



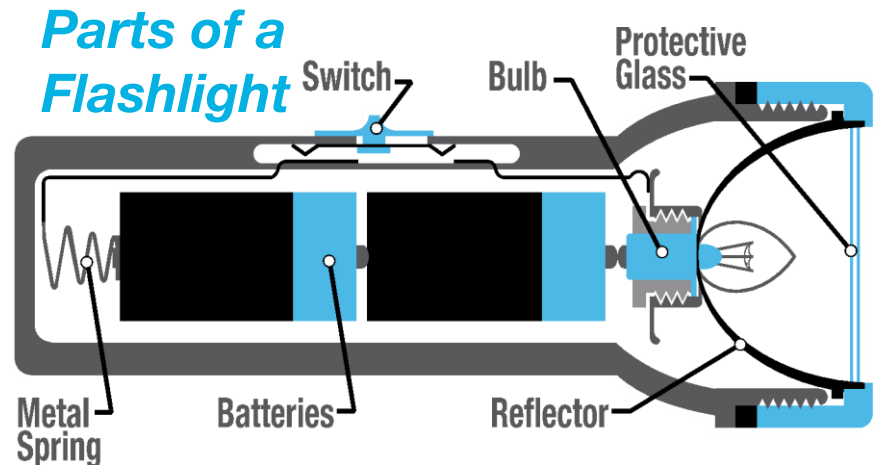
SNAP CIRCUITS[®] STEM Curriculum



Day 1: Electricity In Our Lives

In your work groups, brainstorm responses to the following questions:

- List 10-15 uses for electricity.
- How does electricity work?
- How does a flashlight work?
- What are its different parts and what do they do?



Still in your groups, and keeping in mind the flashlight, try to explain the following terms:

- **Circuit**
- **Voltage**
- **Current**
- **Resistance**
- **Load**

Day 2: Explaining a Circuit

The word **circuit** dates to the 14th century and means ‘to go around’. It consists of tiny particles, that make up everything, called **electrons**.

Electrons travel around in a loop.

- Essential parts of a circuit:
 - A **source** of electrons, (often called a **power source**)
 - A **path** for the electrons to go along
 - A **load** for the electrons to work on

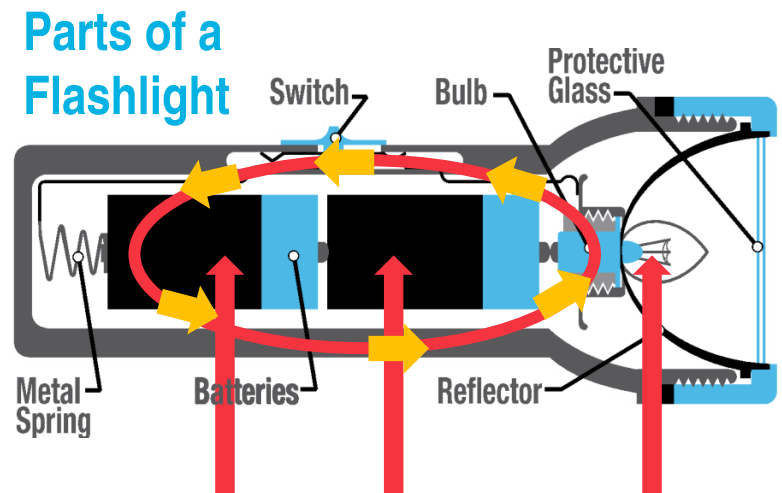


Your **SCAN** has available space for additional notes!



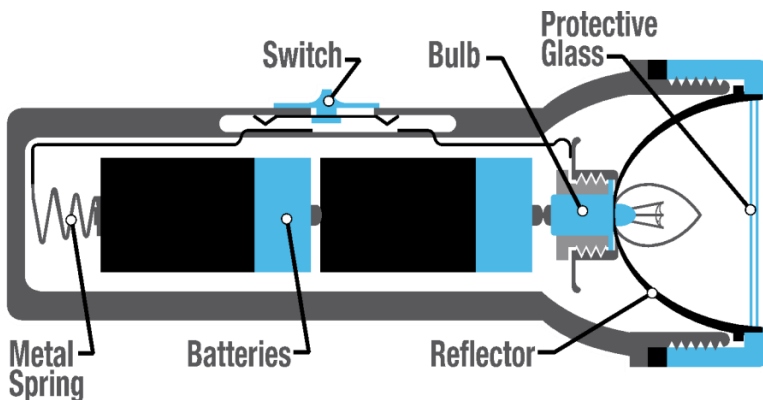
Look back at the flashlight to get ideas about how it works.

- What's your **source** of electrons?
 - *The batteries*
- Find a **path** for the electrons to go along:
 - *From the bottom metal spring → through the batteries → to the bulb → and back to the bottom of the batteries.*
- What is a **load** for the electrons to work on?
 - *The bulb*



Remember: a circuit must be a continuous path with no breaks; this is called a **closed circuit**. If there is a break, it is called an **open circuit**.

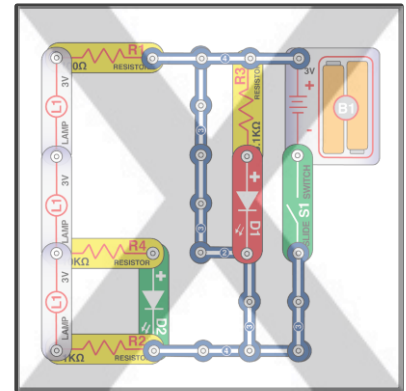
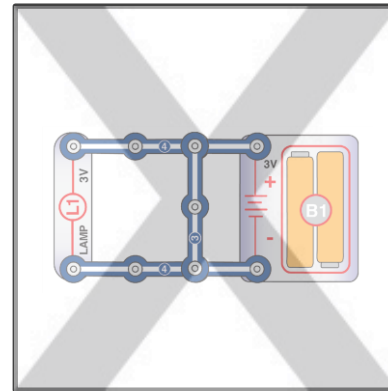
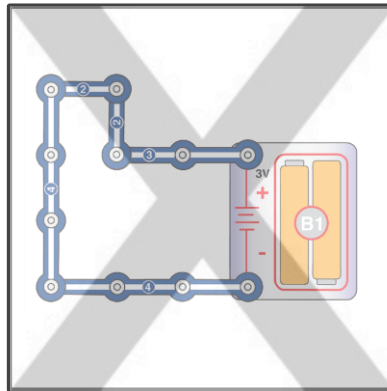
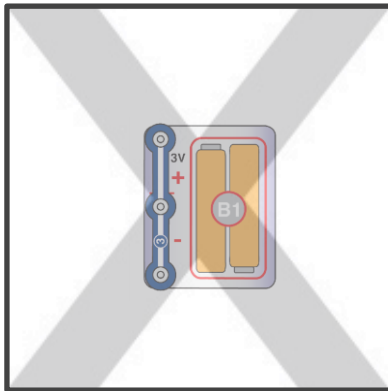
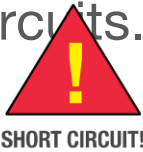
Parts of a Flashlight



- What does the switch do for our flashlight?
 - It turns the load on or off. Or in circuit terms, it opens or closes the circuit.

