# Hub-96 Electric Circuits

We meet to share ideas and support each other in the teaching of Physics

Theme **Circuits**

David Keenahan IOP Physics Coach
Paul Nugent IOP Physics Coach

Alan Casey Teaches in Coláiste an Chroí Naofa, Cork

Thanks to Rory Geoghegan & Máire Duffy for their contributions

upcoming events

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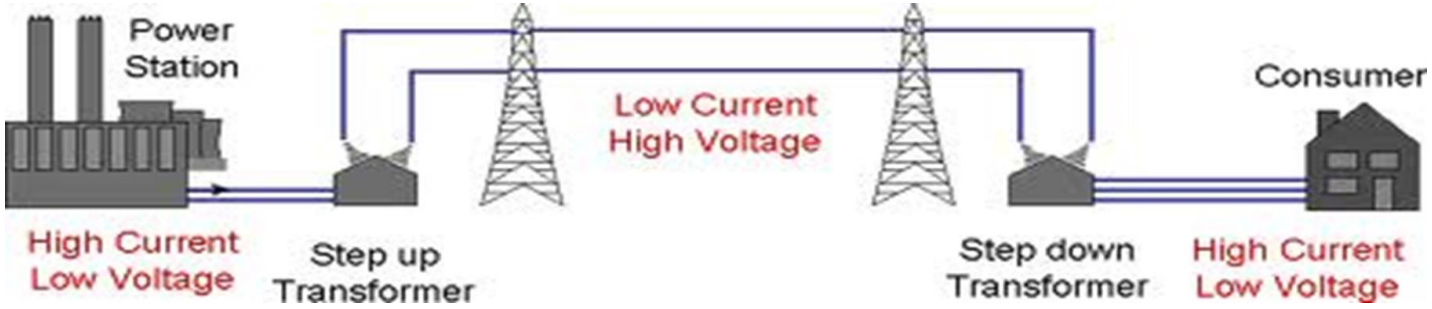
# Hub-95 Engineering

**Theme: Physics is great preparation for a career in engineering**

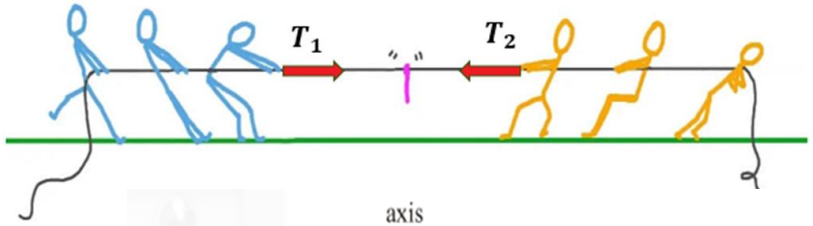
**Eamonn Lannoye**
**Managing Director, EPRI**
**Electric Power Research Institute**

