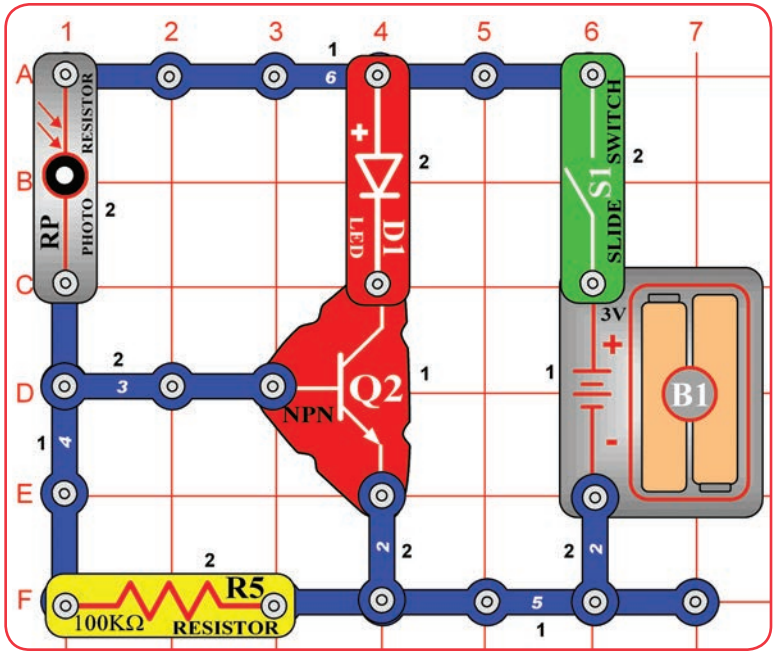
WARNING: Moving parts. Do not touch the fan or motor during operation.

WARNING: Do not lean over the motor.

Activity 28
Light Activator

Materials List

2 2-Snap Wires
1 4-Snap Wire
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 NPN Transistor (Q2)
1 100K Ohm Resistor (R5)
1 Slide Switch (S1)



Build the circuit as shown.

Use the symbols to draw the circuit here.

Turn on the switch (S1). Does the LED (D1) glow? _____

Adjust the light on the photoresistor (RP) by covering with your hand. What happens?

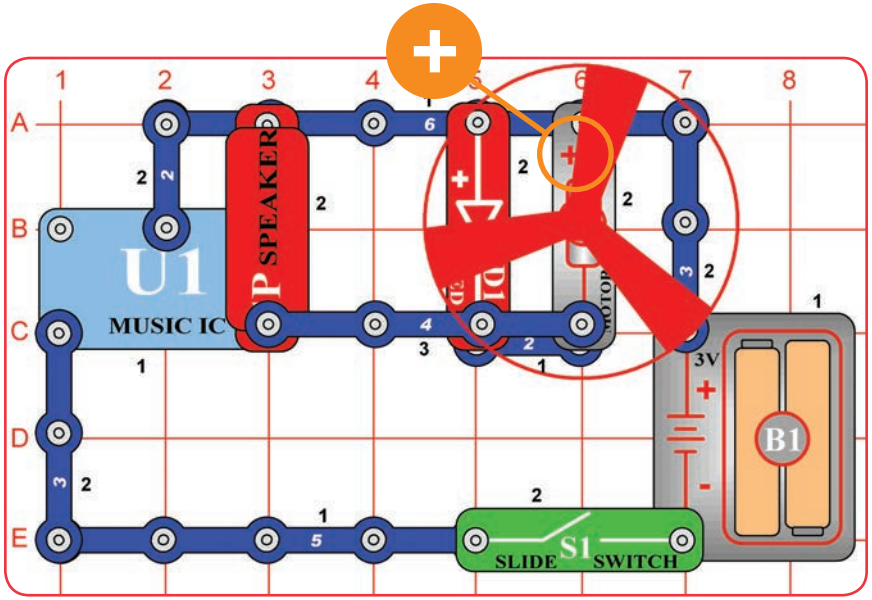
_____

Activity 29
Sounds, Light, and Motion

Materials List

2 2-Snap Wires
2 3-Snap Wires
1 4-Snap Wire
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 LED (D1)
1 Motor (M1) with Fan Blade
1 Slide Switch (S1)
1 Speaker (SP)
1 Music Integrated Circuit (U1)

Build the circuit as shown, with the "+" side of the motor (M1) on top. Turn on the slide switch. What happens?



