

Circuits Theory and Practice

Introduction

Key Vocabulary

Electric Field, charge, electrons
static/dynamic electricity

AC/DC

Volt, voltage, symbol V

Amp, current, symbol I

Ohm, resistance, symbol R

Voltage $V = I \times R$, Power $P = I \times V$

Conductor/Insulator

Open/closed circuits

Polarised components

Breadboards

LEDs (Light Emitting Diodes)

Power Supply, positive to negative (conventional current)

Resistors

Digital/Analogue Data

Series and Parallel

Black box

Safety message

"it's the volts that jolts but the amps that kills. or the current that's abhorrent."

Do not use 240 volt mains power!

Activity: Mind Map, Think Pair Share

What is electricity?

Where is electricity? (Electric fields everywhere, fundamental electromagnetic force)

Where does the electricity coming out of the wall come from? (electricity generation)

Where is Electricity?

- Devices, appliances, electric grid, animals, plants, earth...
- The electromagnetic fundamental force, one of the four basic forces in the universe.
- Forms of electricity generation: wind, solar, geothermal, hydro, nuclear...

What is Electricity?

Static Electricity

The substance that loses electrons becomes **positively charged** and the substance that gains electrons becomes **negatively charged**.

These charges are **stationary** and remain on the **surface** of the substance. Since there is no flow of electrons, this is referred to as **static** electricity.

Dynamic Electricity

Flows along a conductor. It can be either in a single direction (**Direct Current DC**), or it can be changing directions repeatedly (**Alternating Current AC**).

Facts about Static Electricity

A discharge spark of static electricity can measure thousands of volts, but has very little current and lasts for a short period of time. This means it has little power or energy.

Lightning is a powerful and dangerous example of static electricity.

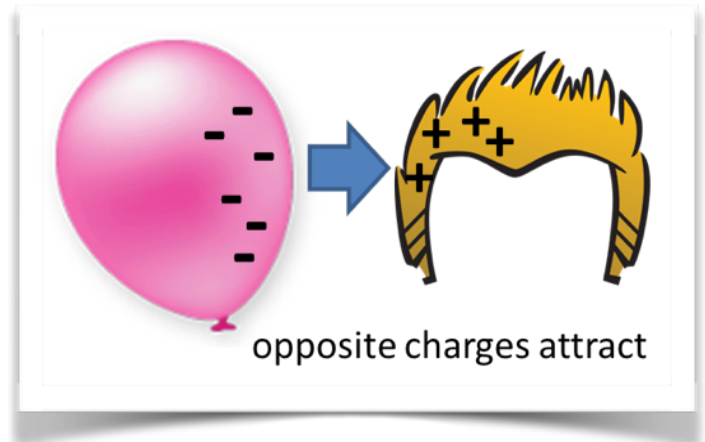
What is Electricity?

Activity: Static Electricity

Materials: Balloon

Method:

Blow up a balloon.
Rub balloon against clothing or hair.
Pick up paper pieces without contacting the paper.
Demonstrates a static electric field.



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Activity: Dynamic electricity

Materials: Multimeter, batteries, wire, magnet

Method:

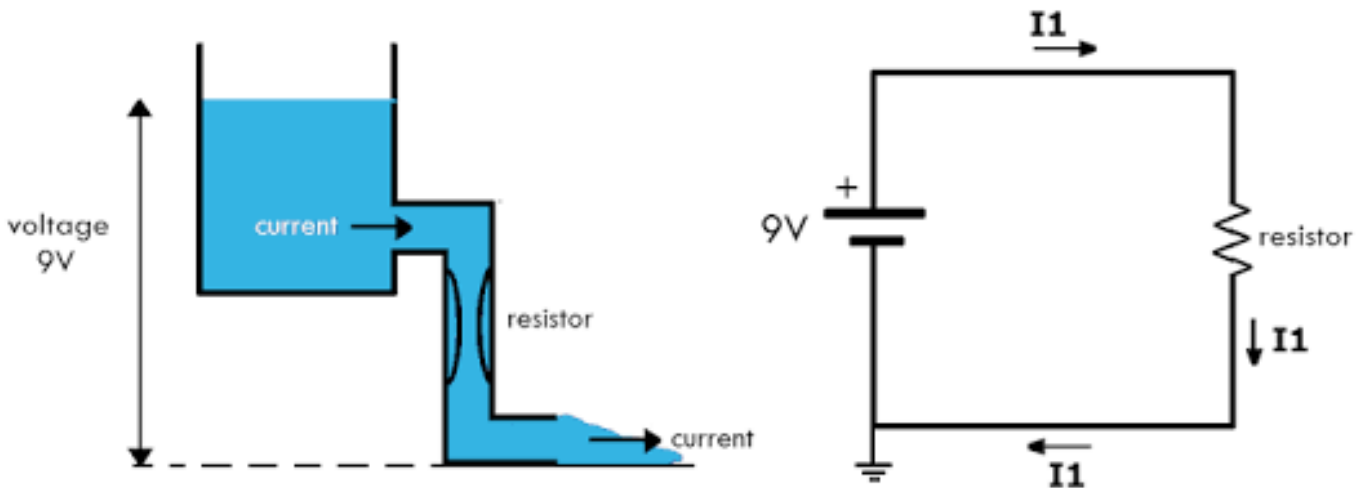
- 1 Measure the **voltage** of a battery using the **multimeter**.
- 2 Measure the voltage of along a piece of wire being stroked with a **magnet**.
- 3 Measure a persons **resistance** from hand to hand.