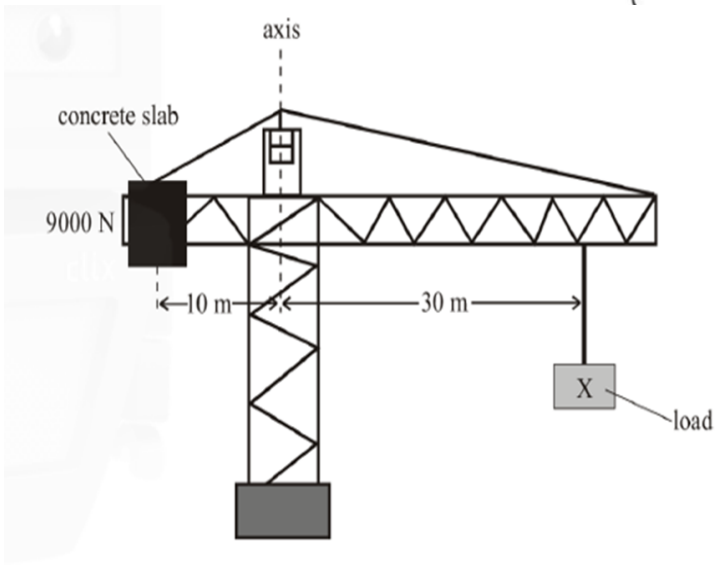
**Ken Keohane**
**President, ISTA**

Senior Manager, Thermo Fisher, Cork



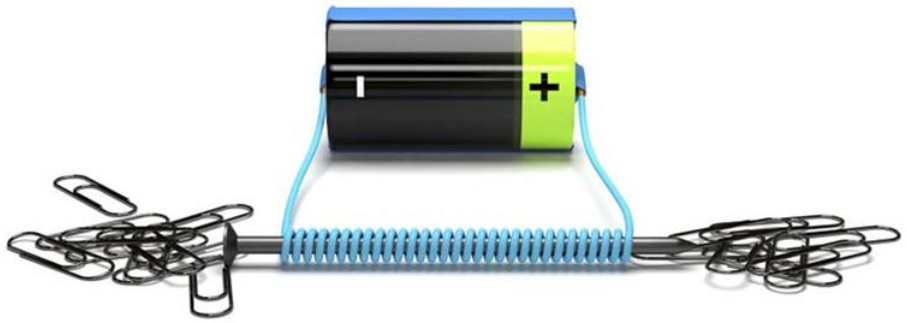


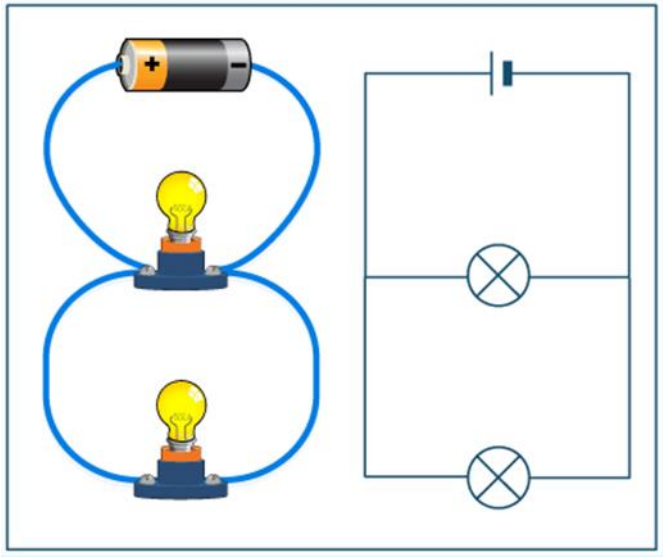


# Overview of Hub-96:

Some simple circuits that students might be familiar with from JC Science





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# Electricity Mandatory experiments

***Joule's law (as $\Delta\theta \propto I^2$)***

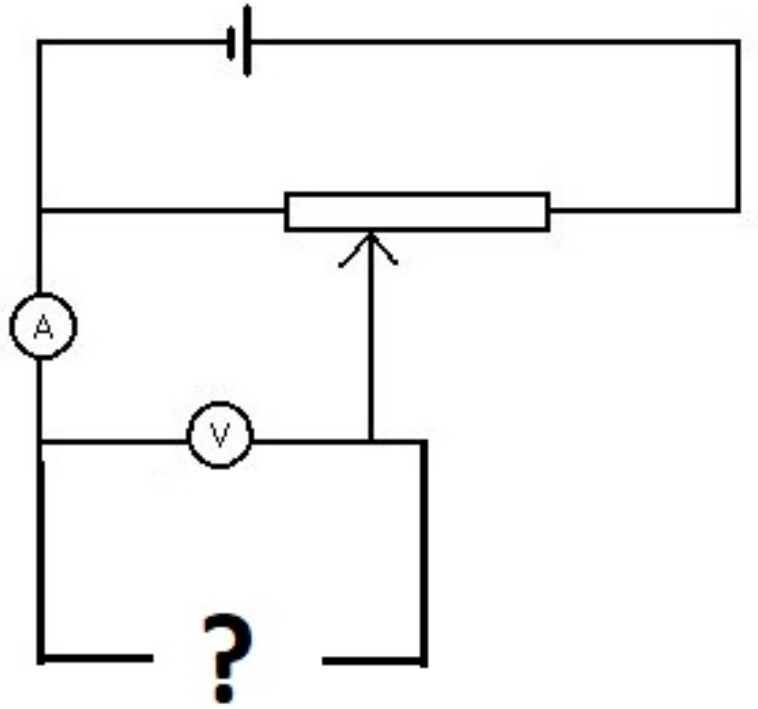
***Resistivity of the material of a wire***

***Variation of the resistance of a metallic conductor with temperature***

***Variation of the resistance of a thermistor with temperature***

***Variation of current with potential difference [ I – V graphs ]***

- ***(a) metallic conductor***
- ***(b) filament bulb***
- ***(c) copper sulfate solution with copper electrodes***
- ***(d) semiconductor diode***

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# Rory 1 https://www.physicsclassroom.com/class/circuits


Electric Circuits

a.Lesson 1 - Electric Potential Difference
   a. Electric Field and the Movement of Charge
   b. Electric Potential
   c. Electric Potential Difference

b.Lesson 2 - Electric Current
   a. What is an Electric Circuit?
   b. Requirements of a Circuit
   c. Electric Current
   d. Power: Putting Charges to Work
   e. Common Misconceptions Regarding Electric Circuits

c.Lesson 3 - Electrical Resistance
   a. Journey of a Typical Electron
   b. Resistance
   c. Ohm's Law
   d. Electric Power Revisited

d.Lesson 4 - Circuit Connections
   a. Circuit Symbols and Circuit Diagrams
   b. Two Types of Connections
   c. Series Circuits
   d. Parallel Circuits
   e. Combination Circuits

https://www.physicsclassroom.com/class/circuits

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# Rory-2 Misconceptions on electric circuits