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

WARNING: Do not lean over the motor.

_____

When the sound stops, what happens? _____

Are the sound, light, and motion circuits connected in series or parallel? _____

What happens when you remove the 4 snap wire on level 3 and why? _____

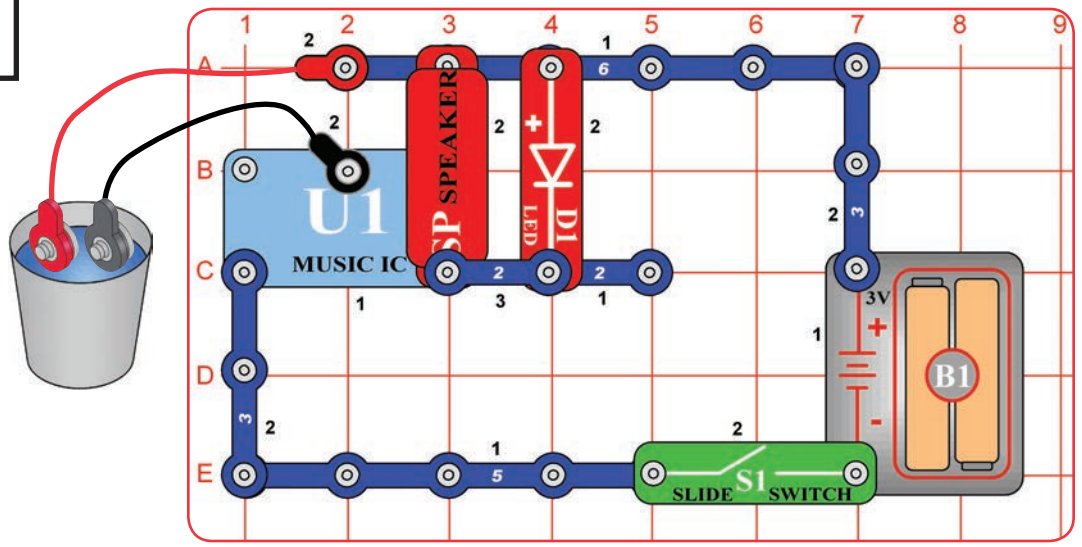
Explain what you think are the functions of the various components in this circuit. _____

_____

_____

_____

Activity 30
Simple Water Alarm



Materials List

2 2-Snap Wires
2 3-Snap Wires
1 5-Snap Wire
1 6-Snap Wire
1 Battery Holder (B1)
1 Slide Switch (S1)
1 Speaker (SP)
1 Music Integrated Circuit (U1)
1 Black Jumper Wire
1 Red Jumper Wire
1 Small cup of water
1 Teaspoon of table salt

Build the circuit as shown, but leave the jumper wires out of the cup of water. Turn on the switch. What happens?

_____

Place the ends of the jumper wires in the cup of water. Now what happens? _____

If the alarm did not sound, add 1 teaspoon of table salt to the water. Place the ends of the jumper wires in the salt water. What happens?

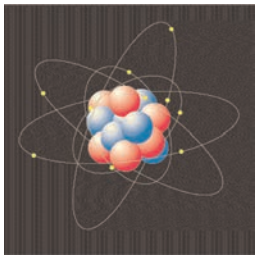
_____

Try holding the ends of the jumper wires with your fingers. Does your body set off the alarm? _____

Are you a conductor or insulator for this circuit that uses only 3 volts? _____

Vocabulary

For Snap Circuits® Home Learning



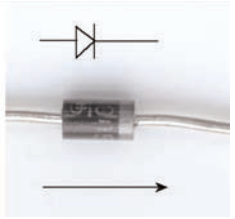
Atoms - the building blocks of matter. Atoms are composed of smaller particles, neutrons with no charge, protons with a positive charge, and electrons with a negative charge. The neutrons and protons make up the nucleus of the atom and the electrons zip around the nucleus.

