Mains Electricity
Mains Electricity

How is electricity supplied?

- Connecting appliances to the mains
- Electrical safety
- Summary activities
There are two main types of electric current: direct current (DC) and alternating current (AC).

Direct current is electric current that always flows in one direction. It is produced by cells and batteries.

Some electronic circuits, such as those in mobile phones and stereos, need direct current electricity in order to work.
Alternating current (AC) is electric current that is constantly changing direction. It is produced by most generators and is used in mains electricity.

Motors often work using AC, but many other electronic devices need to convert AC to DC to make them work.

Why do we use AC in mains electricity instead of DC?
Why use AC and not DC?

Electricity is generated in power stations and then carried around the UK by the National Grid.

It is important that the transfer of electricity from the power station to where it is needed is as **efficient** as possible.

With alternating current, the **potential difference** of the supply can be easily **increased** or **decreased** by **transformers**.

Transporting electricity at a high potential difference and reduced current is much more efficient.

Drax Power Station, North Yorkshire
The **frequency** of AC electricity is the number of complete cycles per second, which is measured in **hertz** (Hz).

The AC frequency can be determined from an **oscilloscope** by counting the number of complete waves per unit time.

If the frequency is **increased**, the number of complete waves shown on the screen also **increases**. For example, if the frequency is doubled, the number of waves doubles.
Mains electricity in the UK

In the UK, the frequency of mains electricity is 50 Hz. This means that the current changes direction 50 times every second.

This frequency is the same at any point in the electricity supply system.

The potential difference of mains electricity supplied to UK homes is labelled as 230 V.

The peak, or maximum, potential difference is actually higher than this.
Mains Electricity

- How is electricity supplied?
- Connecting appliances to the mains
- Electrical safety
- Summary activities
Inside a cable

Most electrical appliances are connected to the mains using a **three-core** electrical cable which contains three wires.

These wires are made of **copper** because it is a **good conductor** of electricity. Each wire is made of thin strands of copper to keep the cable flexible.

Each wire is encased in **plastic** to stop the wires from touching and causing a short circuit. Plastic is used as it is a **good insulator**, as well as being tough and flexible. The whole cable is encased in another layer of plastic.
What does each wire do?

Each of the wires in a cable performs a specific function.

The **neutral wire** completes the circuit. It is kept at, or close to, earth potential (0V).

The **live wire** carries the alternating potential difference from the supply. In the UK, this is about 230V.

The **earth wire** is a safety wire that grounds the circuit. It is connected to the case of the appliance and the Earth.

The insulation covering each wire is colour coded:

- neutral
- live
- earth
Inside a plug

The three pins in an electrical **plug** are connected to the three wires inside a cable.

The current flows from the mains supply into the **live** terminal.

It then passes through the live wire and down the cable, through the connected appliance and back out via the **neutral** wire.
Mains Electricity

- How is electricity supplied?
- Connecting appliances to the mains
- Electrical safety
- Summary activities
Why is electricity dangerous?

Warning signs are used to alert people to the presence of high voltage electricity.

When a current passes through living material, it causes an electric shock.

This interferes with nerve signals from the brain to the body, and can cause a heart attack, muscle spasms and breathing difficulties.

Other dangers include faulty and overheated appliances, which may lead to electrical fires.
**Using electricity safely**

Although electricity can be very dangerous, it is also incredibly useful and is essential for modern life.

**What precautions can be taken to make electricity safer?**

- Do not overload sockets.
- Wire plugs correctly.
- Never mix water and electricity.
- Regularly check cables for breaks and loose wires.
- Never stick anything other than a plug in a socket.
- Use **earth wires**, **fuses** and **circuit breakers** to prevent accidents in the event that a fault develops.
**What is earthing?**

**Earthing** is a process used to increase the safety of electrical appliances and prevent electric shocks.

An **earth wire** is essential for any appliance with a **metal case**. Without an earth wire, electricity could begin to flow through the metal casing if a fault developed.

The earth wire provides an **alternative path** for the current.

If the **live wire** becomes loose and touches the metal case, a very large current flows through the earth wire and blows the fuse in the plug, breaking the circuit.
How do earth wires make appliances safer?

Earth wires and fuses are used to make electrical appliances safer when they develop problems. Press “play” to find out how earthing works.
It could be placed here, in the neutral wire.

When both switches are closed:
- the circuit is complete
- current can flow
- the appliance is working.

When the switch in the live wire is open:
- the circuit is broken
- current cannot flow
- the appliance is not working.

When the switch in the neutral wire is open:
- the circuit is broken
- current cannot flow
- the appliance is not working.

But, what would happen if someone touched the live wire now?

By touching the wire, the person has completed the circuit. The current can travel from the live wire, through the person and into the ground.

Therefore, switches should be placed in the live wire, not the neutral wire. **Never** touch a live wire with any earthed object, including yourself, even if the power seems switched off.
Mains Electricity

- How is electricity supplied?
- Connecting appliances to the mains
- Electrical safety
- Summary activities