Rory Geoghegan recommended:

Journal of Physics: Conference Series

PAPER • OPEN ACCESS

## Revealing Student's Multiple-Misconception on Electric Circuits

To cite this article: W Widodo *et al* 2018 *J. Phys.: Conf. Ser.* **1108** 012088

Available at:
https://iopscience.iop.org/article/10.1088/1742-6596/1108/1/012088/pdf

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# Rory-3

Rory Geoghegan recommends P23 to 40  of PDST booklet available as  PDF if requested by email.

PDST

Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

## Ideas and Conceptual Approaches for Transition Year Science

Autumn 2018

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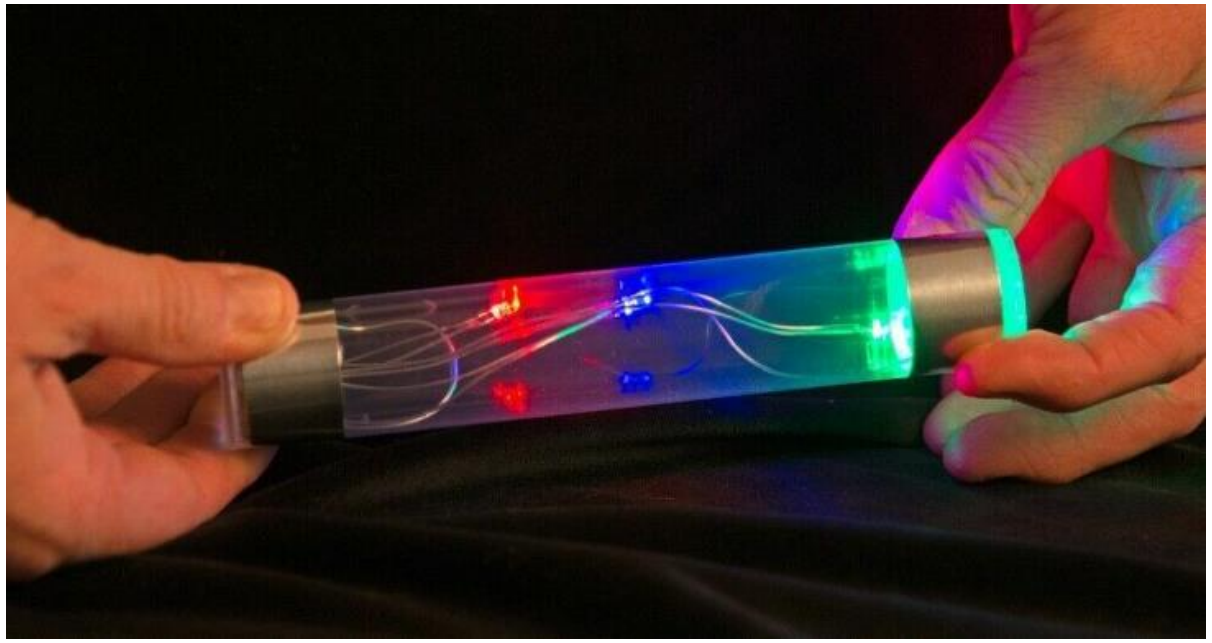
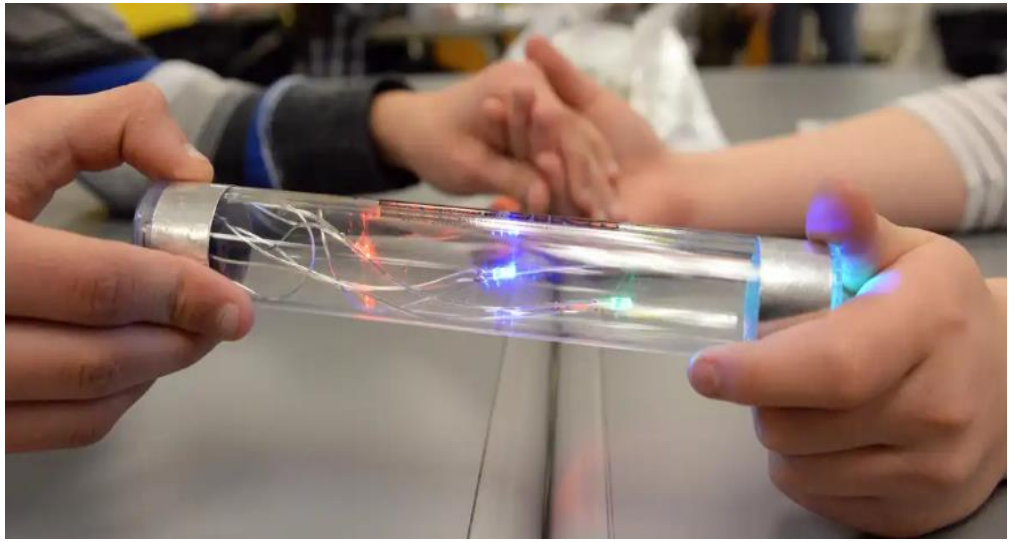
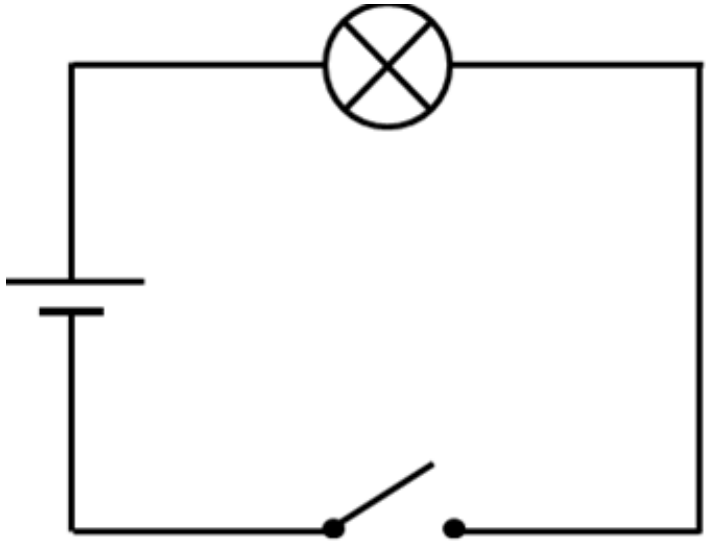
# Energy stick - to demonstrate the need for a circuit

