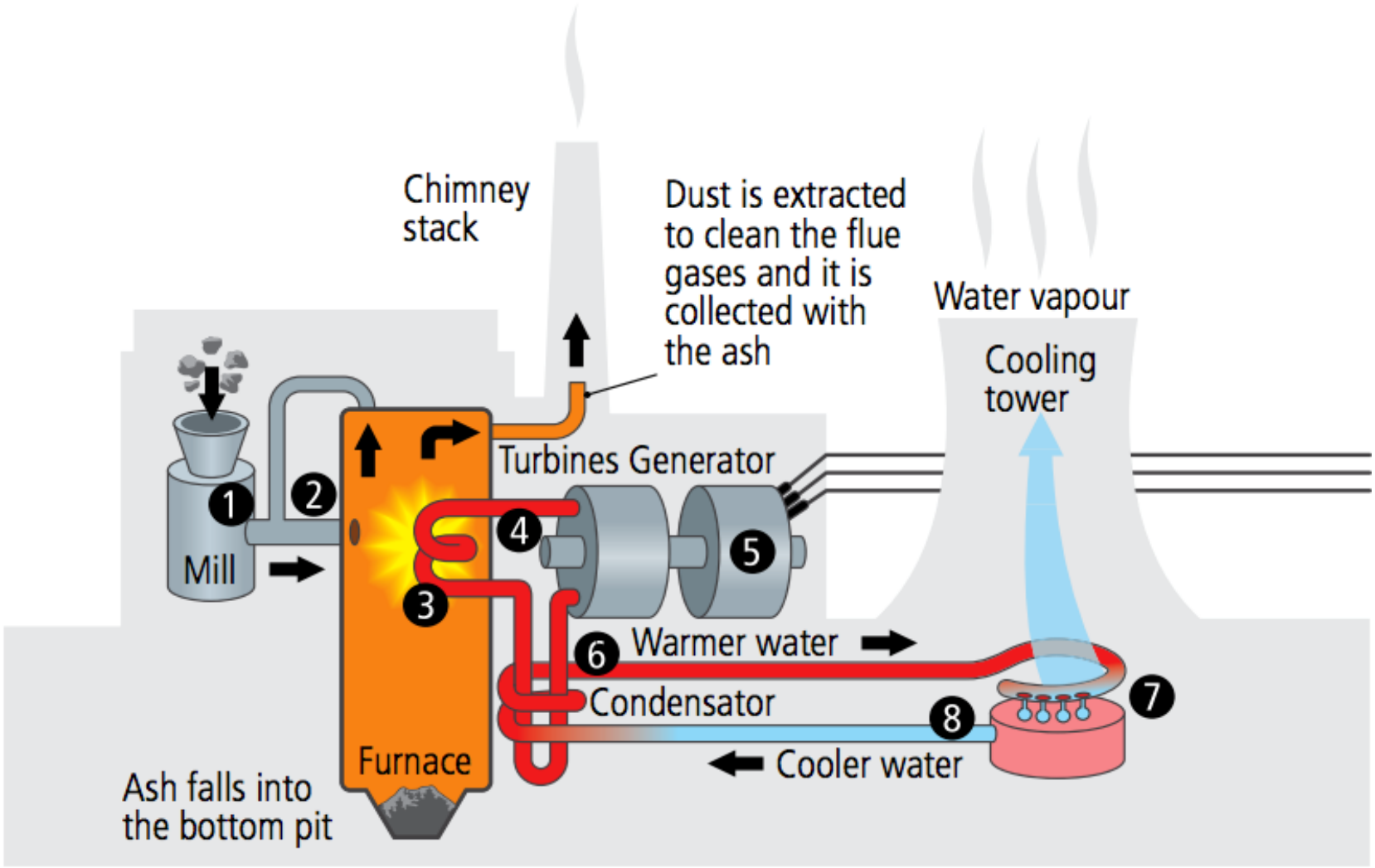
SECTION D

CHAPTER 22
ELECTRICITY

Electrical Power Stations in Ireland

- Fuel-burning
- Wind farms
- Hydroelectric
- Pumped storage

Fuel Burning Power Stations



Wind Farms

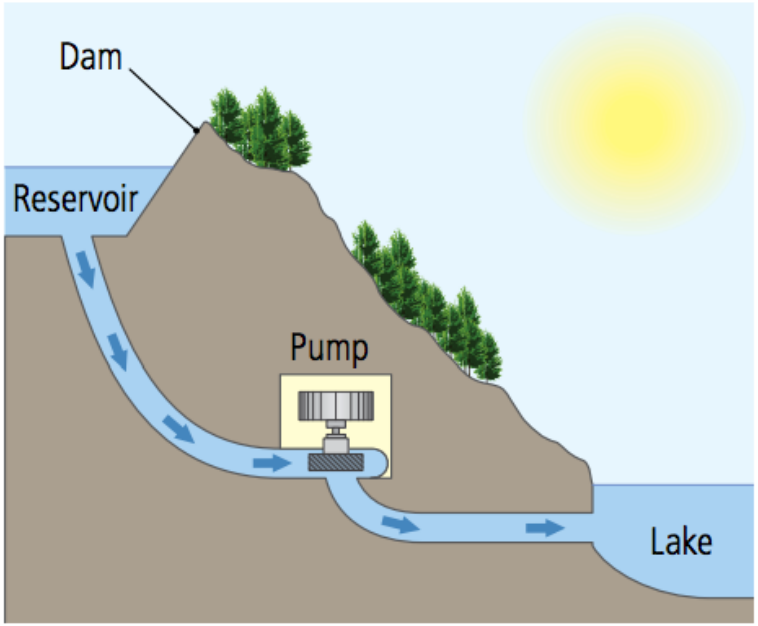
- Wind turbines use the prevailing winds to turn their rotor blades, which then turn an electromagnetic generator, that changes wind energy into electrical energy.
- Wind turbines can only work at low speeds, and for this reason a wind farm, which consists of several wind turbines all hooked up to a collector station, is needed to produce large amounts of electricity.
- Renewable source of energy, and have less environmental impact.
- Sometimes criticised for being very noisy and disrupting the natural view.
- Increasingly popular in Ireland.

