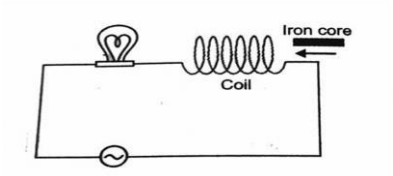
IOP Physics Hub-96 Notes & Resources 140324
Theme of Hub-96 *Electric Circuits*

1. Overview

Students of LC Physics have a significant number of electricity experiments to do within the list of 24 mandatory experiments. Building confidence with simple circuits is the focus of this Hub. The "energy stick" is a popular idea that emphasizes that current needs a closed loop for charge to flow. The energy stick also reinforces the idea that humans conduct electricity, (which leaves us vulnerable to electric shock). The challenge of lighting a bulb with a battery but only one wire is an interesting one, that students of all ages engage well with. See video:
https://www.youtube.com/watch?v=aIhk9eKOLzQ&t=8s
Oersted's discovery of 1821 uses a compass and a very simple circuit and makes a valuable point. Faraday's discovery of 1831 underpins how we still generate electricity today and is worth giving students the opportunity to experience. Connect a coil to a galvanometer and move a bar magnet relative to the coil and observe the needle oscillate. (Galvanometers are fragile!). See the PhET simulation: https://phet.colorado.edu/sims/html/faradays-law/latest/faradays-law_en.html
A **short circuit** is an electrical circuit that allows a current to travel along an unintended path of very low resistance. A large current may flow through part of the circuit and another part, be disabled.
At 3V water only conducts a tiny current, but a Galvanometer may be used to detect it. When salt is added, molecules dissociate, and the resulting increase in ions support a larger current. Students may investigate the effect of adding more salt or changing the surface area of the electrodes.
The principle of self-inductance may be demonstrated with the circuit shown (and finds application in a dimmer switch). An a.c. voltage is connected to a filament bulb and coil as shown. When an iron core enters the coil, a back emf is established which accounts for impedance and a resultant reduction in brightness of the bulb. Students could investigate the effect of using different voltage values, different cores, different numbers of turns of coil, and bulbs of different Wattage. A simple circuit whereby a thermistor is connected to a multimeter may be used to explore how resistance changes with temperature. A simple water-level detector was also shown. The ease and convenience of electrical connectors (compared to soldering) was noted.



2. Alan Casey presented a video illustrating the triboelectric generation of current

Alan showed how an LED may be powered by a triboelectric generator TENG as an alternative to using a battery. He reviewed some static electricity including, charging by contact and charging by induction. He showed how 2 aluminium electrodes (kitchen foil) may be attached to a sheet of paper with a small gap between the electrodes. An LED is then attached to the electrodes using wires and crocodile clips. When positioned with the paper above the foil, a PVC card is slid back and forth on the paper above the gap. Alan's video and further details are available at:
https://padlet.com/mathsmrcasey/from-static-to-light-let-s-illuminate-the-charge-ztfzmqkd2xorna0p

3. Rory Geoghegan recommends

P23 to 40 of the PDST booklet: ***Ideas and Conceptual Approaches for TY Science, 2018*** and the journal article at: ***https://iopscience.iop.org/article/10.1088/1742-6596/1108/1/012088/pdf***
and the resource: https://www.physicsclassroom.com/class/circuits

4. Máire Duffy's FET electroscope is documented in the Hub presentation