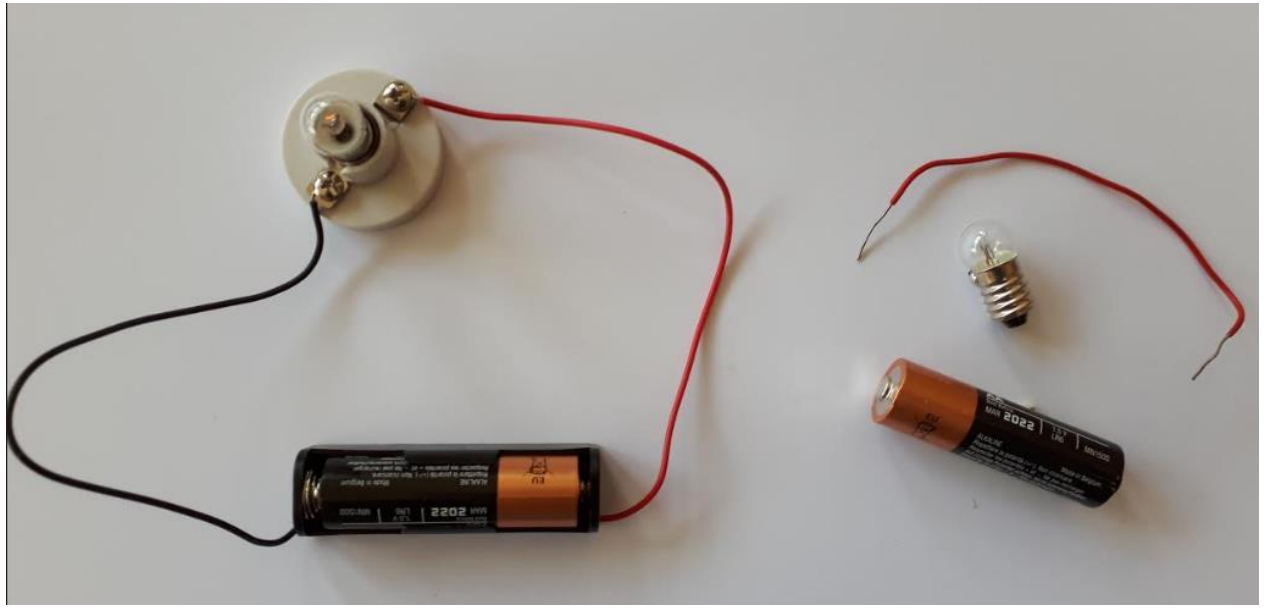




Type “energy stick science” into Amazon and order for about €14


# Simple circuits





The symbols and the reality look quite different.

**MIT graduates cannot power a light bulb with a battery**
https://www.youtube.com/watch?v=aIhk9eKOLzQ&t=8s

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# The link between electricity and magnetism


Oersted's famous discovery in 1821.
Close the circuit and see the compass needle deflect.