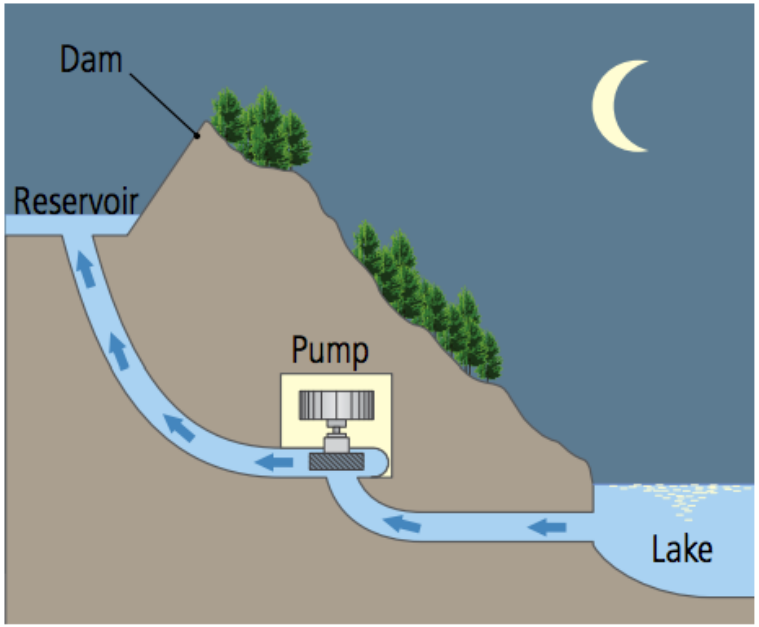
Hydroelectric power stations

- Rely on water as their source of energy.
- Trap a large body of water behind an artificial dam, and then lets it flow through turbines which convert the potential energy of the water into electrical energy.
- **Ardnacrusha**, built on the Shannon in Co. Clare, is Ireland's largest river hydroelectric scheme.

Ardnacrusha power plant, Co. Clare.

