

## Using semolina and an EHT to show electric field lines

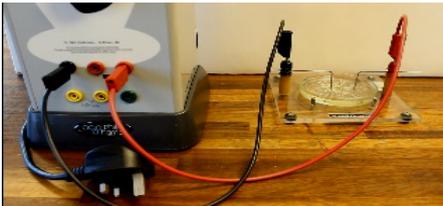
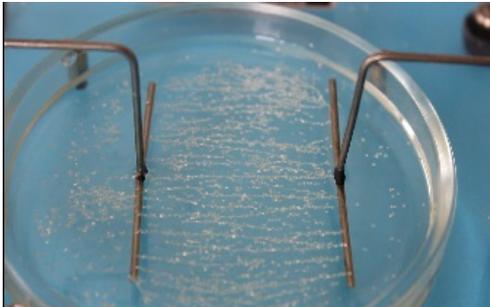
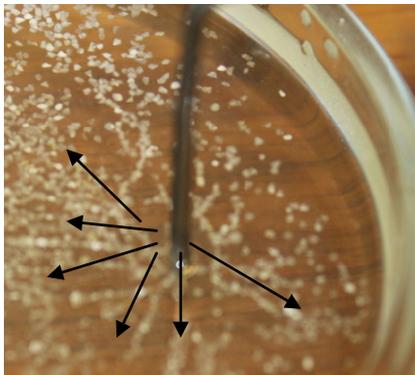
Most A-Level Physics syllabi require students to sketch various combinations of electric field patterns (e.g. a positive point charge and negative point charge, or a positive point charge to a negatively charged plate). This practical demonstration provides a vivid illustration which will help students both understand such fields, and remember them.

### You will need

- An Extra High Tension (EHT) supply capable of delivering up to 5kV. **Warning** – Do not try to perform this demonstration using a High Tension (HT) supply that can supply more than 5mA. ⚠
- Electric Field Lines apparatus (e.g. Phillip Harris order code: B8H26771)
- Semolina
- Castor oil
- Video projector or web cam if you have a larger class (optional)

### Method

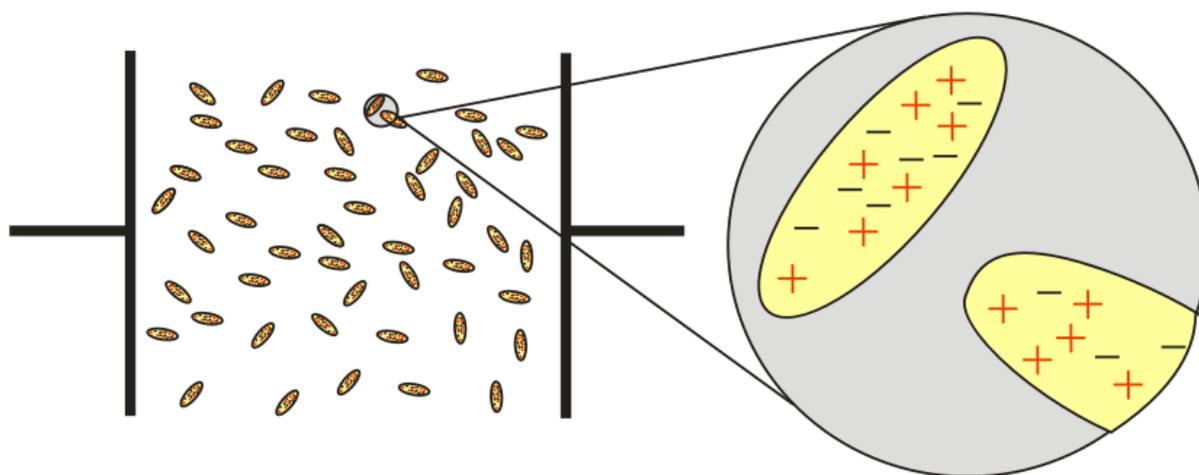
<p>1.</p> <p>Put the oil on top of a radiator for a few minutes to warm, or place the bottle in a beaker of warm water. Do no heat the oil directly.</p>	
<p>2.</p> <p>Ensure that the EHT is switched off, and not connected to the apparatus. Fix the electrodes in the screw down holders.</p>	
<p>3.</p> <p>Pour the oil into the dish, aim for a depth of about 0.5cm. The ends of both the electrodes should be submerged.</p> <p>Sprinkle the semolina on the oil, aim for a light dusting at first. Less is more.</p>	

