

## Episode 405: Preparation for electric fields topic

Students will have first come into everyday contact with electric field phenomena when seeing a rubbed balloon stuck to a wall, or, on a much grander scale, through lightning. They may have been told of many other applications of electric fields in areas such as photocopying, laser-printing, flue-ash precipitation, spray-painting etc.

They will now study the field in more detail, following much the same route as with the gravitational field (although there is naturally more practical work that can be included with E-fields than with g-fields). In fact, from the beginning the similarities between g-fields and E-fields should be brought out – in particular the fact that they are both inverse square laws, and so their equations look very similar indeed. The only major differences are that with E-fields we deal with repulsions as well as attractions, and that the strength of the electric force between two point charges is gargantuan compared to the gravitational force between them.

### Episode 406: Fields, field lines and equipotentials

### Episode 407: Coulomb's law

### Episode 408: Field strength, potential energy and potential

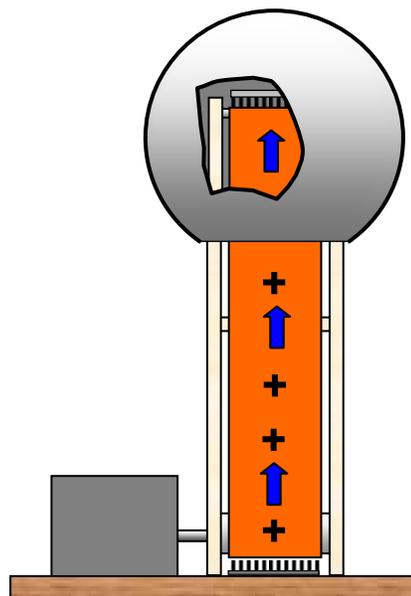
### Episode 409: Uniform electric fields

#### Advance warning

There are some tricky experiments in this topic, and it is well worth practising them in advance. Some equipment to look out for:

A **van de Graaff generator** is a most useful accessory. Learn to operate it without giving yourself (or your students) electric shocks.

The **flame probe** is a useful device for exploring potential in electric fields, but you need to know how to set it up, calibrate it and use it.



(resourcefulphysics.org)

#### TAP 409-2: Flame probe construction

Try to establish in your mind the similarities and differences between the three types of field that you will be teaching about: electric, magnetic and gravitational. Watch out for confusions among your students. One common problem that can occur is confusing electric charge with magnetic poles. This more normally happens when students are studying magnetic fields, when they talk about magnets being charged up, or the field emanating from the positive end of a magnet, for example. It is best when studying electric fields to be aware of this confusion, and any time it crops up (rare in this part of the course) to try to nip it in the bud as soon as possible.

#### Main aims

Students will:

1. Understand the concept of an electric field and explain how a field might arise.
2. Interpret diagrams showing field lines and equipotentials.

3. Understand the meaning of the term **field strength**.
4. Understand and use Coulomb's law, and the meaning of the term **permittivity**.
5. Understand and use uniform field equations.
6. Understand and use the terms electric potential energy and potential, and relate potential to field strength.
7. Draw parallels between electric and gravitational fields.

## **Prior knowledge**

Your students should have covered the following concepts:

Basic definition of a field, law of force between charges, charging by friction and induction, work, kinetic energy, Newton's laws of motion.

We have assumed that students have already studied gravitational fields. Hence, they should have covered the following concepts:

Inverse-square field, field lines, equipotentials, gravitational field-strength, potential energy and potential, zero of potential at infinity.

## **Where this leads**

These sections will consolidate the work on fields that was started with gravitational fields. With the occurrence of repulsions, students will learn to think carefully about the sign of an energy change and what this means, linking into the core ideas of change of potential energy and field strength.

For those who go on to study beyond A-level, the firm grounding in field ideas they've had here, coupled with those from magnetic fields, will lead them into one of the great pillars of classical physics – electromagnetism. Indeed difficulties in electromagnetism led the way for relativity and the more modern field theories of today.