Pumped Storage

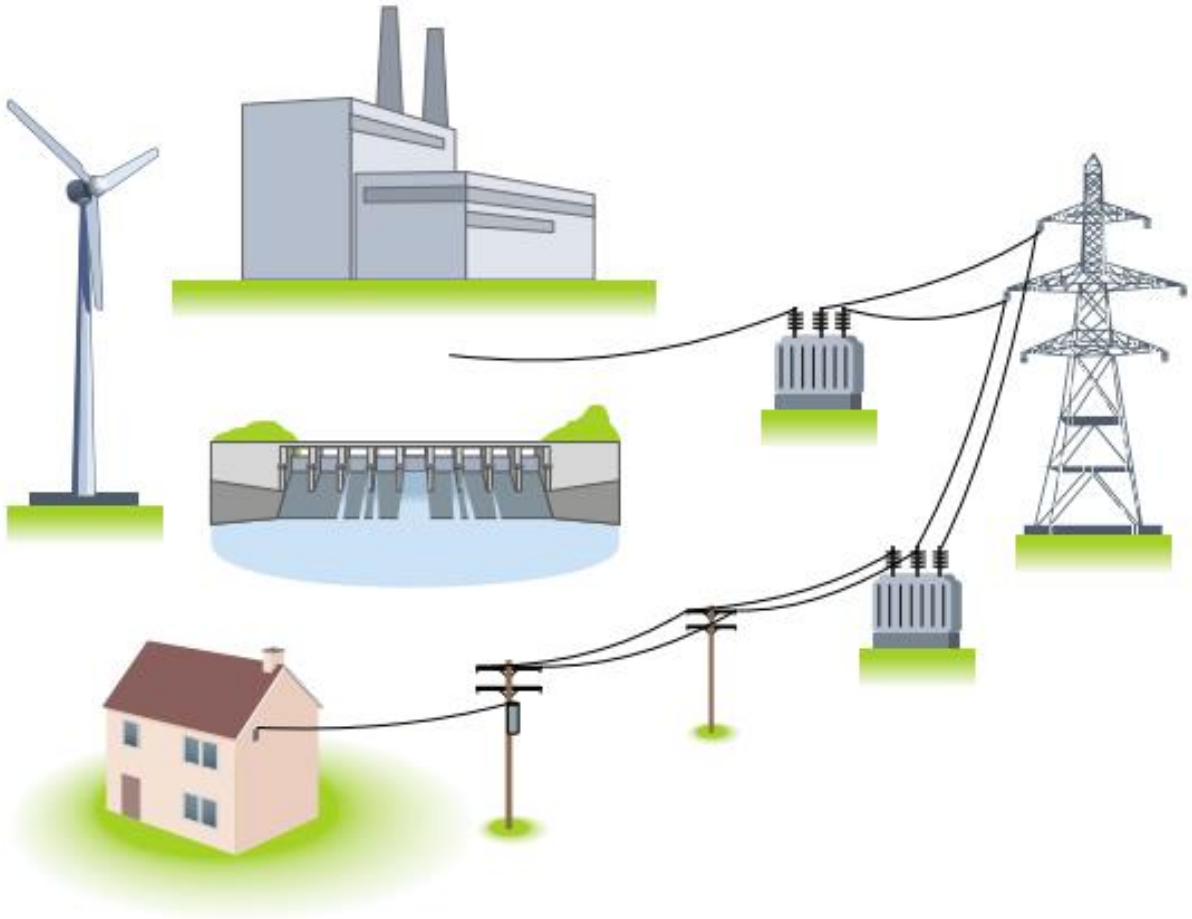




National Grid

- Power stations located around Ireland provide the country with its electricity.
- In order to deliver this energy to towns and cities, it must pass through the national grid (operated by Eirgrid), which supplies the country with electricity.

Energy process from the power station to the home



Transmission System Operators

- Transmission System Operators (TSOs) are given the task of operating and maintaining the transmission of this electricity nationally.
- The TSO sells electricity to private companies for a wholesale price, and the private companies pass on the electricity, and the cost, to householders.

Local Substations

- Electricity is transmitted at a high voltage from its source to local substations.
- It is sent at high voltages, and low current, to prevent energy being lost as the electricity travels over long distances. Energy is lost as heat – the cables heat up as electricity passes through them.
- When the electricity reaches the substation, the voltage is reduced by a transformer – a device which is used to change the power of the electricity in the circuit – to between 220 and 240 volts.

Step Down Transformer

In cases where there is no local substation, the voltage is stepped down using a pole mounted transformer

Electrical current

- Electrical current is related to the flow of electrons, the small particles that orbit atoms. When enough electrical charge is applied, they leave the atom and begin to flow; this is what we know as electric current.
- The current is also related to the diameter of the wire along which it travels. Larger wire gives the capacity to carry more current without overheating.
- The standard unit of measurement of current is the **ampere** (A), or **amp** for short.

Voltage

- Voltage (V) is the force of the current in an electrical circuit.
- Similar to water pressure, voltage is the push or force caused by the movement of electrons.
- The greater the voltage, the greater the pressure driving the current of electrons in a circuit.

Resistance

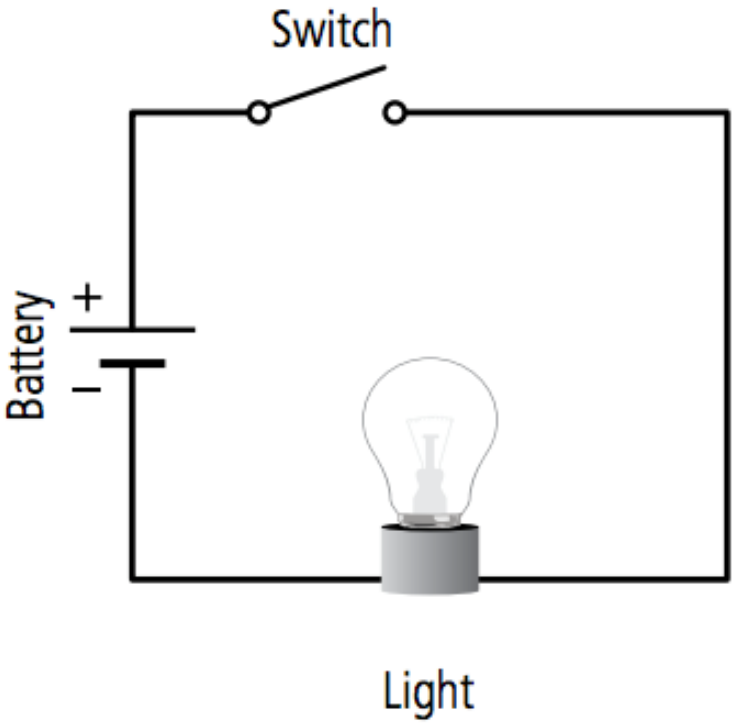
- The flow of electrons (current) is obstructed by a force known as resistance.
- Resistance is measured in **ohms**.
- The amount of resistance varies from material to material. Due to its low resistance ratio, and its relative abundance, copper is the metal most commonly used for conducting electricity.