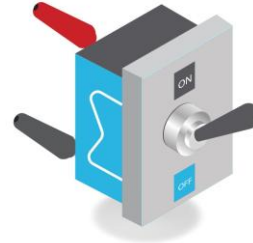
Warning: Short Circuits

What **NOT** to do with a circuit: never create a path for electrons without the path going through a load. If you do it is called a short circuit, which you **DON'T** want. This prevents the circuit from working and may damage and/or quickly drain your batteries. Below are some pictures of short circuits.

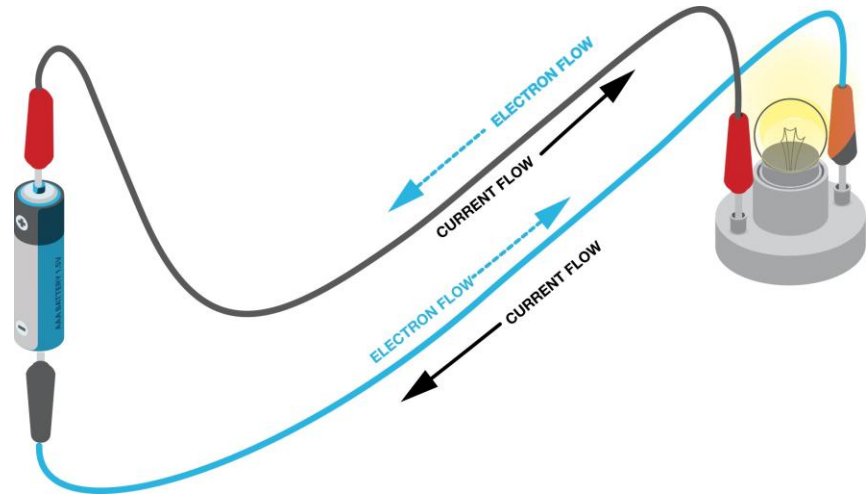


Let's put together a circuit

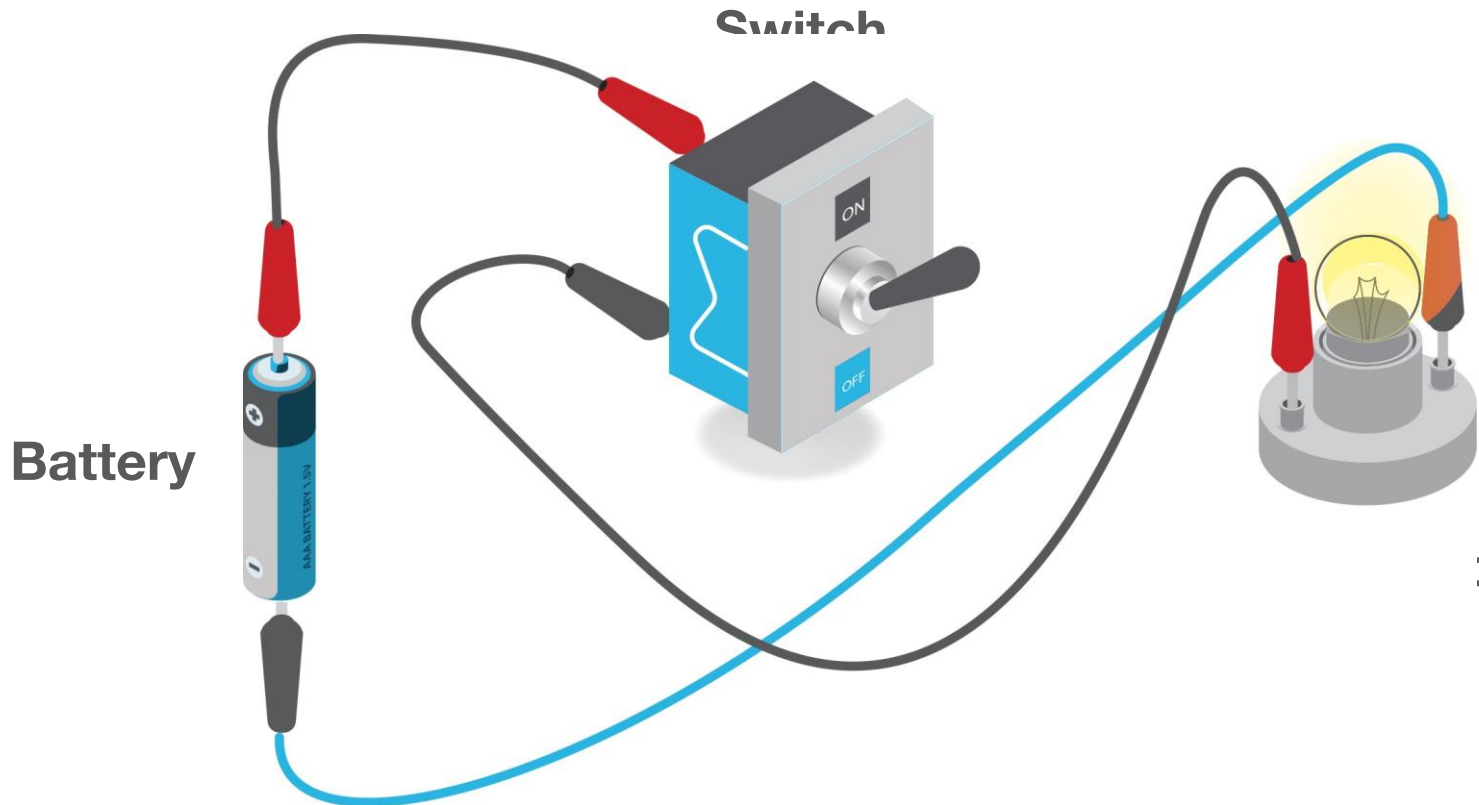
Given a battery and a light bulb, how would you connect these two devices together with the wire to turn on the light bulb?