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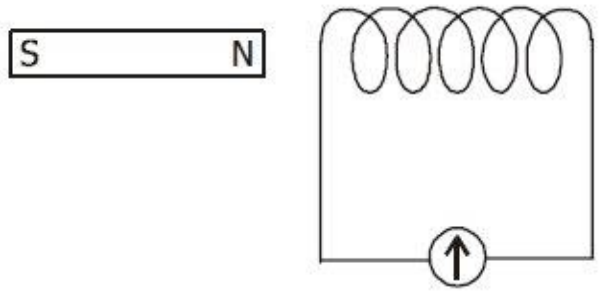
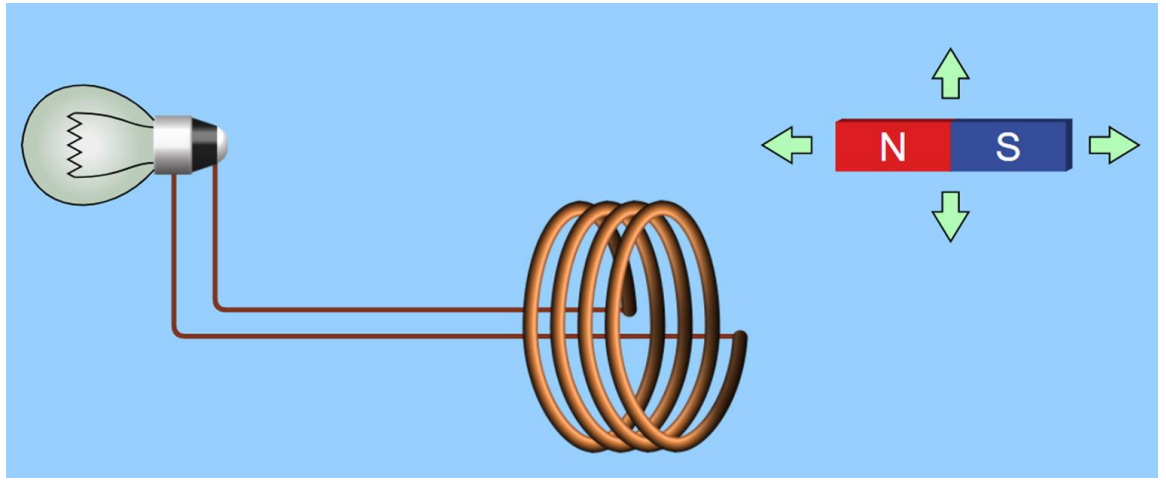
# Faraday’s electromagnetic induction

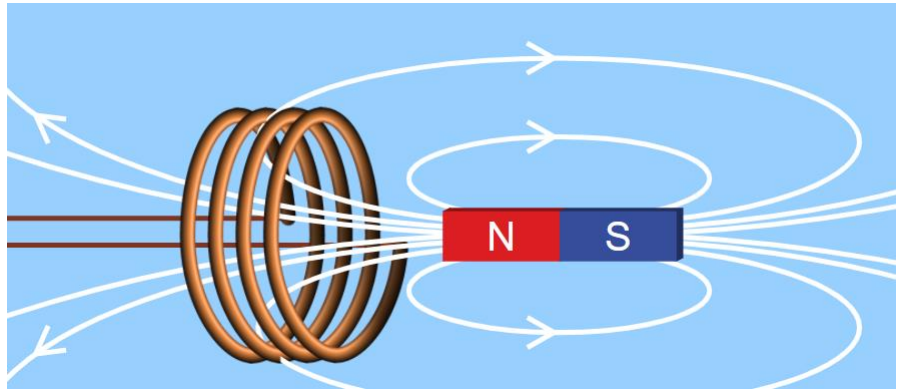




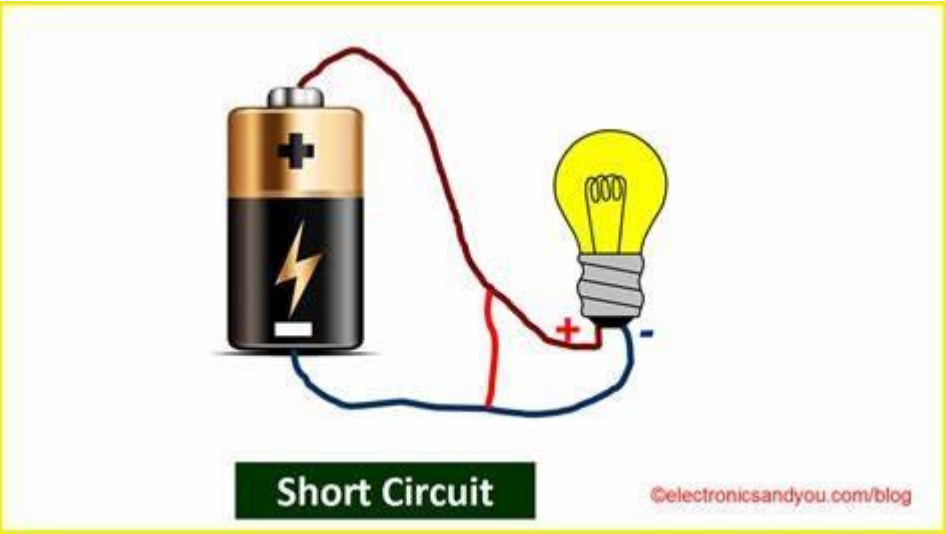
A simple circuit but a vital concept discovered by Faraday in 1831 that underpins the generation of electricity up to the present day.