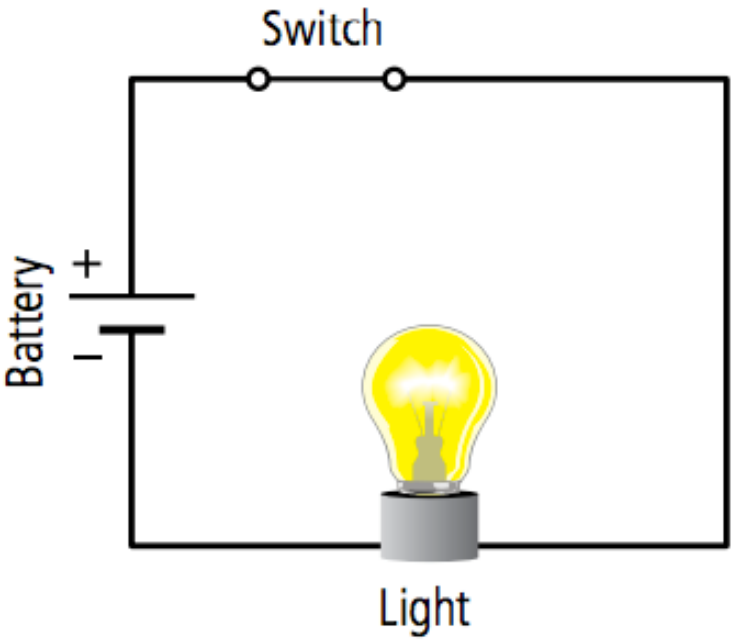
Wattage

- Wattage measures the rate of conversion of electricity. It is a standard unit and is equal to 1 amp per second through a material of 1 ohm resistance.
- Wattage measures the rate of conversion of the input of electricity

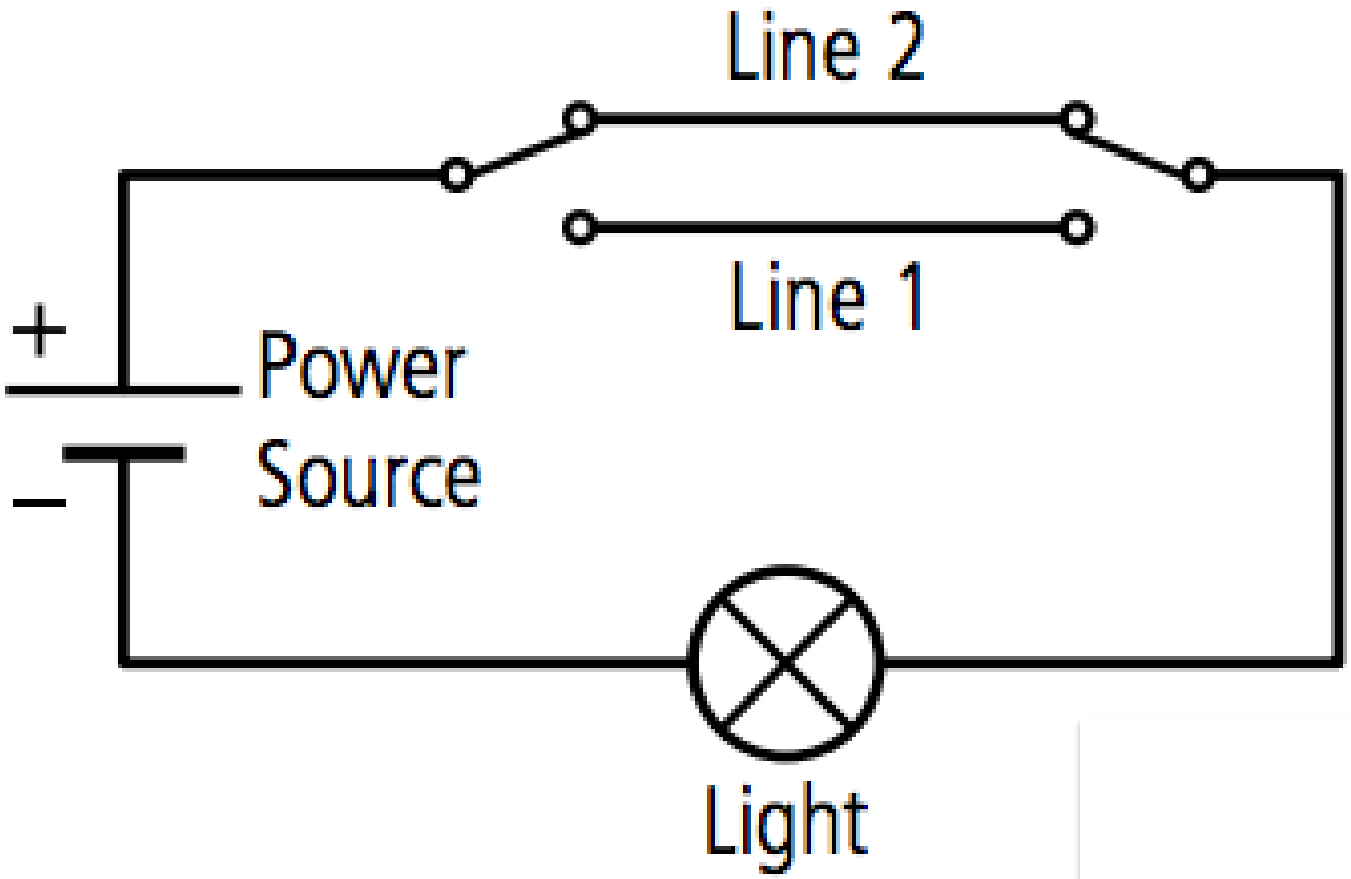
Watts (W) = Voltage (V) x Current (Amps)

