SNC1D PHYSICS

THE CHARACTERISTICS OF ELECTRICITY

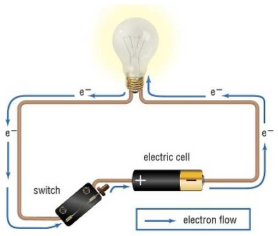
- Electric Circuits (P.432-434)

Current Electricity

The electricity of the electric eel and the electric ray is similar to the static charges you have felt from a sweater or the huge static charges of lightning. Unfortunately, static charges are not useful for operating electrical devices – they build up in one place and discharge, but they do not flow continuously. To operate electrical devices, you need a continuous flow of electrons.

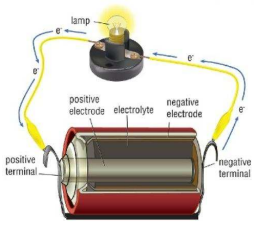
Current Electricity – DC

*This continuous flow of electrons, known as **current electricity**, comes in two forms: direct current and alternating current. In **direct current (DC)**, electrons flow in one direction only. Direct current is produced by an electric cell, such as a battery, to power portable electrical devices.*



Current Electricity – DC

*A **battery** is a package of chemicals that converts chemical energy into electrical energy. A simple electric cell consists of two different metal electrodes (such as zinc and copper) in a conducting solution, called an electrolyte.*

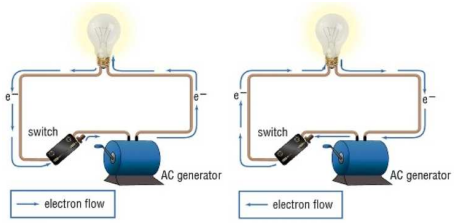


BATTERY

- device that converts chemical energy into electrical energy

Current Electricity – AC

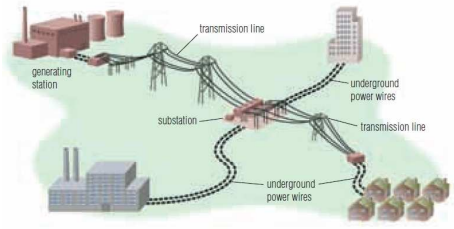
*In **alternating current (AC)**, electrons move back and forth, alternating their direction. Alternating current is produced by generators at electric generating stations. Alternating current is used in electric generating stations because it is a more efficient method of distributing electrical energy over long distances. Wall outlets provide alternating current.*



Current Electricity – AC

NOTE!

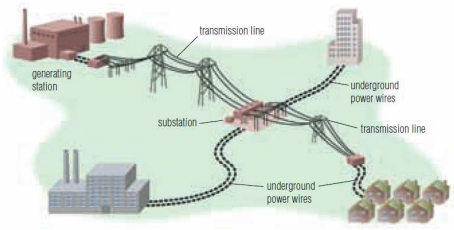
*The **electrical energy distribution grid** is commonly called "the power grid." You use the power grid every time you plug the cord of an electrical device into a wall outlet.*



Current Electricity – AC

ELECTRICAL ENERGY DISTRIBUTION GRID

- the "power grid"
- provides the majority of the energy we use daily



Current Electricity

CURRENT ELECTRICITY

- continuous flow of electrons in a circuit
- two types ☞ DC & AC

DIRECT CURRENT (DC)

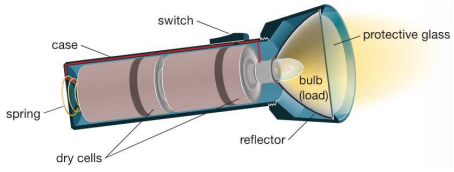
- electrons flow in one direction only
- battery

ALTERNATING CURRENT (AC)

- electrons move back and forth (alternate their direction)
- wall outlet

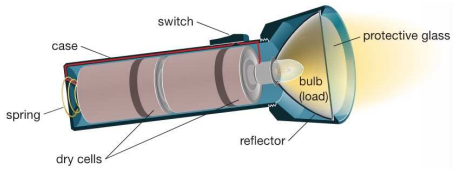
Electric Circuits

Unlike static electricity, a flow of electrons moves continuously as long as two conditions are met. First, the flow of electrons requires an energy source. Second, the electrons will not flow unless they have a complete path to flow through.