Circuit - a series of wires or electric devices that form a closed path for the flow of electricity. You are not able to see current moving through a circuit, but you can see the effects when a bulb lights or a motor spins. A circuit needs a source of electric energy traveling through it to operate electric devices.

Computer - an electronic device that stores, processes, and receives information in the form of ones and zeroes.

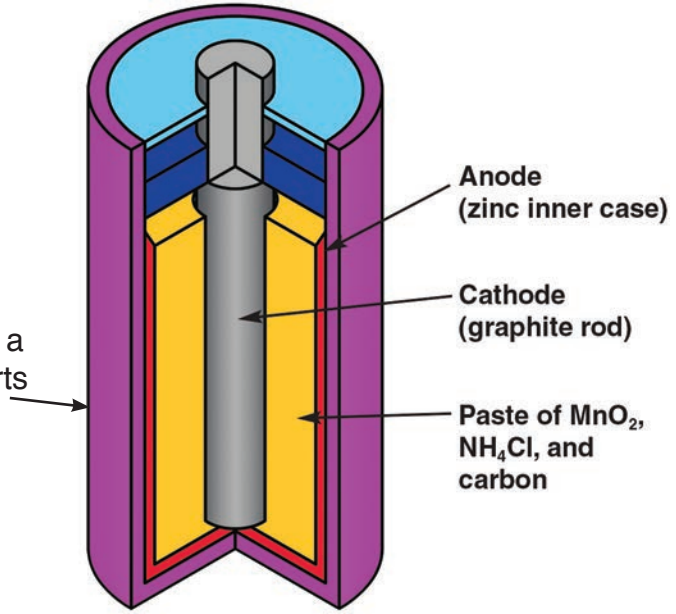
Conductors - materials such as metals with loosely held electrons in their atoms. The electrons are able to move from atom to atom fairly easily. The flow of electrons through a conductor is called electric current. All metals are conductors. Some non-metals such as graphite (a form of carbon) are also conductors.

Current - a measure of how fast electrical energy is flowing through a circuit.



Diode - a device which allows electric current to flow in only one direction.

Dry cell - electrochemical cell usually made with a zinc can, a carbon rod, and a chemical paste. A cell has a positive and negative terminal. The dry cell converts chemical energy into electrical energy. If the terminals are connected to a wire, direct current will flow until the chemicals are used up and the dry cell is dead. Most people refer to dry cells as batteries.

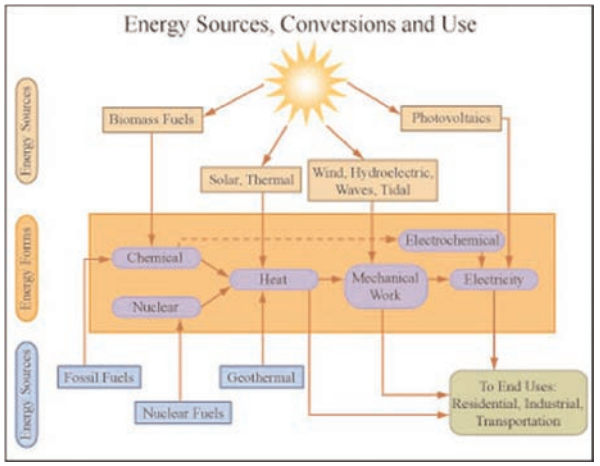


Electricity - moving electrons produce electric current. Electricity and magnetism are closely related. Electricity can be produced by a moving magnet. Electricity moving through a wire creates a magnetic field around the wire. Electric current can be direct (DC) or alternating (AC). Batteries produce direct current. The electricity in your house is alternating current.

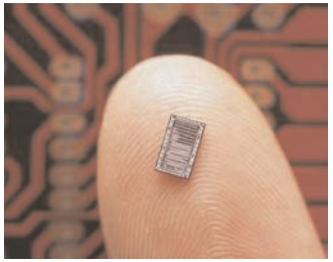
Electromagnet - a large coil of wire, which acts like a magnet when a current flows through it. Placing an iron bar inside increases the magnetic effects.

Electronics - the use of electrons to control, communicate or process information. An electronic signal is a varying electric current. The parts in electronic circuits change the flow of electricity. Some slow the flow down, others speed up the flow.