https://phet.colorado.edu/sims/html/faradays-law/latest/faradays-law_en.html

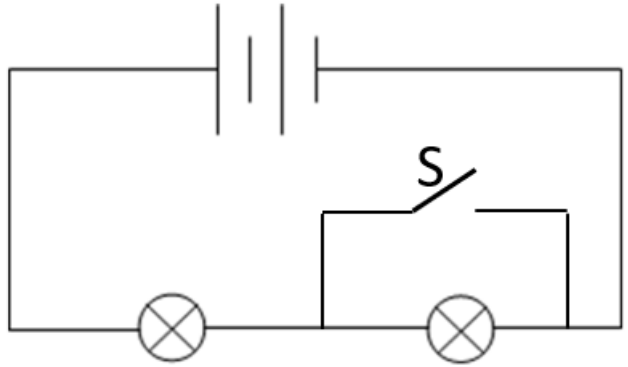


# Short circuit




A **short circuit**
(sometimes abbreviated to **short**)
is an electrical circuit that allows a current to travel along an unintended path with no or very low resistance.
This results in an excessive current flowing through the circuit.

The opposite of a short circuit is an **open circuit**, which is an infinite resistance between two nodes.




Close switch S to see the effect of short circuiting that bulb.

Current prefers to take the easy path.

# Alan Casey

Alan Casey presented a 4-minute video on the Triboelectric effect.

He 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.

The video and further details are available at:
https://padlet.com/mathsmrcasey/from-static-to-light-let-s-illuminate-the-charge-ztfzmqkd2xorna0p

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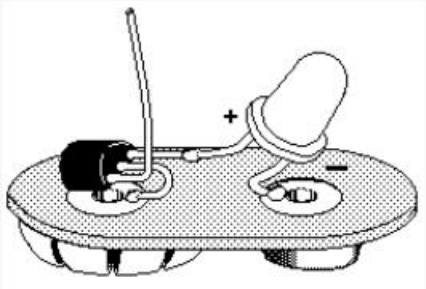
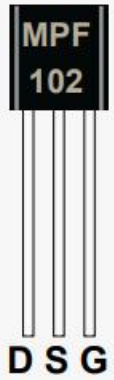
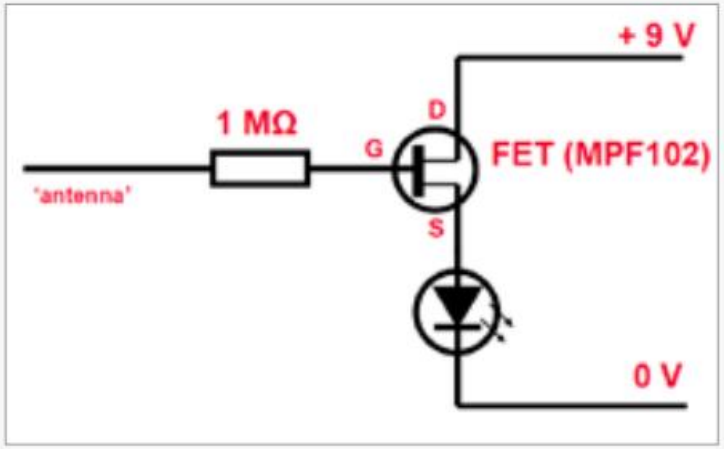
# Máire Duffy’s amazing demo