Simple Circuits





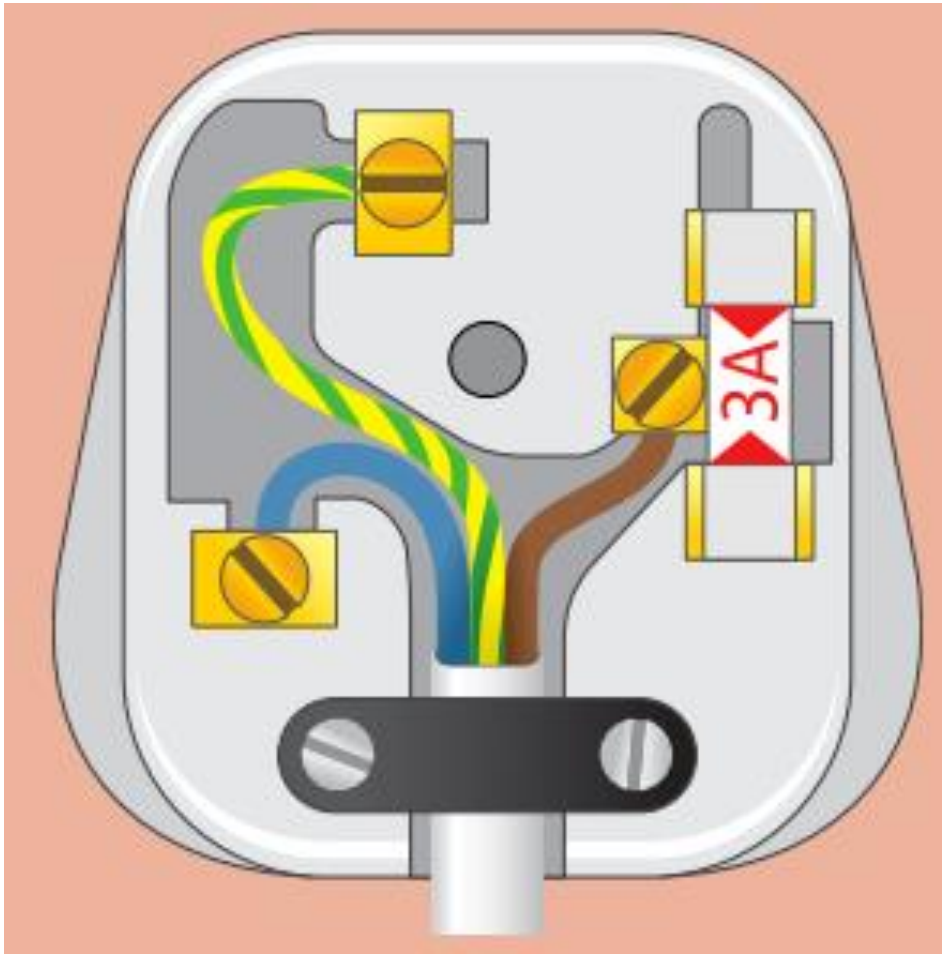
Double light switch



Wiring a plug - steps

1. Strip down the three core flexes.
2. When the wires have been prepared, they can be connected to the terminals in the plug.
3. Tighten the cable using the cord grip. This ensures that the cable ends cannot be pulled from their terminals

Wiring a plug - diagram

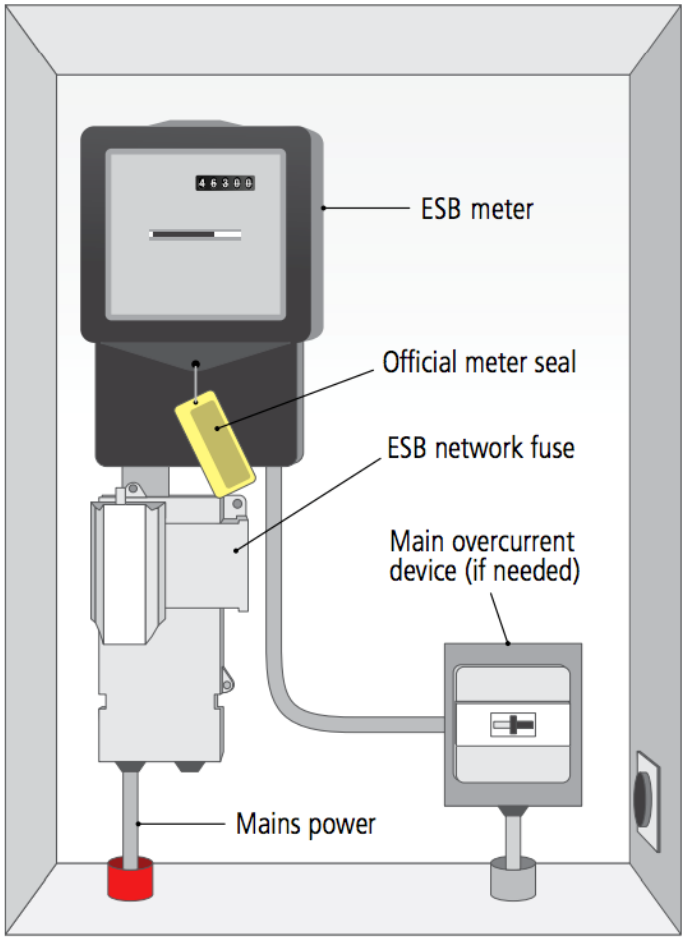


Blue = BL = Bottom Left

Brown = BR = Bottom Right

Earth is connected to the Earth terminal (top)

ESB meter enclosure



Electrical distribution board

- The electricity is taken from the mains power cable to a distribution board in the house
- This board is filled with miniature circuit breakers (MCBs), residual current devices (RCDs) and fuses, which regulate and control the distribution of electricity in the home.

