

Read About Electricity & Circuits

WHAT ARE ELECTRICITY & CIRCUITS?

Electricity is the flow of electrical energy, and a circuit is the path that allows the electricity to flow. Electrical circuits can contain different components, which can be used to regulate the flow of electrical energy.

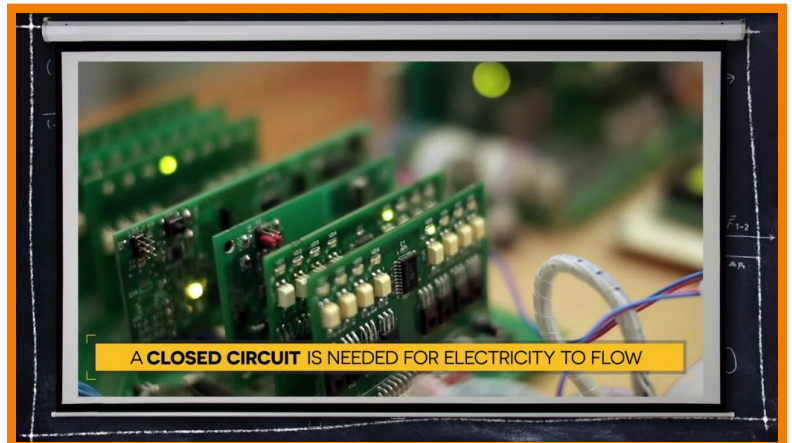
To better understand electricity & circuits...

LET'S BREAK IT DOWN!

Electricity requires a closed path to flow.

Current electricity is the form of electricity that makes all of our electronic devices possible. This form of electricity exists when charges are able to constantly flow. To flow, current electricity requires a circuit—a closed, never-ending loop of conductive material. A circuit could be as simple as a conductive wire connected end-to-end, but useful circuits usually contain a

mix of wire and other components that control the flow of electricity. The only rule when it comes to making circuits is that they can't have any gaps in them.



Conductive materials are needed for electrical energy to flow.

Only certain materials allow electrical energy to flow. These materials are called conductors. Metals tend to be good electrical conductors, but electricity can flow through water or a solution with dissolved salts—like your body or a pickle! Materials that do not conduct electricity are called insulators. Examples of insulators are wood, rubber, plastic, ceramics, and glass. Different



combinations of conductors and insulators can be used to control the flow of electricity. For example, wires in our electronic devices are usually copper wire wrapped in a plastic coating. The copper wire conducts electricity, and the plastic coating prevents the electrical energy from being transferred to another conductor.

Components in a circuit can be arranged in a series or in parallel.

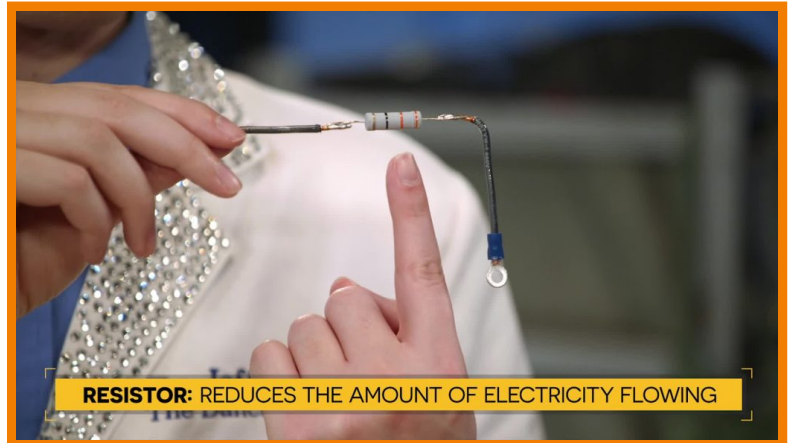
Compare the arrangement of the components of these two circuits. Notice that in the one labeled series, all the components (battery, wire, lights, switch) are connected so that the same current would flow through all of them. When we flip the switch, all of the lights come on at the same time. Holiday lights are an example of something wired in a series. Because all the lights are in a series, one light going out breaks the entire circuit, causing the rest of the lights to also go out.