Here's a simple answer:



Show how to connect the circuit parts, including the switch, by using wires in order to light the bulb.



Circuit Vocabulary

Voltage: This is considered the push of electrons and has units of volts. Think of voltage as electrical pressure. The more *volts* the more *push*.



The 9 volt battery, on the left, has more push than the 1.5 volt battery on the right.



Circuit Vocabulary

Current: How fast the electrons are flowing, with units of amps. This is easier to understand when related to something many of us have experienced: *water rides* at amusement parks.



The lazy river ride, on the left, has a much slower current than the rapids ride shown on the right.

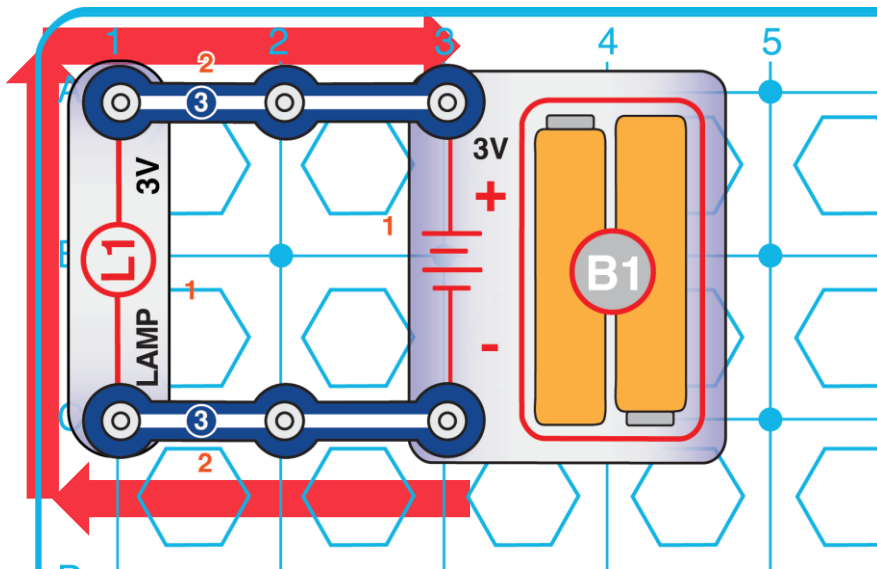
Circuit Vocabulary

Resistance: This means restricting or blocking the flow of electrons and has units of ohms. Whether it's dragging your feet on the lazy river ride or coming up against boulders on the rapids ride, you won't go as fast when there is resistance.



More resistance with the boulders.

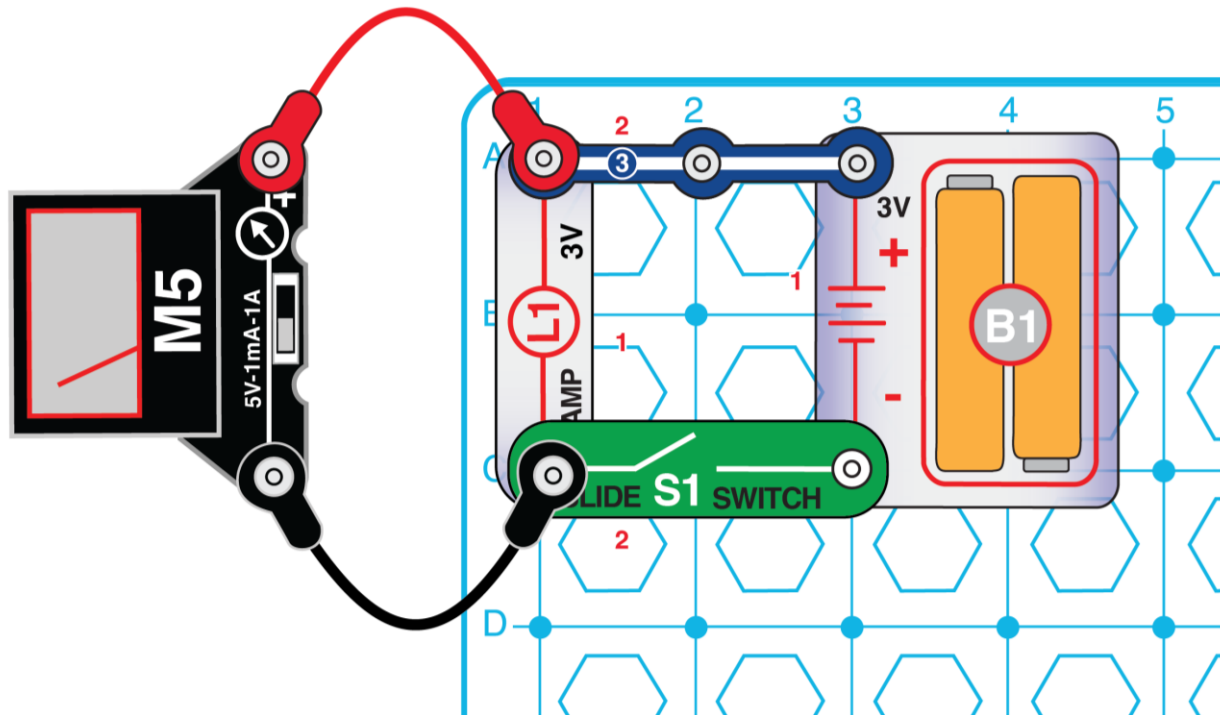
Day 3: Creating a Snap Circuits Flashlight



Create your own flashlight using Snap Circuit parts. The black numbers, **1** and **2**, next to the parts, indicate the placement order you should use when making the circuit.

Let's try to figure out the pathway through this circuit.

When you finish with the first flashlight then you are going to remove one of the #3 wires and replace it with a switch.



To be able to measure the voltage going through the lamp you are going to use a meter attached to lamp using jumper wires.

Day 3: Changing Loads

Follow the directions in your SCAN for this part of the day's activity, where you will be changing loads.



