Static Electricity
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- Charging materials
- Electrostatic forces
- Summary activities
What causes static electricity?

Static electricity is due to electric charge that builds up on the surface of an insulator, such as a plastic comb.

The charge that has built up cannot easily flow away from the insulator, which is why it is called static electricity.
Where does static charge come from?

All materials are made of atoms, which contain electric charges.

The nucleus at the centre of an atom contains **protons**, which have a **positive** charge. Around the outside of an atom are **electrons**, which have a **negative** charge.

An atom has equal numbers of electrons and protons and so has no overall charge.

Electrons do not always stay attached to atoms and can sometimes be removed by rubbing.

Atoms that have lost or gained electrons are called **ions**.
How does static charge build up?

Static charge can build up when two insulating materials are rubbed together, such as a plastic comb moving through hair.

Friction between the materials causes electrons to be transferred from one material to the other:

- one material ends up with more electrons, so it now has an overall negative charge
- one material ends up with fewer electrons, so it now has an overall positive charge.
How can static charge be created?

Friction can be used to create a static charge.

If an insulator is rubbed with a cloth, it can become charged in one of two ways:

Electrons move from the cloth to the insulator. The insulator ends up with an overall negative charge.

OR

Electrons move from the insulator to the cloth. The insulator ends up with an overall positive charge.
Static charge – true or false?
How can static charge be detected?

A gold leaf electroscope can be used to detect charge.

An electroscope consists of an earthed metal case, inside which a metal rod is connected to a metal plate.

A piece of gold leaf is attached to the other end of the metal rod.

When the metal plate becomes charged, the charge spreads out through the metal rod and the gold leaf.

The metal rod and the gold leaf gain the same charge, so the thin gold leaf is repelled from the rod and sticks out.
A Van de Graaff generator is a machine used to build up static charge.

It was invented in 1931 by Robert Jemison Van de Graaff, an American physicist.

This machine uses the simple principle of rubbing insulating materials to build up a supply of charged particles.

The generator can produce very high voltages and was first used to help scientists study the behaviour of subatomic particles.
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What are the forces between charges?

The forces between charges can be investigated using rods made of insulating materials.

What happens when two positively-charged acetate rods are placed near each other?

The rods repel each other because they have the same overall charge.

What will happen if one rod is replaced with a charged polythene rod?
How do opposite charges behave?

When a charged acetate rod is placed near a charged polythene rod, the rods attract each other. Why does this happen?

The polythene rod has an overall negative charge and the acetate rod has an overall positive charge.

The overall charges of these rods are opposite and so they attract each other.
Investigating pairs of charges
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