The other arrangement is a parallel circuit—the type of circuit used to wire our homes. In a parallel circuit, each component is connected in parallel to the other components, which allows each to receive its own supply of electricity. This allows us to turn each components on and off separately.

Circuits can be composed of many components.

A range of components can be a part of a circuit. A fuse might be added to prevent too much current from flowing and starting a fire. Resistors are added to a circuit to reduce current flow, and a potentiometer can be added to allow better control of the flow. You may have noticed that LEDs (light emitting diodes) are used in a range of electronic devices. Diodes allow electricity to flow in only one direction, so if you put the battery in wrong, the diode will not light up.



Integrated circuits (ICs) have been a major advancement in electronics, because they allow a range of components to be a part of the circuit and can be very small. In addition to fuses, resistors, potentiometers, and LEDs, an IC might include transistors, which can amplify the signal, or capacitors, which can store electric charge.

Electrical engineers design electrical circuits for a range of devices.

Electrical engineers use their understanding of circuits and components to design a broad range of devices, such as phones, computers, video game systems, and televisions, which many of us use every day. Their advancements in developing microcircuits greatly reduced the size of many devices. For example, the first computers were the size of a room, but now we can hold a computer much more powerful than those in the palm of our hands! Electrical engineers may also work to design, maintain, and troubleshoot large power grids, which deliver electricity to our homes.



Major improvements have been made in prosthetics thanks in large part to electrical engineers. In addition to tiny circuits that control the movements of the prosthetics, electrical engineers have made electronic skin that allows amputees to feel a range of touch-based sensations.

ELECTRICITY & CIRCUITS VOCABULARY

Electricity

Flow of electrical energy from one place to another.

Circuit

Path that can allow electricity to flow, if closed.

Conductor

Materials that electricity can easily flow through (e.g., metals).

Insulator

Materials that electricity cannot easily flow through (e.g., wood, plastic, rubber).

Volts

Measure of potential energy between two points in a circuit or in a battery.

Resistor

Component of a circuit that reduces the amount of electricity flowing through it.

ELECTRICITY & CIRCUITS DISCUSSION QUESTIONS

What is electricity?

Electricity is the flow of electrical energy from one place to another.

Why is a closed circuit needed for electricity to power our electronics?

For electricity to flow, it needs a closed path from the source, through a conductor, and back to the source.

What would be an advantage of a series circuit? Of a parallel circuit?

In a series circuit, you could turn on and off all the lights or devices at the same time, instead of turning each one on and off separately. In a parallel circuit, each light or device has its own path to the source, so you can control each one separately. If one light or device goes out, the other devices in the circuit are not affected.

What could you do to control the brightness of a light bulb or the spin of a motor in a circuit?

You could use a higher or lower volt battery to control the brightness of a light bulb or the spin of a motor in a circuit. Volts are the measure of potential energy in a battery; the higher the volts, the more potential energy. Or you could add or remove resistors from the circuit, as resistors reduce the amount of electricity flowing through a circuit. Or you could add a potentiometer to the circuit and change the amount of electricity flowing by adjusting a knob or a slider. Students might even mention using a transistor in an integrated circuit to boost the electrical signal.

What are some advantages of using circuit boards in electronic devices?

Circuit boards allow all of the components (fuses, LED, capacitors, resistors, transistors, potentiometers, etc.) to be integrated into a small package. Minimizing circuit boards has been a major advancement in electronics. Using a circuit board makes it easier to switch components as needed.

What are some careers that require knowledge and use of circuits?

Electrical engineers design circuits for a vast range of things—robots, video games, electric cars, computers, phones, prosthetics, power grids, drones, space shuttles, and more.