**WARNING: MOVING
PARTS –**

Do not touch the motor or fan

Day 4: Conductors and Insulators

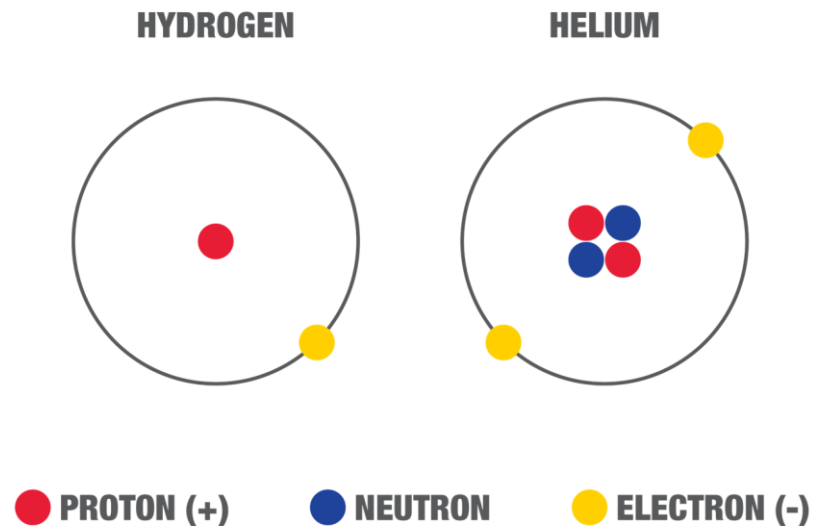
Everything is made up of **atoms**. Let's look at 2 atoms you've probably heard of: **hydrogen** and **helium**.

All atoms have locations for the parts that make them up, which are-

- **Nucleus:** that holds the protons and neutrons
- **Electron Cloud:** holds the electrons.

For there to be a circuit, it is these teeny, tiny electrons that must easily move from one atom to another.

When this movement happens, it means the material is a conductor.



Conductors



While all atoms have electrons, not all atoms have electrons that easily move from atom to a different atom.

- Materials that allow for this movement between atoms are called **conductors**. They are generally metals and have low resistance. Metals like **copper**, **gold**, and **silver** make excellent conductors.

Insulators

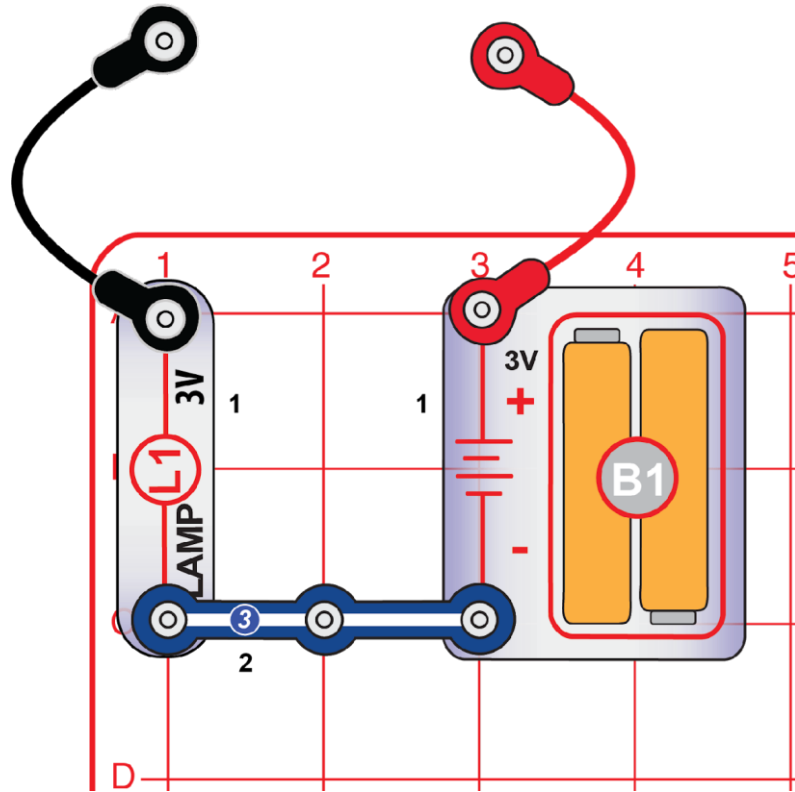


Materials that don't allow for this movement easily between atoms are called **insulators** and have high resistance.

- You can see the NON-METALS section of the periodic table; while these could technically be insulators, they are not generally used for practical reasons.
- Most insulators are made of rubber or plastic, each is a mix of elements and other materials.

Day 4: Conductors and Insulators . . .

- Create the circuit below and follow the directions in your SCAN to complete the table shown.



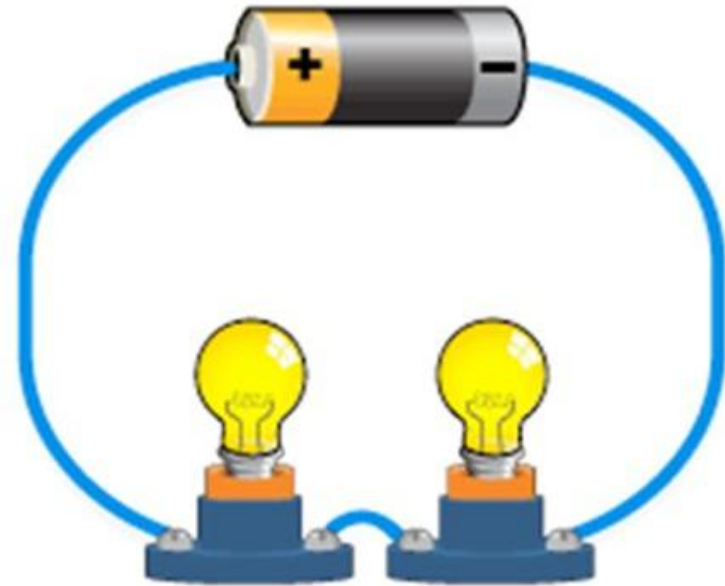
Materials (use Items you have)	Lamp ON or OFF	Conductor or Insulator?
Paper clip		
Metal spring		
Pen		
Coin		
Paper		
Shirt		

Day 5/6: Loads in Series

When loads are arranged in series the circuit loop only has one path.

The circuit path/loop goes from – side of the battery, through the light bulbs, to the + side of the battery. Two bulbs are shown here but other numbers are possible.