Electric Circuits

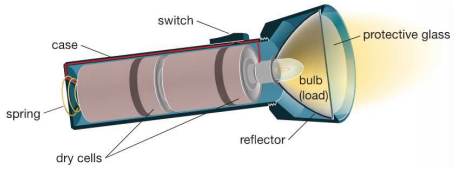
*This complete path is called an **electric circuit**. A flashlight is an example of a simple electric circuit. It consists of a light bulb, some wire, a couple of batteries, a switch, and a plastic casing to hold and protect the electrical parts.*



Electric Circuits

ELECTRIC CIRCUIT

- continuous, or closed, path in which electrons can flow



Electric Circuits

PRACTICE

1. Why would it be challenging to use static electricity in electrical devices, such as your television or stereo? Explain.

   static charges are not useful for operating electrical devices – they build up in one place and discharge, but they do not flow continuously – to operate electrical devices, you need a continuous flow of electrons

Electric Circuits

PRACTICE

2. How is current electricity different from static electricity?

static electricity – charge builds up in one place and doesn't move
current electricity – involves a continuous flow of electrons

Electric Circuits

PRACTICE

3. How do electrons transfer energy in a circuit?

How Do Electrons Transfer Energy in a Circuit?

When you turn on the light switch on a wall, you close the circuit and immediately the light comes on. How do the electrons get from the switch to the light bulb so fast? You can picture electrons in a wire like marbles in a tube. If you push a marble in at one end of the tube, the energy is transmitted through all the marbles in the tube, and a marble comes out the other end immediately.

How Do Electrons Transfer Energy in a Circuit?

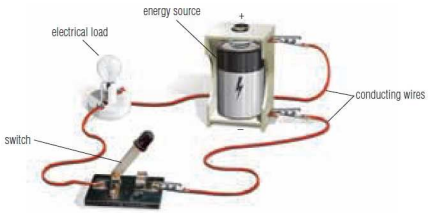
Electrons in a wire work in a similar way. When an energy source is connected to a circuit, electrons in the conductor "push" or repel other electrons nearby. As soon as one electron starts to move at one end of the wire, it pushes the next one, which pushes the next one and so on. By pushing the first electron, you make the last electron move. That is why when you flip the switch, the light goes on instantly even though the electrons themselves have not moved from the switch to the light bulb.

Parts of an Electric Circuit

The simplest electric circuit is a loop. It requires an energy source, a load, conducting wires, and sometimes a switch.

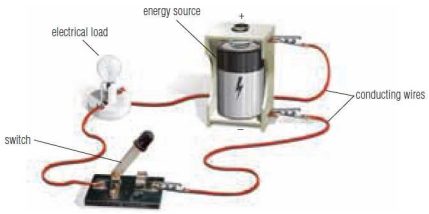
Parts of an Electric Circuit

*An electrical **load** is an electrical device such as a light bulb that converts electrical energy into another form of energy. Loads are usually made of materials that have high electrical resistance. They can be heaters, lamps, fans, computer hard drives, or microchips.*



Parts of an Electric Circuit

*A **switch** is a control device that allows you to safely open or close a circuit. When the switch is closed, the circuit is complete and electrons can flow. An open switch means there is a break in the path, so electrons cannot flow through the circuit. The circuit is turned off when the switch is open.*

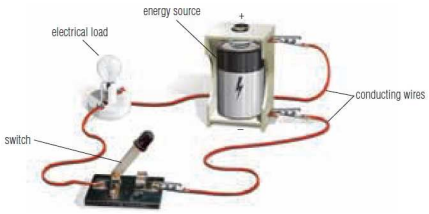


Parts of an Electric Circuit

*An **energy source** provides the electrical energy in a circuit. For example, a simple circuit may use a dry cell battery as the energy source. Other devices such as televisions require more energy for longer periods of time. These devices use electricity from a wall outlet rather than from a battery.*

Parts of an Electric Circuit

***Conducting wires** (or "connecting wires") join all the parts of an electric circuit together. They provide a pathway for electrons to flow from one component of the circuit to another. Connecting wires are usually made of materials that have low electrical resistance such as insulated copper or aluminum wires.*



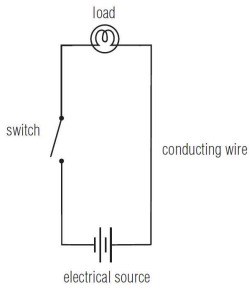
Parts of an Electric Circuit

PARTS OF A CIRCUIT

Component	Description	Example
Energy Source	provides electrical energy	• battery • power outlet
Load	converts electrical energy into other forms of energy	• light bulb • toaster
Switch	device to control the electric circuit	• wall switch • thermostat
Conducting Wire	pathway for electrons	• electrical wire • transmission lines

Circuit Symbols & Circuit Diagrams

To simplify the drawing of an electric circuit, engineers and designers of electric circuits use special symbols that show the components and connections in a circuit. For example, the drawing to the right represents the same simple electric circuit shown earlier. These symbols make it easier to plan and analyze a circuit before you build it. A drawing made with these symbols is called a ***circuit diagram****.*

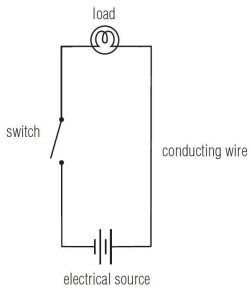


Circuit Symbols & Circuit Diagrams

NOTE!