<p><b>4.</b></p> <p>Connect the electrodes to the EHT. Use the extra resistor built into the EHT (if available). See the CLEAPSS guide to EHT supplies.</p>	
<p><b>5.</b></p> <p>Switch the EHT on and set the voltage to between 3 and 4kV. Watch as the semolina grains align themselves with the field. The alignment is fairly quick – typically a few seconds.</p>	
<p><b>6.</b></p> <p>Switch off the EHT, and disconnect from the mains. Try a different combination of electrodes (the picture shows a radial field from a point charge) and repeat experiment.</p> <p>It is possible to make your own electrodes if your set hasn't got all the combinations. Use 20-24 SWG Copper wire for best results.</p>	

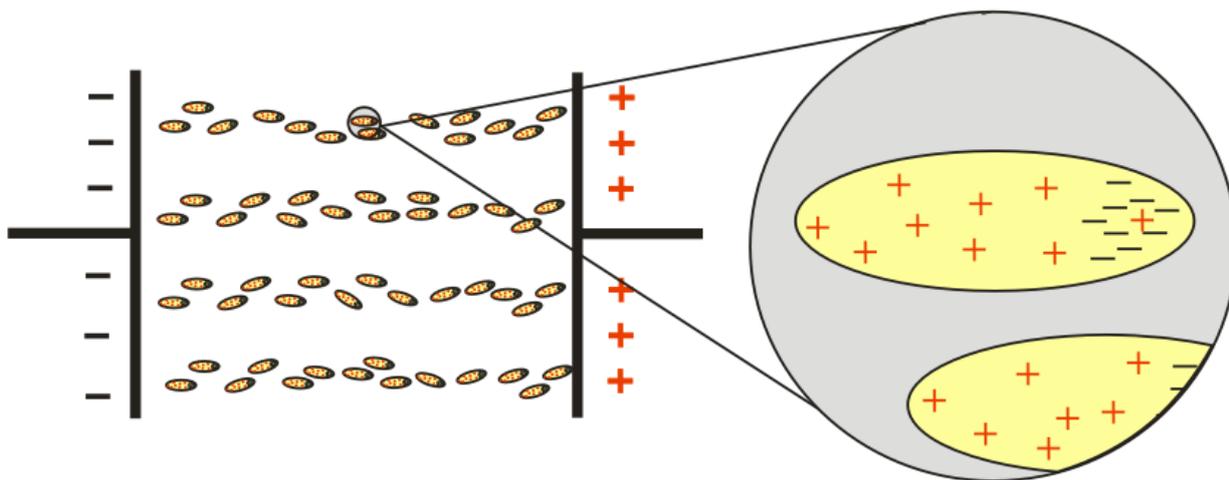
### The science behind the demonstration

In physics, a field is defined as a region where a force acts. Electric fields (along with gravity and magnetism) are examples of *non-contact forces*. Objects do not have to be touching for the force to be experienced. Electric fields are directional, and the electric field strength is defined as the force which is experienced per unit positive charge.

The positive terminal of the EHT will give the electrode a positive charge with respect to the negative. As the castor oil acts as an insulator, the positive and negative charges remain on their respective electrodes. This creates a field within the castor oil. The semolina will then align itself to the field in a similar way that iron filings align themselves in a magnetic field.



*When there is no voltage across the plates the charges within each piece of semolina are evenly distributed and the semolina is arranged randomly on the oil*



*Applying a large (3-4kV) voltage across the plates causes the charges in the semolina to redistribute creating negative and positively charged ends. The charged ends interact with the voltage on the plates and the resulting turning force aligns the semolina with the electric field*

### Practical tips

- It is sometimes difficult to see the semolina move around in the castor oil. Doing the experiment with a dark coloured A4 card or paper background will help increase visibility.
- Using a video projector will ensure everyone can see the movement of the semolina on the screen.
- After a few minutes, the semolina absorbs the oil, making the grains puffy. They don't move as much or at all. You may want to empty out your dish and replenish with new oil and semolina.

### Hazards and Risks:

- Do not attempt to use a HT power supply for this particular demonstration. EHT supplies are current limited to 3 or 5mA, HT supplies are not, and should never be used with bare conductors such as the electrodes which come with the apparatus.
- Be sure to switch off the EHT, and unplug it when changing the electrodes, sometimes (especially) in the middle of a lesson or demonstration this can easily be overlooked, causing an electric shock.



You can view this in action on our own YouTube Channel using the following link

<https://www.youtube.com/watch?v=Fhp63yvJAHs>