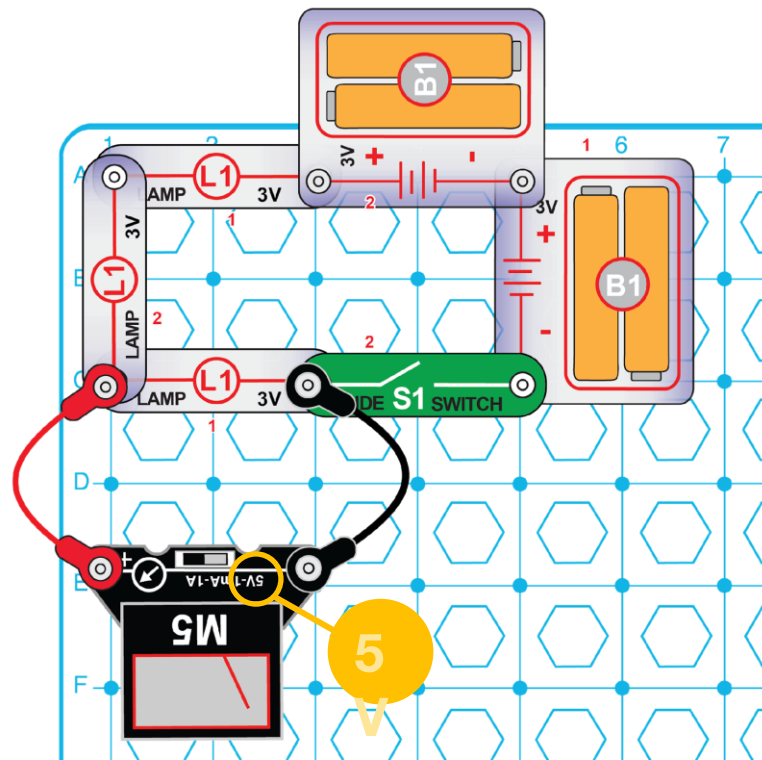
Follow directions in your **SCAN** to build several circuits with different numbers of loads. Try to find out how having loads in series might change the characteristics of the loads.



You can also have sources of electrons in series.

While you probably saw lower voltage to each bulb in series, for sources of electrons in series, like batteries, the impact is very different.

Putting sources in series results in adding together their voltages!



Many of us have ceiling fans at home. Many of these fans also have a light. With one flick of the wall switch, both the ceiling light and fan are turned on. What if you wanted the fan to work with or without the light?

- Can you design a circuit that can do that?



WARNING: MOVING PARTS –

Do not touch the motor or fan

over the motor.

Path of Least Resistance

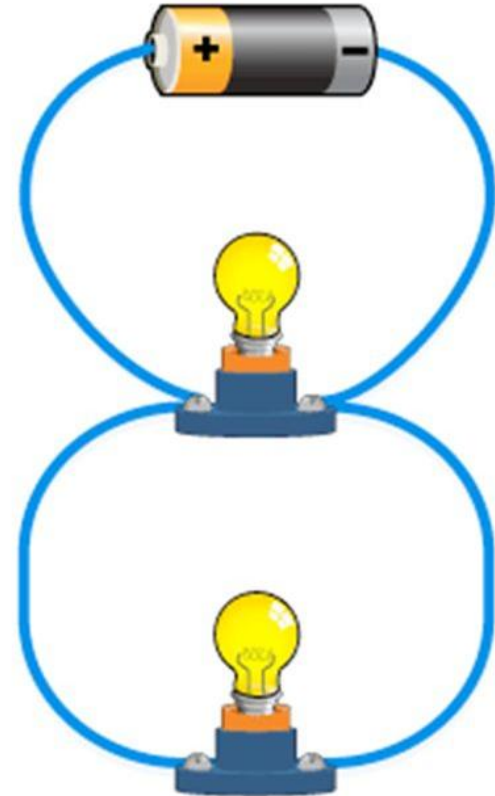
If you created a successful fan circuit for the challenge, then you might have used the **path of least resistance**.

- Remember: all materials have *some* resistance.
- Electrons will choose to travel along the path with the lowest resistance.
So, if you used a second switch across the light, when the switch was on, the electrons went through the *switch wire* and not the light.
 - The switch has lower resistance than the light.
 - The switch was the path of least resistance.

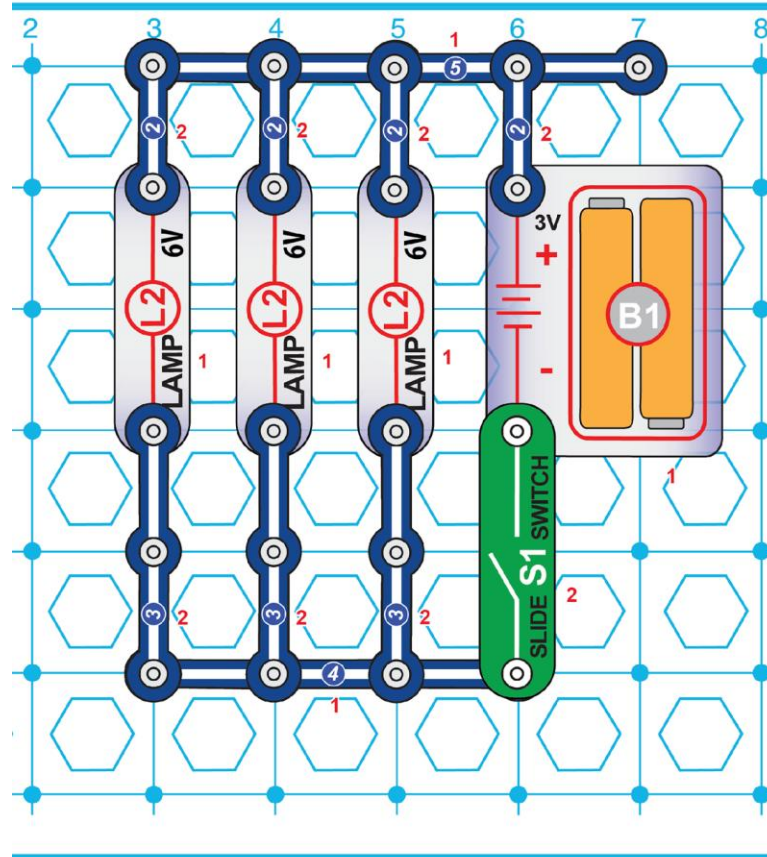
Day 6/7: Loads in Parallel

In electrical circuits, **loads** can be arranged so that they have separate pathways.

