

CIRCUIT BLOCKS

Duration: 2-15 minutes

Institution: Science Museum of Minnesota

Skill level/Age Level: K-Grey

Group size: 1-5 depending on how many blocks you have

INTRODUCTION

Circuit Blocks is an activity to help visitors play with circuits and electrical components. Visitors will use alligator clips to explore how to create simple circuits. It is a safe low-power activity. People often do not have a clear idea of how electricity works: they may be unsure if they can get a “shock from battery-powered circuits. We’re using two 1.5 volt batteries together—adding up to 3 volts—very low voltage.

LEARNING GOALS

- Share how electric circuits work in a fun way.
- Provide the opportunities for building eclectic circuits by an array of electrical switches, sensors with outputs.
- Explore conductive material in different forms and functions.

KEY CONCEPTS

- A circuit is a closed loop of conductive material that allows electrons to flow through continuously without beginning or end
- The terms “open” and “closed” refer to switches as well as entire circuits. An open switch is one without continuity: electrons cannot flow through it. A closed switch is one that provides a direct (low resistance) path for electrons to flow through
- In a conductor, electric current can flow freely, in an insulator it cannot. Metals such as copper typify conductors, while most non-metallic solids are said to be good insulators, having extremely high resistance to the flow of charge through them.
- Current is a flow of electric charge through a conductive medium. In a single (on loop) circuit, the amount of current at any point is the same as the amount of current at any other point.
- A short circuit is an eclectic circuit offering little or no resistance to the flow of electrons. Short circuits occur when the path of a working circuit is changed—and allows the electricity to take an unintended short cut.
- Voltage is the measure of “push” available to motivate electrons.
- Most metals are good electrical conductors, most non-metals are not.

<http://hyperphysics.phy-astr.gsu.edu/hbase/electric/conins.html>

MATERIALS AND TOOLS*Essential Materials:*

- Power for the circuit—battery, two 1.5 volt AA batteries



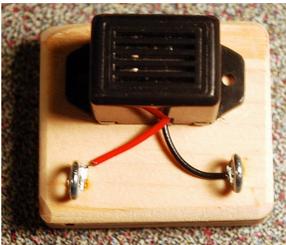
- Motor—with a fan blade attached (inside the fan blades is another tiny circuit with batteries and LED lights that turn on when it spins)



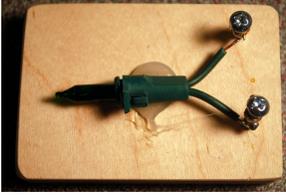
- LED—this is a Light Emitting Diode. LED's are used more and more now as they use a fraction of the electricity that incandescent bulbs use.



- Buzzer—make some noise—this buzzer works like the LED it lets electricity flow only in one direction—so if it does not make noise but your circuit looks right then revers the wires.



- Light—an incandescent holiday string light glows brightly when electricity passes through a tiny wire. Look closely when it is off and you can see the wire or “filament.”



- Pager motor—pager motors are tiny motors inside cell phones and pagers that vibrate when they are on.



- Meter—when a meter is in a circuit the needle moves based on how much or how little electricity is passing through it



- Doorbell button—a simple switch that lets electricity pass through when the button is pushed and stops when you release the button



- Washer switch—as the washer slides inside this switch it will make contact with both sides of the aluminum foil areas. When it touches both it lets electricity through



- Ball-bearing switch—This works like a “tilt” switch inside an old pinball machine: as the ball rolls around in the tube it makes contact with the two sides of the switch, completing the circuit



- Potentiometer (sometimes called a “pot”) is actually a variable “resister”, A resister is something that ‘resists’ the flow of electricity. A variable resister can be adjusted to increase or decrease that flow. Potentiometers have a knob you turn to increase or decrease resistance, which increases or decreases the amount of electricity.



- Slider switch, another variable resister—you move the slider to increase or decrease the amount of electricity flowing though your circuit.



Optional Materials:

Consumer Electricity building kits to have as an example such as Little Bits (<http://littlebits.cc/about>), Snap Circuits (<http://www.snapcircuits.net/>) --these kits can sometimes be helpful as they are constructed to make it very simple to have assured success with the circuit, however they are often opaque in terms of revealing their basic functions for instance LittleBits uses magnets to make the electrical connections, however in the “real” world these connections are made with wire.

SET UP

On the tabletop:

1. Circuit blocks, alligator clip wires. One or two example circuits
2. Materials: cardboard, clear tape, aluminum flashing tape, aluminum foil roll, clear acetate cut in smaller pieces and strips, copper and aluminum wire
3. Fresh batteries
4. Tools: scissors, hole-punches, and needle-nose pliers (if doing construction); and voltmeter (not left out on tabletop)—digital or analog, for checking continuity of circuits and materials and voltage

Note: if the table is too organized visitors are slower to get their hands on and start playing.

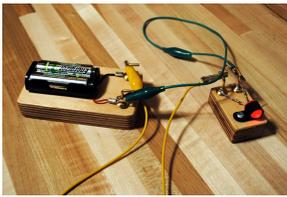
HOW TO OR STEP-BY-STEP

Circuit Blocks is an activity to help visitors play with circuits and electrical components. Visitors will use alligator clips to explore how to create simple circuits. It is a safe low-power activity. People often do not have a clear idea of how electricity works; they may be unsure if they can get a “shock” from battery-powered circuits. More often than not, the adults have this concern. We’re using two 1/5 volt batteries together—adding up to 3 volts—a very low voltage.