Energy - Energy can change from one form to another. Electrical energy can be changed to mechanical energy, energy of movement, when current is run through a motor. It can be changed to heat and light when current runs through a lamp.

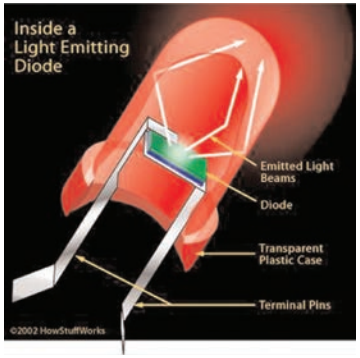


Insulators - materials which do not allow electric current to flow through them under normal conditions. Examples are glass, rubber, and plastic.



Integrated circuit - a circuit that has been made on a small semiconductor chip (silicon). It has many diodes, transistors and resistors which are very tiny. In this kit you have a blue music integrated circuit U1.

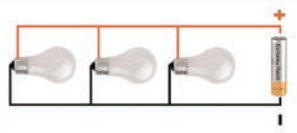
Lamp- In your kit a lamp is a small light bulb which screws into the lamp socket. The lamp has a filament of wire inside which glows when an electric current flows through it.



LED - Light Emitting Diode. A diode allows electricity to flow in only one direction, and only if the voltage exceeds a turn-on threshold. LEDs have a semiconductor inside, a material which only allows some electricity to flow. LEDs only need a small amount of electricity to light up so they are put in a circuit with a transistor. Many electronic devices use LEDs as indicator lights. They are often seen on CD players, televisions, and radios.

Motor - a device which converts 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 three coils of wire with many loops. If a large electric current flows through the loops the magnetic effects become concentrated enough to move the coils. The motor has a magnet on a shaft so, as the electricity moves coils to align them with the permanent magnet, the shaft spins.

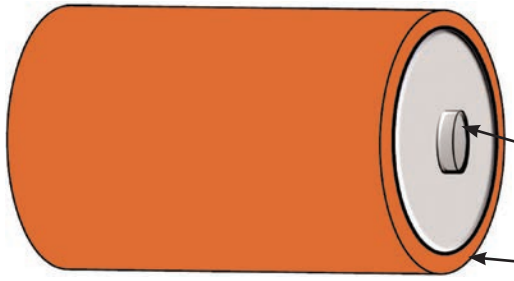
Parallel circuit - a circuit with a number of separate paths for electricity to flow through.



Resistance - anything that opposes the flow of electricity in a circuit. The wires in a circuit provide some resistance, as do lamps, motors, speakers, LEDs, transistors, and integrated circuits. It is expressed in ohms.

Semiconductor - a material, usually silicon, which only lets some electrons flow through it.

Series circuit - a circuit with only one path for electricity to flow through. All of the parts in a series circuit are connected one after the other. The light bulbs in a series circuit become dim as more lights are added. When resistance increases, current decreases.



Terminals - the point where connections are made to an electrical device. For example, a dry cell has two terminals. One is positive and the other is negative.

Transistor - a device which either amplifies an electronic signal, or switches current on and off. Transistors found in computers and most electronic devices act as switches. One computer chip can hold millions of transistors.

Voltage - a measure of how strong an electric charge between materials is. It can be thought of as the electrical pressure pushing electric current through a circuit. It is expressed in volts.

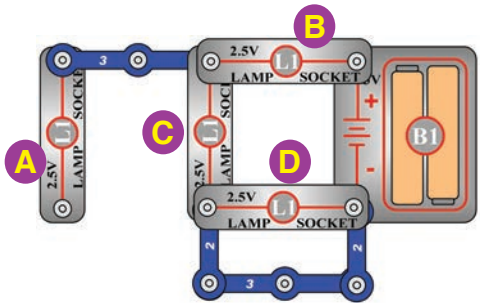
End of Unit Test for Snap Circuits® Home Learning

Name_____ Date_____

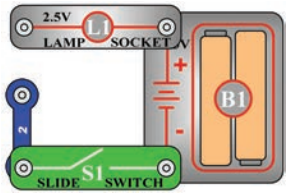
Answers are at www.elenco.com/product/snap-circuits-home-learning/

1. Look at the four circuit diagrams.

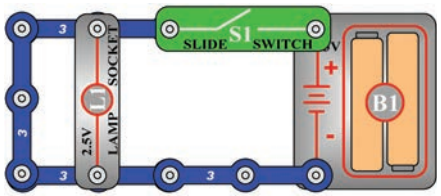
A. Which bulbs will light up?