Electrical safety - Fuses

- A fuse is a deliberate weak link in a circuit.
- If the current becomes higher than it should be, the fuse burns out and breaks the circuit, thereby saving the circuit and the appliances attached to it from burning.

Electrical safety – Miniature Circuit Breakers (MCBs)

- Miniature circuit breakers monitor the amount of current flowing in the circuit.
- MCBs are set to a safe maximum current, and if the current exceeds the safe maximum they will trip.
- When an MCB ‘trips’ – physically, a switch flips from on to off in one-tenth of a second – it prevents current from flowing.
- The MCB will trip, for example, if the circuit is overloaded with too many appliances, or if there is a fault in the circuit.
- When the fault is solved, the trip switch can be flicked back to the On position, which will restart the current.

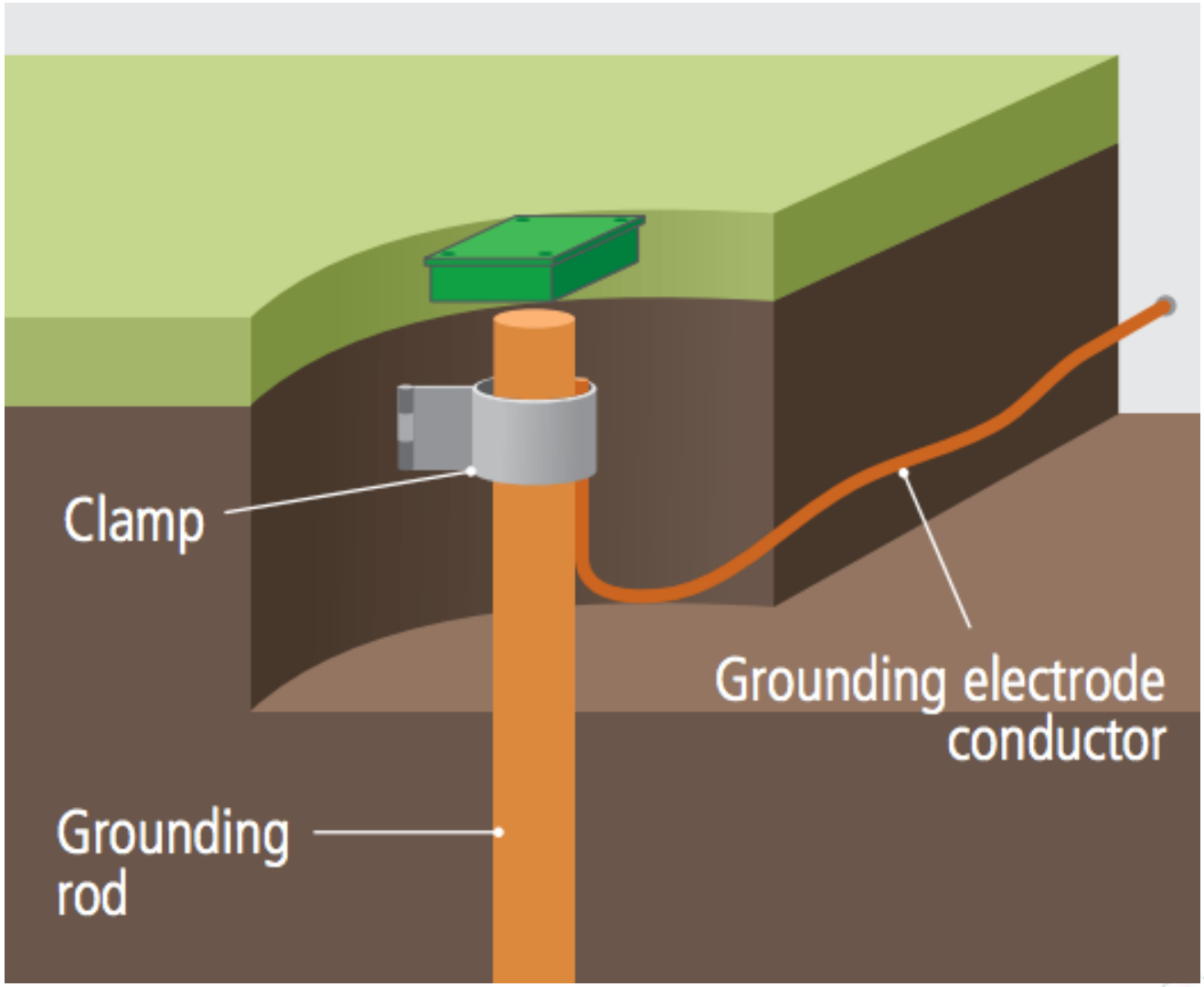
Miniature circuit breakers

Electrical safety – Residual Current Devices (RCDs)

- An RCD reacts to differences between current in the circuit.
- If a circuit is damaged, the current can leak and flow through nearby objects, creating a danger of electrocution.
- The RCD detects any leakage of current, and if there is a difference of 30 milliamps or more in the circuit it will trip in milliseconds and stop the current flow.
- Most RCDs have a test button, which allows a homeowner to test that the RCD works as a safety device (Fig. 22.20). RCDs must be fitted as standard on all socket, water heater and electric shower circuits.