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Hydraulic Analogy

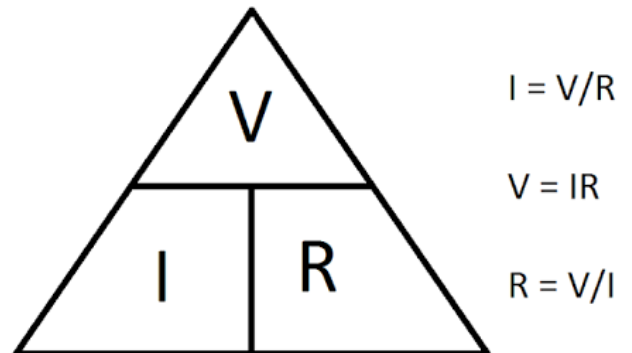
- **Volts: Voltage** is like electron **pressure**, like high pressure water in a pipe.
- **Amps: Current** is the **amount**/number of electrons, like a lot of water in a pipe.
- **Ohms: Resistance** or the **size** of the pipe that carries water



Ohms law $V = IR$. $I = V/R$, $R = V/I$.

What happens to current and resistance if voltage increases?
If resistance increases?

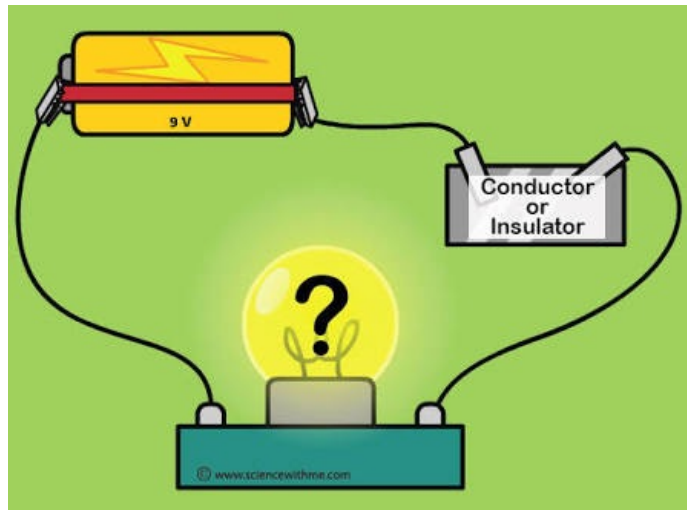
Do the Math, measure with a multimeter.



Conductors and Insulators

Insulators do not let electrons flow very easily from one atom to another. Insulators are materials whose atoms have tightly bound electrons. These electrons are not free to roam around and be shared by neighboring atoms.

Some common **insulator** materials are glass, plastic, rubber, air, and wood.



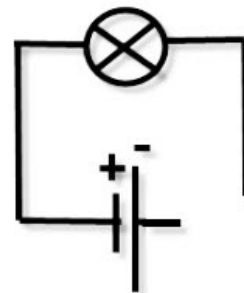
Conductors let the electron current or flow of electrons move through them easily. Most metals are considered to be good conductors of electrical current, especially gold, silver, copper and aluminium.

Open/closed circuits

Open Electric Circuit



Picture Diagram



Symbol Diagram

Electric Signals/Data

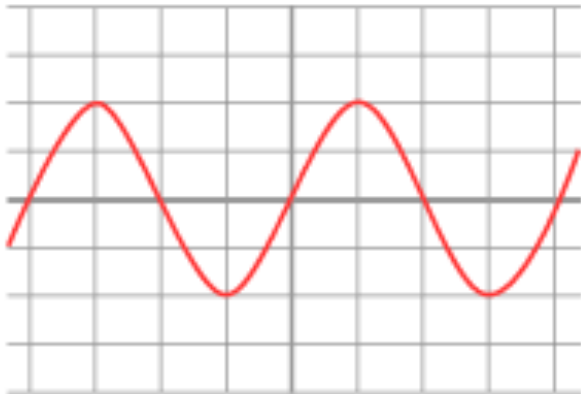
Pattern/Pulse of current/voltage/frequency

Digital: On or Off, High or Low, binary number system, discrete information

Analogue: Continuously changing voltage, current or frequency

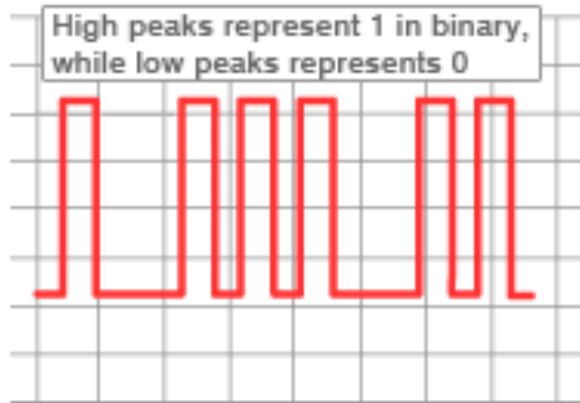
Inputs/Outputs: sensors, switches, sound, light, motors

Analogue signal



Analogue signals work by transmitting sounds and pictures as continuously varying waves.

Digital signal



Digital information is sent as computerised pulses of information, coded as 1s and 0s.

Black Box

Any Component or Process who details are unknown but can still be used functionally.

Eg an **integrated circuit IC**