Encourage parents to build a circuit at the same time as their child. Have them compare the circuits and call out the parts and what they do. Suggest that they connect their circuits together.

Examples—tabletop demos (these are simple to complex constructed examples)

We’ll start with lighting a light as this is great simple start with clear success when it works (it either lights or it does not light). This is a circuit to light up an LED (light emitting diode). LEDs only light up in one direction. If you connect the two sides of the battery terminals to two sides of the LED and it does not light up, try reversing the wires. If it works you can then explain that this LED is a light but that it is also a “diode,” an electronic component that only lets electricity move in one direction.

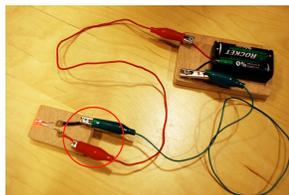
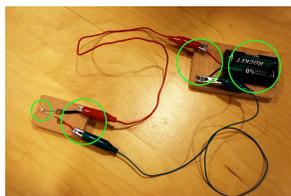


This can be a great way to get visitors started—have an example ready for them to explore and rewire with other components.

This example has a push-button switch connected in the same circuit (just follow the wires). It’s important to build the above circuit that just turns on the LED so you can ensure the LED is connected in the correct direction. Once it’s working you can “open” or “break” one side of the circuit to add the push-button.



These should get you started playing with the blocks. These example blocks have outputs and switches. An output does something when electricity passes through it and the switches let electricity pass or not pass through the circuit—on and off or more or less.

FACILITATION TIPS

Build a circuit—explore properties of this circuit

1. Assist visitors with helpful suggestions, and any component/materials needed.
2. Choices of how to create circuits is open-ended—visitors build it and we encourage/support them to do so.
3. If things don't work it's a great time to model troubleshooting
4. Have visitors try their circuit and encourage them to change components or try to improve at any time.
5. Test it again after the changes. Talk about how it was different each time.

Going further

1. Explore the differences of the types of LEDs. Explore the buzzer. Can you “play it”—creating differing sounds? Try the “familiar” switches then try the “artistic” switches. How do you make them work?
2. Try the light sensor—it works best with a switch circuit. Suggest replacing the switch with a light sensor. If light is low, use a flashlight to provide additional light.
3. Build a circuit with multiple switches—this can lead to sequence and logic conversations.

Troubleshooting

Figuring out why a circuit does *not* work may be **even more** helpful to understanding electrical circuits. This leads directly to very rich conversations and questions that can reveal deeper understanding or misunderstandings.

In this circuit the LED light is not working—it seems connected—and that may be the first thing to do; ask visitors to trace the circuit from beginning to end. “You want to circle in a sense—with no open areas—we call that ‘an open circuit’.” Then check the connections. Are they clipped on well? Metal to metal? Look at the batteries. Make sure you have a fresh pair to test. Grab another battery block you know is working and tell visitors to try that one. Make one change at a time. They may not know it, but you can also explain the difference between LEDs and incandescent bulbs. A LED lets electricity move only in one direction. How can you check this? Reverse the connection on the battery or the light.

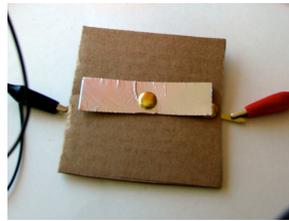
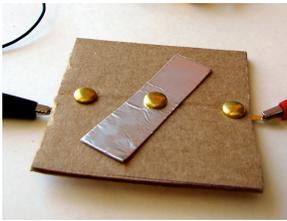
Talking through each of these tests models a systematic approach to troubleshooting. As the facilitator, you may not know what is wrong—make the process transparent by saying so and working through the problem methodically. Letting visitors know that you are not an “expert” allows you to learn and explore with them. Together you should be able to find a solution.

MAKE YOUR OWN SWITCH ACTIVITY TO ADD TO CIRCUIT BLOCKS

As you’ve seen in the circuit blocks, there are a few examples of homemade switches. This is a great activity to build on the circuit blocks: adding a switch you make yourself. Using simple materials and simple tools visitors can quickly build their own switches with conductive and insulating materials.

Examples

This switch is open until you turn the aluminum foil-wrapped cardboard center piece so it connects the two sides as it touches the brass fasteners. The alligator clips connect to the brass fasteners and back to the circuit.



Materials: toilet-paper tubes, aluminum foil and masking tape. Simply cut the tube lengthwise and wrap the foil around each edge. Because it’s a tube, the ends stay apart until it’s squeezed then the sections come together. The tools are scissors and a hole-punch.



And some variations:



KEYWORDS

- Beginner
 - a. Light
 - b. Sound
 - c. Circle
 - d. Materials
- Intermediate
 - a. Circuit
 - b. Electricity
 - c. Conduct
 - d. Insulate
 - e. Resistance
 - f. Short Circuit
 - g. Series and parallel circuits
- Advanced
 - a. LED (Light emitting Diode)
 - b. Current