A residual current device (RCD)

Electrical safety - grounding the circuit



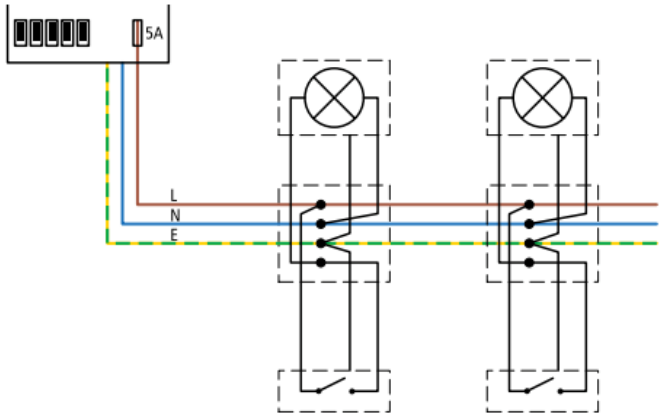
Electrical safety – Appliance isolation

- Appliances that require higher than normal current need to have additional safety elements installed.
- This applies to electric cookers, water heaters and instantaneous electric showers.
- They need to have higher gauge – i.e. higher diameter – wiring from the distribution board to the appliance and they also require a double pole isolation switch.
- This switch disconnects both the live wire and neutral wire at the same time.
- Acts as a secondary safety device to those found on the distribution board.

Circuits in the home: Lighting circuit

The lighting circuit starts at the distribution board and passes through all light fittings before returning to the distribution board.

In comparison to other circuits, lighting is ‘low drain’, which is to say it uses little electricity.



Circuits in the home: Ring main circuit

- The ring main circuit is the loop of electrical outlets (sockets) which are used to power appliances around the home.
- Large houses may have more than one main ring circuit.
- The kitchen warrants having two dedicated ring main circuits because a high amount of heavy draw appliances are located here, and several of them may be in use at the same time.