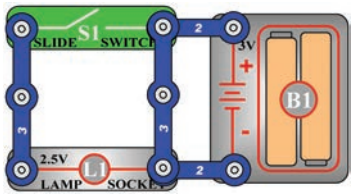
B. What could you do to repair this circuit?



C. What could you do to repair this circuit?



D. What could you do to repair this circuit?



2. What is a circuit?

3. What does a switch do in a circuit?

4. What is the function of the battery in a circuit?

5. In a series circuit with a motor and a lamp will the motor spin faster with or without the lamp?

6. Label each of the following items as a conductor or an insulator.

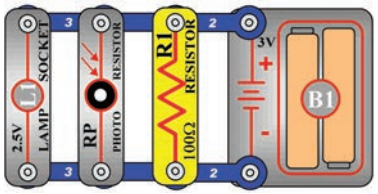
Material	Conductor or Insulator	Material	Conductor or Insulator
Steel nail		Pencil lead	
Brass fastener		Rubber eraser	
Piece of chalk		Cardboard strip	
Plastic straw		Wooden craft stick	
Penny coin		String	
Strip of aluminum foil		Coated paper clip	

7. What do all of the conductors have in common?

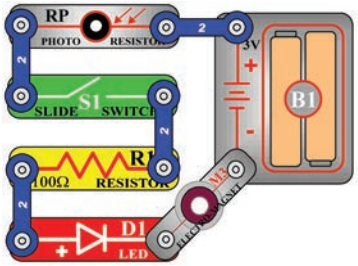
8. List two uses for insulators in everyday life.

9. Label the following four circuits as series or parallel.

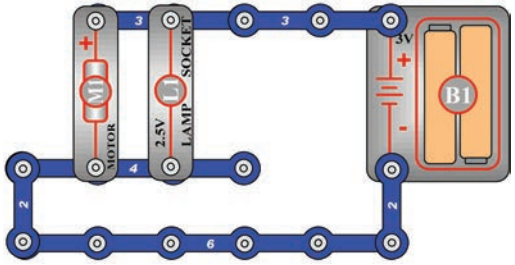
A.



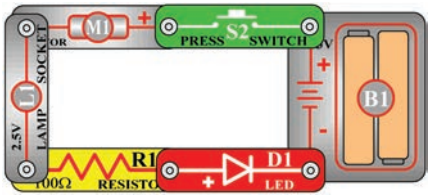
B.



C.



D.



10. If a lamp and a motor are in the same series circuit, how does the resistance of the motor affect the brightness of the lamp?

11. Draw a picture of a light operated Morse code sending circuit.

12. List 3 uses for electricity in your life.

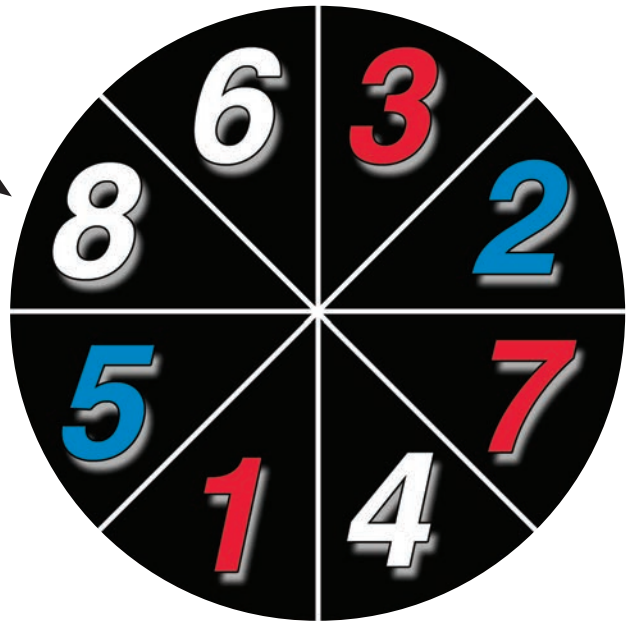
    a.

    b.

    c.