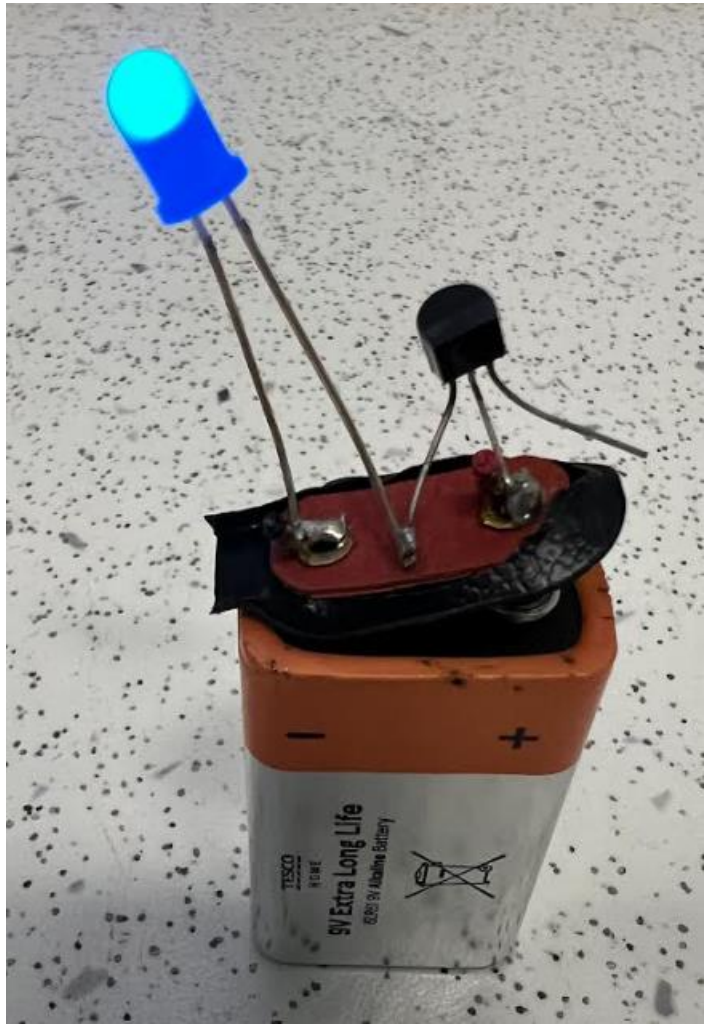
Máire Duffy’s amazing demo

- ✓ balloon
- ✓ materials to test for static electricity.

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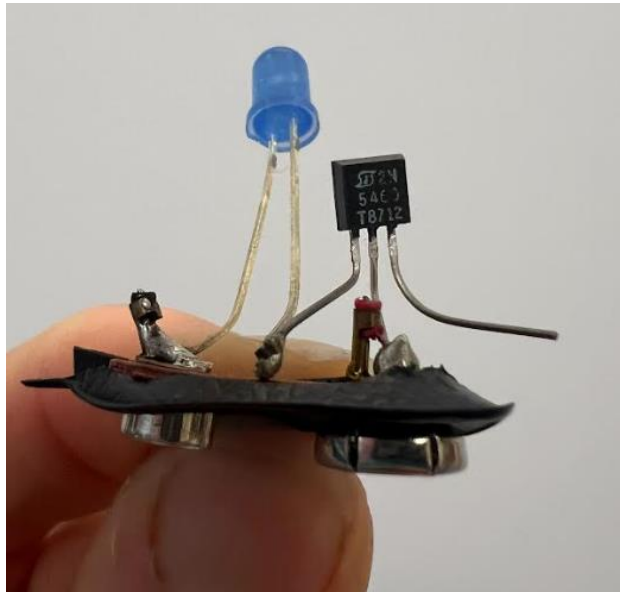
# Máire Duffy FET electroscope

**Background**

The MPF102 is a Field Effect Transistor (F.E.T) (Can be bought online on Amazon)
9-volt battery & 9-volt battery clip 9
red/blue light emitting diode (L.E.D)
soldering iron & solder
balloon and materials to test for static electricity.



**Follow these steps**

1. Bend the gate wire of the F.E.T upwards. This acts as the antenna so leave it unconnected.
2. Connect the middle wire, the Source, to the red positive lead on the 9-volt battery clip.
3. Connect the remaining wire, the Drain, to the positive leg of the L.E.D (longer leg).
4. Connect the negative leg of the L.E.D (shorter leg) to the black negative lead of the 9-volt battery clip.
5. Check your circuit is correct and then connect the battery clip to the top of the 9-volt battery. The red L.E.D should light up.
6. To test the circuit rub a balloon on your hair and bring it close to the gate wire. The L.E.D should go dark but will light up again when you remove the balloon. 7. If it doesn't work the humidity may be too high. You can check this using a balloon and rubbing it on your hair.
8. A wire (0.5m) can be soldered to the gate leg to act as an antenna,
9. If the L.E.D does not light up touch the gate wire with your finger to reset