Ring main circuit - diagram

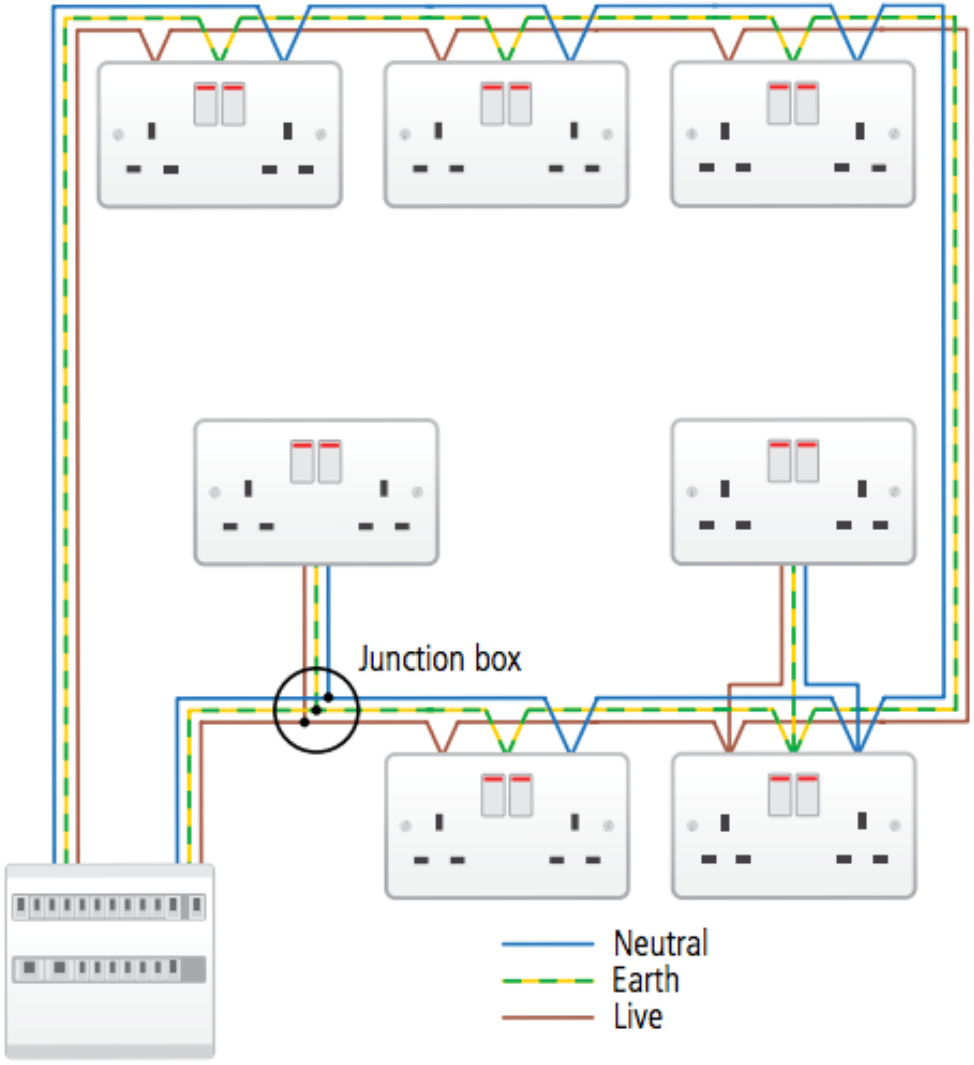
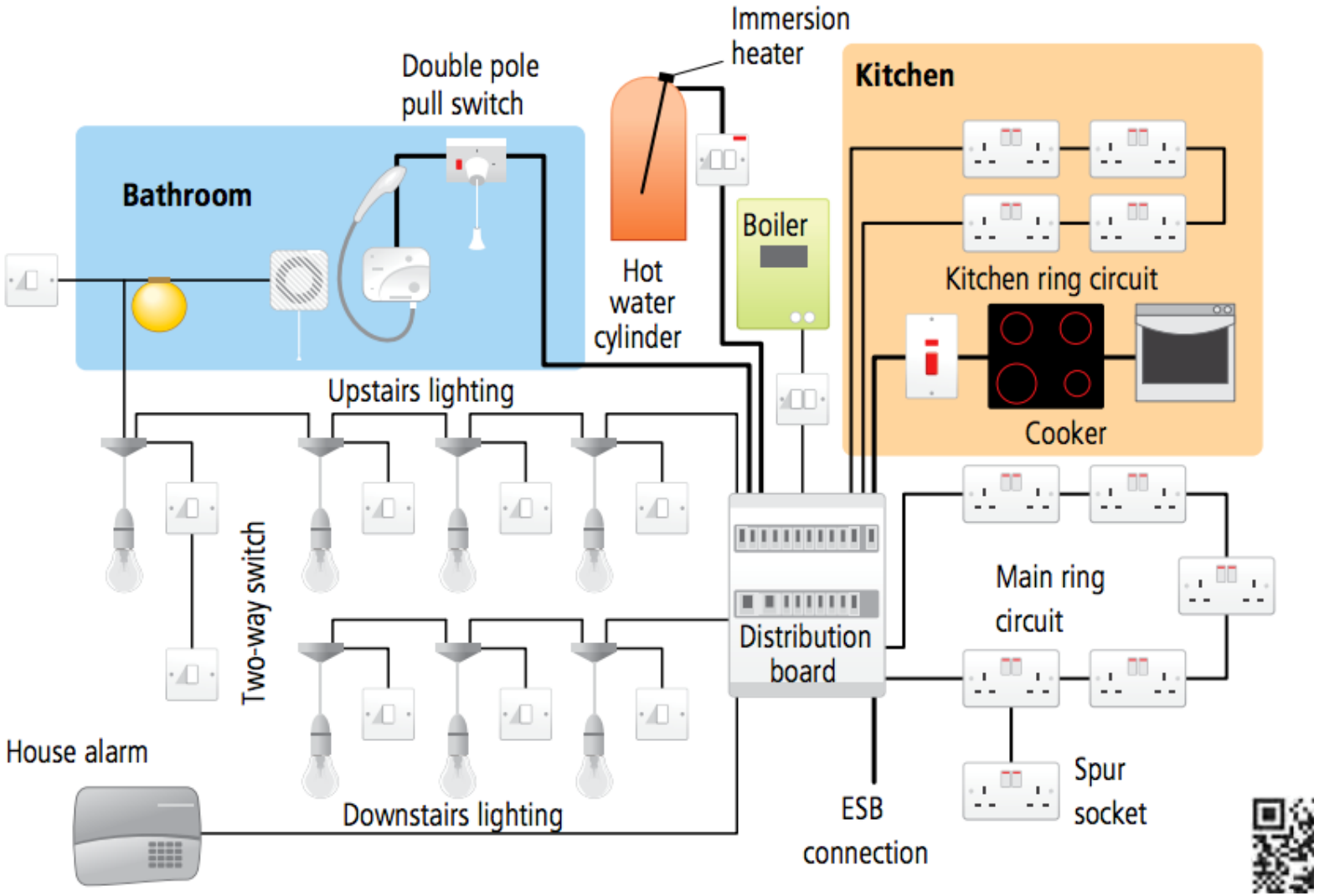


Fig. 22.25 Main ring circuit.

Overview of electrical circuits in the home



Typical appliance ratings

Light bulbs	40W, 60W, 100W, 150W
Electric fire	1kW, 2kW, 3kW
Television	200W
Electric kettle	1kW, 2kW,3kW
Hairdryer	1500W or 1.5kW
Electric cooker	8kW
Fridge	600W
Washing machine	920W

Home Certification

- Electricity is a dangerous element, so it is important that a qualified electrician carries out all electrical work in the home.
- Whenever electrical contractors carry out a new electrical installation, or modify an existing installation, they are obliged to test and certify that it meets current standards set by the **ElectroTechnical Council of Ireland** (ETCI).
- The client should receive a copy of this certification when the work is completed.
- The client passes this on to the ESB, who will in turn connect or reconnect the dwelling to the network.