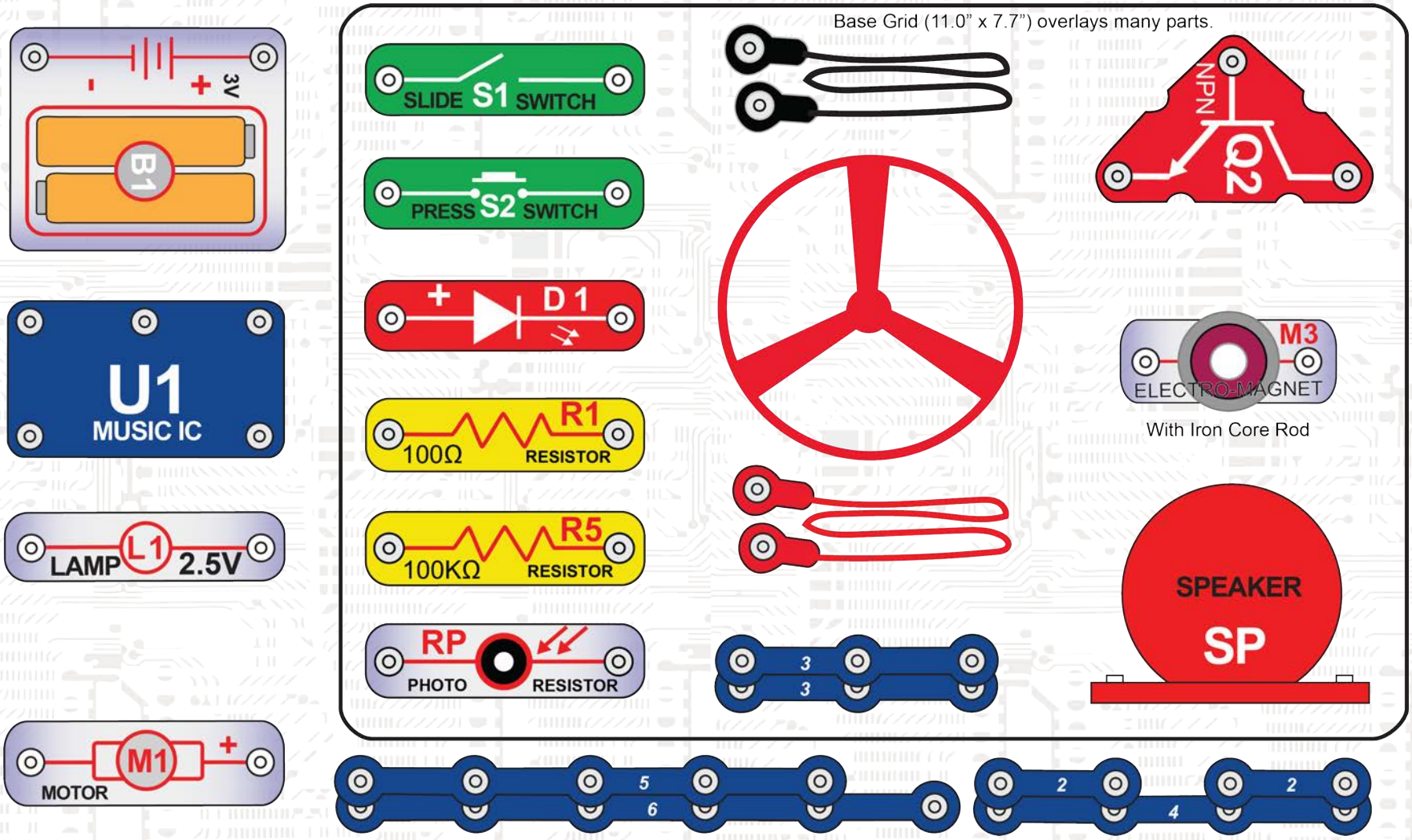
Page 22 for
Activity 16

Page 29 for
Activity 25



Snap Circuits® Home Learning Kit Parts Layout

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



Not responsible for typographical errors.

ELENCO®
Learn by doing.®

150 Carpenter Avenue
Wheeling, IL 60090
elenco.com

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