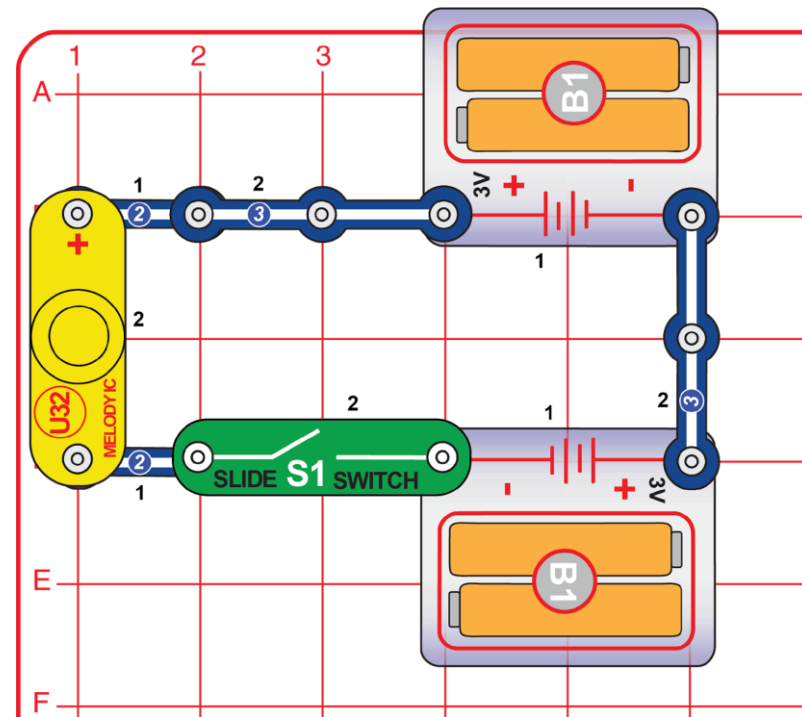
- The circuit path/loop goes from the – side of the battery, through each light bulb separately, to the + side of the battery. Two bulbs are shown here but other numbers are possible.



Follow directions in your **SCAN** to build a circuit with multiple loads in parallel. Try to find out how having loads in parallel might change their performance.



Build the following circuit,
to create a doorbell.



**Note that you will use 2 power sources in series.*

After you feel comfortable on how this circuit works, we have a challenge!
For those with hearing loss, create a doorbell circuit that both rings and
has a light that turns on.

Day 8: Diodes and Resistors

Remember from Day 2 we discussed **resistors**, which are materials that restrict the movement of electrons through the material.

- They come in a range of values.
- The higher the ohm value, the more the resistance.
- The colored stripes help tell its value.

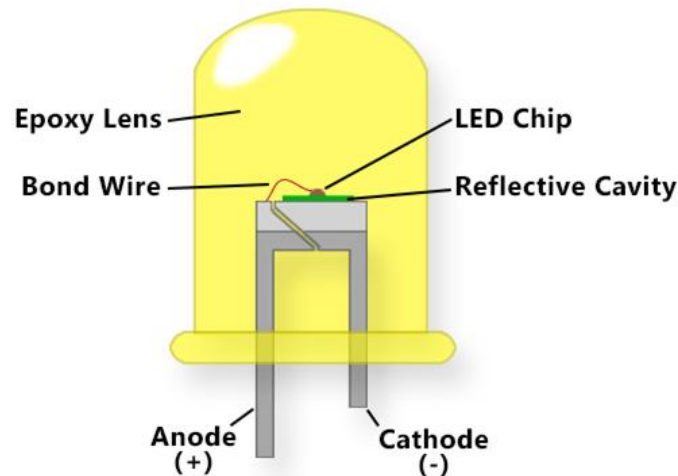


A new component to introduce you to is one that you see all around: Light Emitting Diodes or **LEDs**. In nearly every place you can have a light, an **LED** will work.



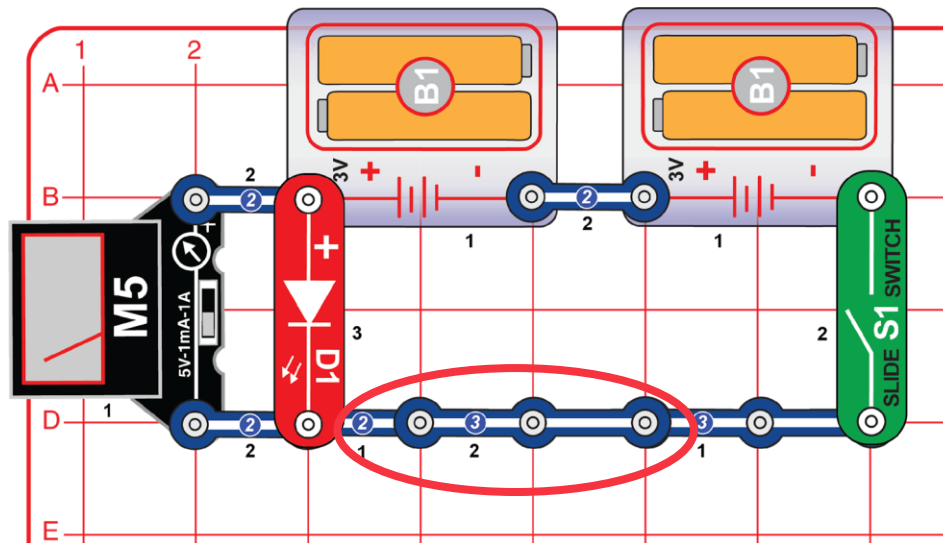
An **LED** is a semiconductor device that emits light when activated.

- The light color depends on the semiconductor material used.
- An **LED** works as a one-way valve, only allowing electricity to flow in only 1 direction.
- When the + side of the **LED** is facing the + side of the source, then electricity will flow through the circuit.



For the next 3 days you'll get to work with **LEDs** in different types of circuits. The first of these circuits examines the impact that resistors can have on a circuit's function.

- During the activity, change out the #3 wire, shown in the red oval, for different values of resistors.

