Static Electricity - Teacher's Notes

Forces which formed our Solar System

There are four forces that cause change in the Universe. Strong nuclear forces (which hold the nuclei of atoms together), weak nuclear forces (which cause radioactive decay), electromagnetic forces (which cause materials to be attracted and repelled from each other) and gravitational forces (which pull a less massive object towards a more massive object). The first pair of forces only act across minuscule distances. The effects of the second pair can be seen to act across the Universe and affect our everyday lives. If we are sitting on a stool, we can feel gravity pulling us down but the electromagnetic forces acting between the atoms in our chair stops us being pulled through the chair onto the ground.

In short:

A force is a push or a pull which can affect objects.

1. ***Both magnetic (or static fields) and gravity are forces which act at a distance.***
2. ***Gravity is a very weak force which acts over immense distances and is a force of attraction.***
3. ***Static electrical fields are strong forces but only act over very short distances and can be a force of attraction or repulsion.***

Static electricity is the first weak force that pulled parts of the Universe together. It was the first force to assemble our Solar System.

Static Electricity

If two objects are rubbed together and if the outer electrons in their atoms are not strongly bound to their nuclei, electrons can be transferred within the objects and from one to the other. The objects or parts gaining

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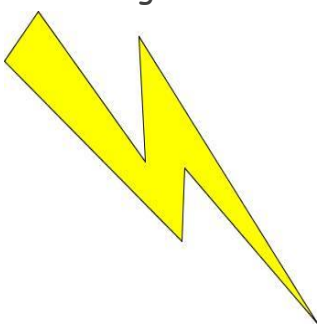
electrons develop a negatively charged field and those losing electrons develop a positively charged field. These fields are similar to magnetic fields and can cause the objects to be pulled together or to move apart.

The charge between them is called static electricity. It differs from current electricity that we get from the domestic electricity supply because it does not flow easily but discharges in single dramatic events like the discharge caused by lightning.



The blue flash and crackle you may have noticed when removing clothing in the dark is caused by static discharge. Similarly lightning is the result of static discharge. Dry skin tends to give up electrons and polyester clothing tends to gain electrons. When you move they cling together. When, however, the polyester clothing is dragged away the electrons discharge back to the skin with a flash of light and a crackle.

Students are probably also aware that if they don't clean their bedrooms, wind from doorways or fans will blow dust under their beds. Dust and hair particles will rub together to make dust "bugs" or "mice".

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Six Experiments or Demonstrations

Materials per group

- 1 balloon inflated and tied off
- A generous student with a good head of fine hair or a woolen scarf or a dry microfiber cloth
- A clean plastic comb
- Smooth wall or roof
- A pile of small pieces of paper
- Chads from a hole punch or a finely shredded tissue
- An aluminium cool drink can

Method

A. Balloon and wall or ceiling

1. Rub the inflated balloon vigorously on hair or a scarf or a microfibre cloth to "charge" it.
2. Place it firmly against the wall or ceiling. If it does not stick, repeat.
3. Record observations.

B. Balloon and shredded paper

1. Rub the inflated balloon vigorously on hair or a scarf or a microfibre cloth to "charge" it.
2. Hold the balloon a short distance above the shredded paper.
3. Record observations.

C. Balloon and hair

1. Rub the inflated balloon vigorously on hair or a scarf or a microfibre cloth to "charge" it.
2. Hold it above the head of another student with fine hair.
3. Record observations.

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D. Balloon and fine stream of water

1. Rub the inflated balloon vigorously on hair or a scarf or a microfibre cloth to "charge" it.
2. If you have a goose necked tap, let a very fine stream of water run and approach it from the side with the charged balloon. Note: If the balloon is touched by the water it will instantly lose all its charge. It must be rubbed again to pick up a new charge
3. Record observations.

E. Comb, hair and shredded paper or chads

1. Vigorously comb hair to charge the comb.
2. Hold the comb just above the shredded paper.
3. Record observations.

F. Comb and aluminium can

1. Vigorously comb hair to charge the comb.
2. Approach the can laid on its side. Note: If the comb and can touch repeat combing to recharge it.
3. Record observations.

Teacher Notes

Static electricity completely loses its charge at once. The charged object will not hold any charge until it is recharged.

Balloon and wool	The balloon collects electrons and gains a negative charge.
Comb and hair	Comb collects electrons from hair. Each strand of hair now has a positive charge and is forced away from other strands since like charges repel. People, cats and dogs can suffer from "fly away hair" after brushing.
Sparks or "boots"	If you brush your hair in the dark, once a few electrons

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scraped off the outer hair strands move across to the comb they create heat which expands the air and makes it glow.

Sitting on a car seat and moving about can build up quite a static charge. Metal conducts electricity, so that when you touch the metal body of the car you can get an electrical discharge or "boot".

Students living in dry desert areas will know that shoes rubbing as they walk across a carpet is sufficient friction to cause a static charge to build up. Touching a metal door handle releases the charge and the "boot".

Static charges began clumping together dust and gas in the early Universe. When hydrogen atoms spread outwards after the "Big Bang" they rubbed together, built up a static charge and started to form larger clumps of matter and gas.

"From little things big things grow" Paul Kelly