① *Use a ruler.*

② *The finished diagram should be a rectangle.*



Circuit Symbols & Circuit Diagrams

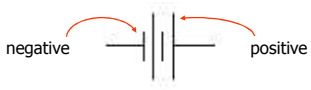
This table shows some common circuit diagram symbols. A more complete list of these symbols can be found on P.552 of your text. Knowing the basic circuit symbols can help you analyze existing circuits and make it easier to understand how the device functions.

Symbol	Component	Function
	wire	conductor; allows electrons to flow
	cell, battery	electrical source; longer side is the positive terminal, shorter side is the negative terminal
	lamp (light bulb)	specific load; converts electricity to light and heat
	resistor	general load; converts electricity to heat
	switch	opens and closes the circuit
	ammeter	measures current through a device, connected in series
	voltmeter	measures voltage across a device, connected in parallel

Circuit Symbols & Circuit Diagrams

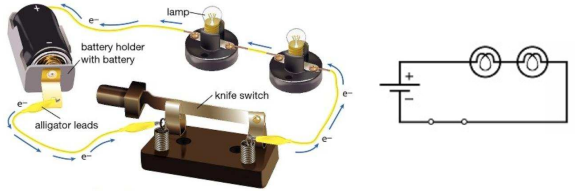
NOTE!

For an electric cell or battery, the longer line is the positive electrode, while the shorter line represents the negative electrode. Also, most circuits used in everyday life have more than one load. These loads may be connected in two ways: in series or in parallel.



Series Circuit

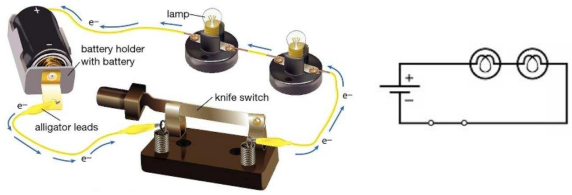
*In a **series circuit**, the electrons can follow only one path. Notice that the battery, switch, and lamps are connected one after the other in one continuous loop. Electrons flow from the negative terminal of the battery, through the circuit, toward the positive terminal.*



Series Circuit

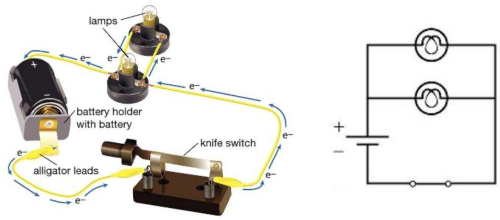
NOTE!

If that pathway is interrupted, the whole circuit cannot function.



Parallel Circuit

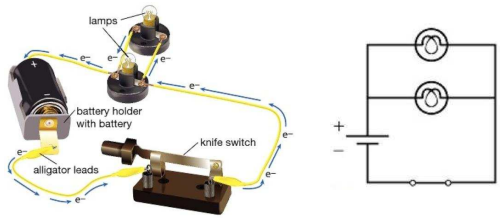
*In a **parallel circuit**, electrons can flow more than one way because the loads are on at least two different branches of wires. When the electrons reach a branch, they separate – some follow one branch, while the others follow the other branch – and then merge before returning to the energy source.*



Parallel Circuit

NOTE!

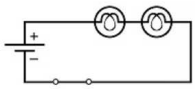
If the electron flow in one branch is interrupted, the other branch remains unaffected and continues to function.



Series & Parallel Circuits

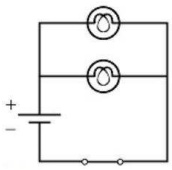
SERIES CIRCUIT

- loads are connected end to end
- only one path for electrons to flow



PARALLEL CIRCUIT

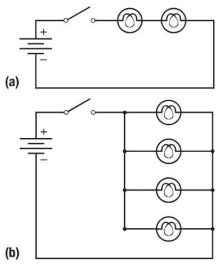
- loads are connected by branches
- two or more paths for electrons to flow



✔ Check Your Learning

1. How many complete pathways are there for electrons to follow in each circuit shown?

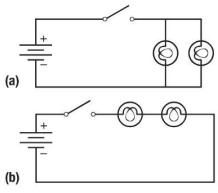
   (a) 1
   (b) 4



✔ Check Your Learning

2. Identify whether each circuit shown is series or parallel.

   (a) parallel
   (b) series



✔ Check Your Learning

3. Given one battery, three bulbs, one switch and connecting wire, design as many different ways as possible to connect all three bulbs together. Draw a circuit diagram for each arrangement. (Hint: there are only four unique yet different ways to connect three bulbs together!)

✔ Check Your Learning

WIKI (PHYSICS)

✎.... 1DPHYS - WS4 (What Will Happen When …)