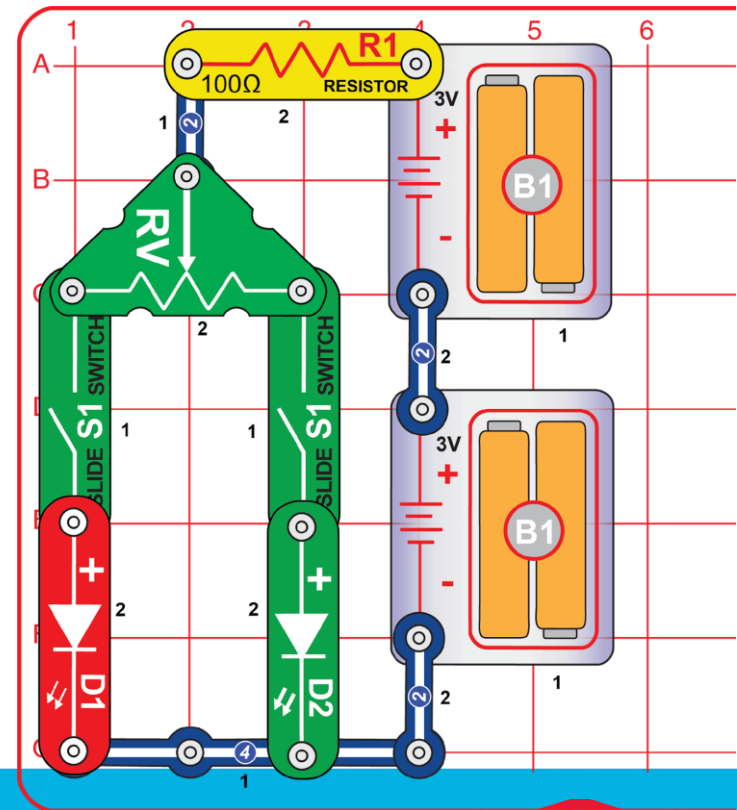


**Note that you will use 2 power sources in series.*

Day 9: LEDs and Variable Resistor

The resistors we used in **Day 8** all had specific levels of resistance. A **variable resistor** can easily change its value. It's another item you've probably come into contact with daily. If you've ever used a dimmer light switch, then you are using a **variable resistor**.

- In today's activity you'll use multiple **LEDs**, multiple **switches**, multiple **sources**, and a **variable resistor**.



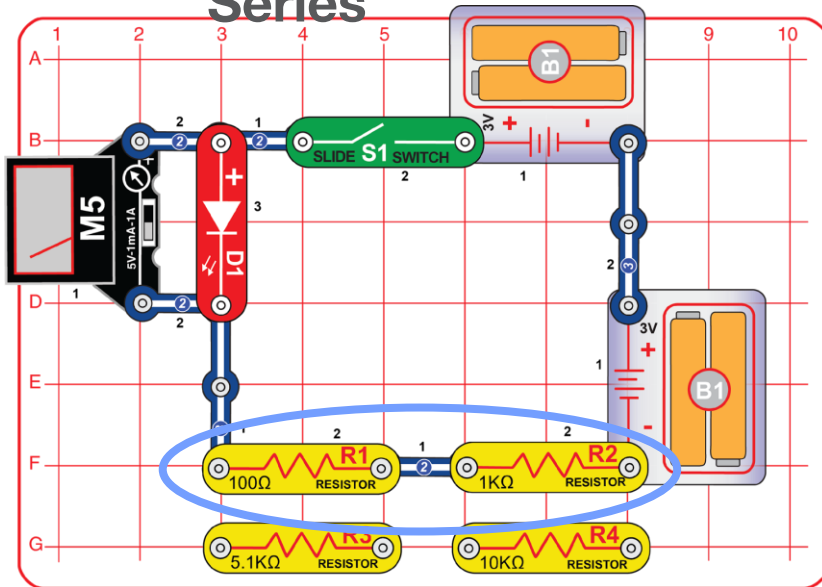
 Find directions in your **SCAN** for this circuit

SNAP CIRCUITS

Day 10: Resistors in Series and Resistors in Parallel

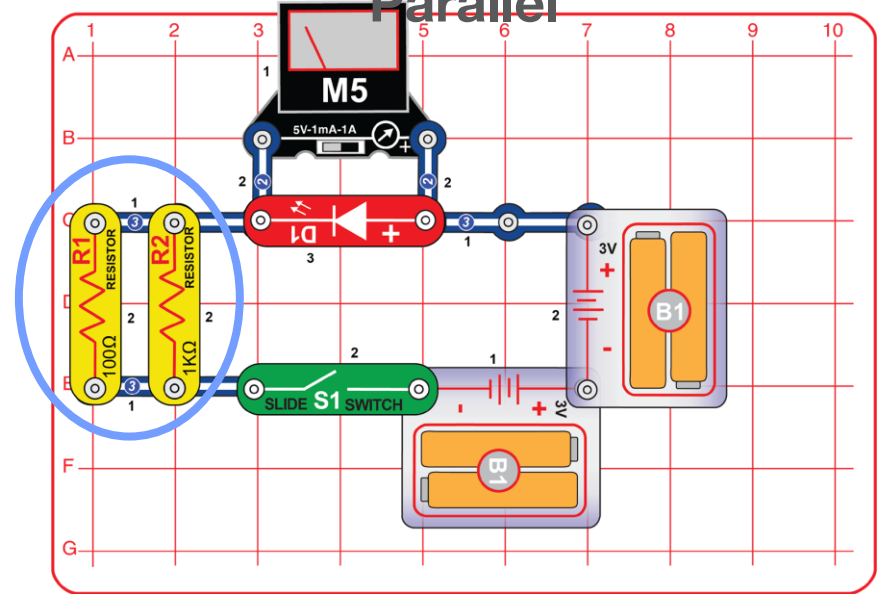
In the past 9 days you've worked with many different components and found that the way they're arranged in the circuit directly impacts the outcome. Today we'll see what happens when resistors are arranged either in **series** or in **parallel**.

Resistors in Series



Here's the starting circuit for evaluating **resistors in series**. Swap out the resistors in the red oval.

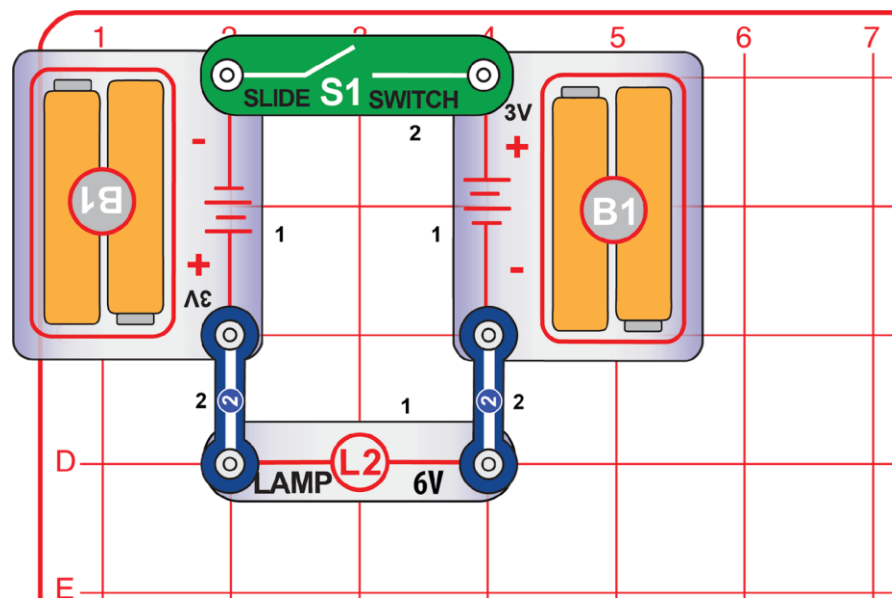
Resistors in Parallel



Here's the starting circuit for evaluating **resistors in parallel**. Swap out the resistors in the red oval.

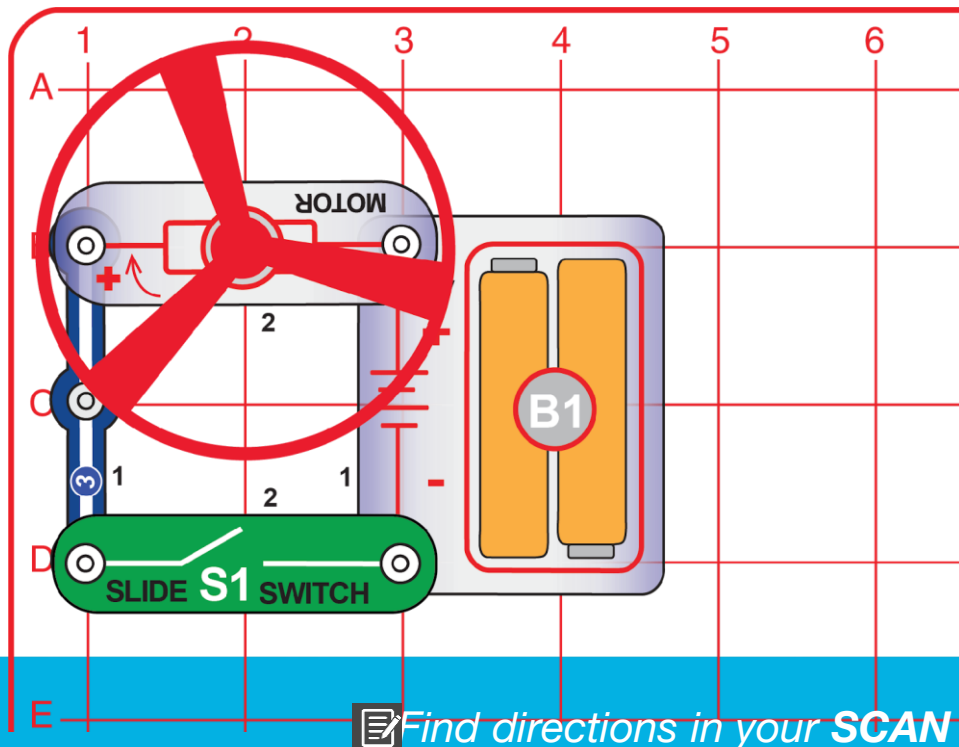
Extra Day Activity: Electric Heater

Around 1907 Albert Einstein said, “Energy cannot be created or destroyed; it can only be changed from one form to another”. We’ve seen electrical energy converted into **light**, **sound** and **motion**. Today, we will evaluate the conversion of electrical energy into **light** and **heat**.



Extra Day Activity: Flying Saucer

On **Day 3** and **Day 5/6** you had a chance to use a circuit with the load being a motor with a set of fan blades. We're going to work with these again, but this time let's see if we can create a flying saucer.



WARNING: MOVING PARTS –

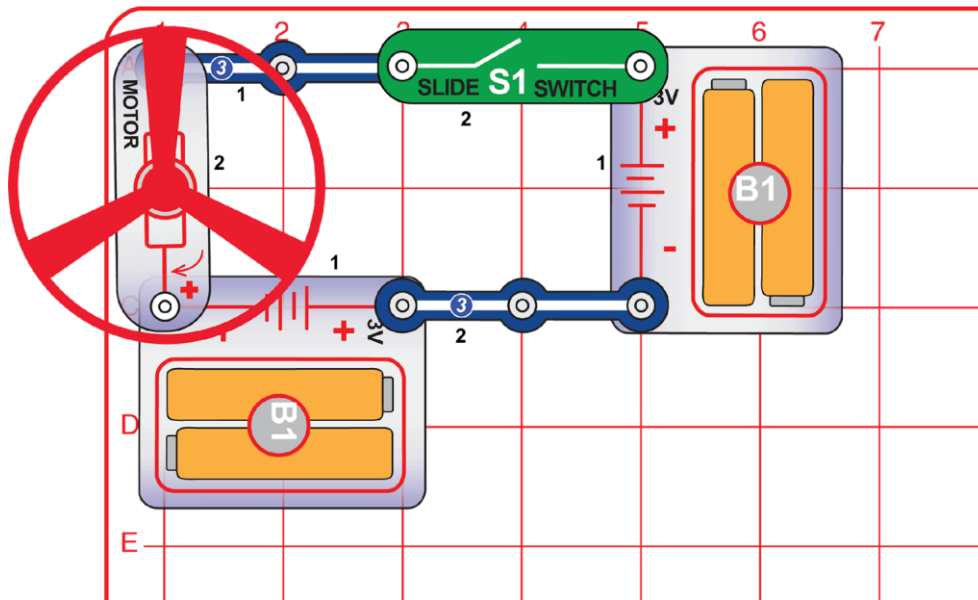
Do not touch the motor or fan



Find directions in your **SCAN** for this circuit

Extra Day Activity: Super Flying . . . Saucer

You've already worked with **sources in series**, let's see what impact they will have on our flying saucer. Can we send it higher?



WARNING: MOVING PARTS –

Do not touch the motor or fan

over the motor.



Find directions in your **SCAN** for this circuit