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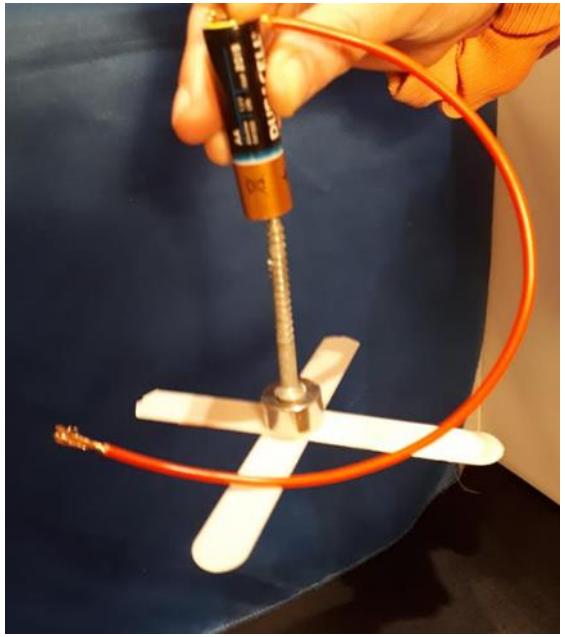
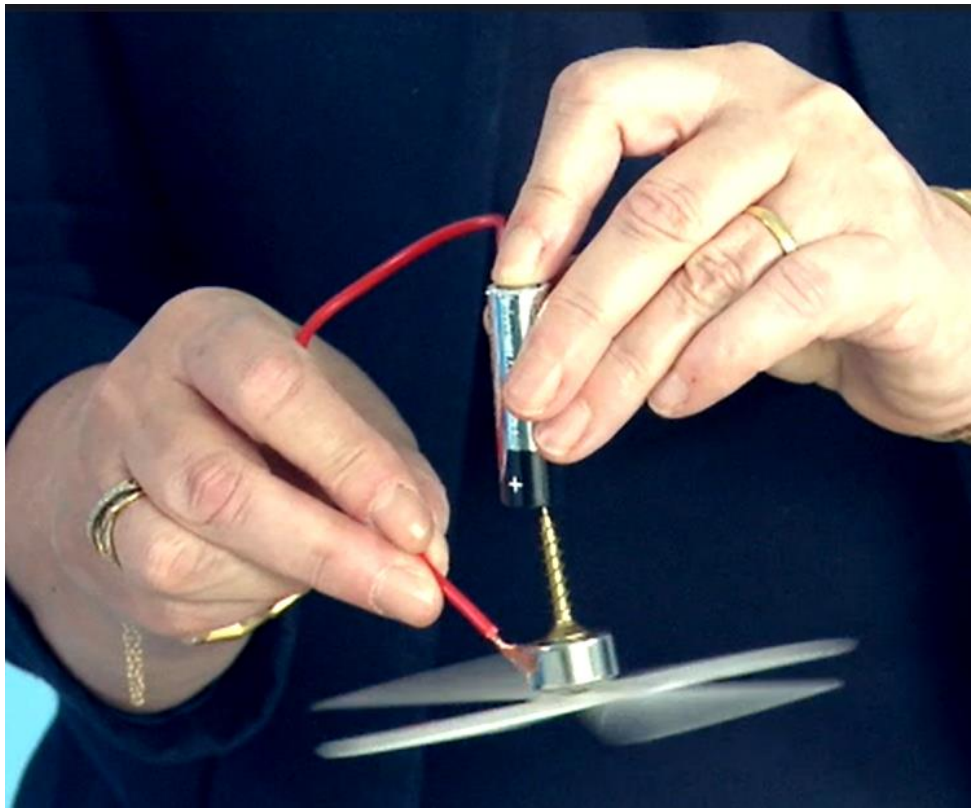
# A really simple electric motor

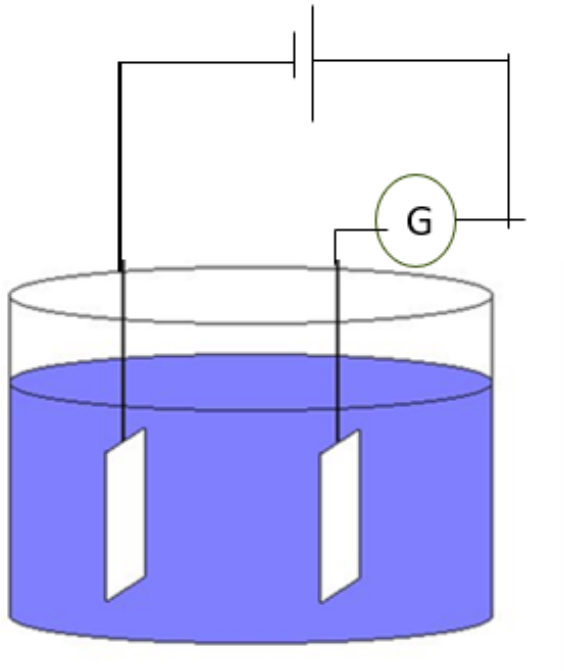




**Ackowledgement:  Paul Nugent**

Bring the bare end of the wire in contact with neodymium magnet and current will flow through the closed loop, inducing a magnetic field and the propeller rotates

# Conduction in liquids



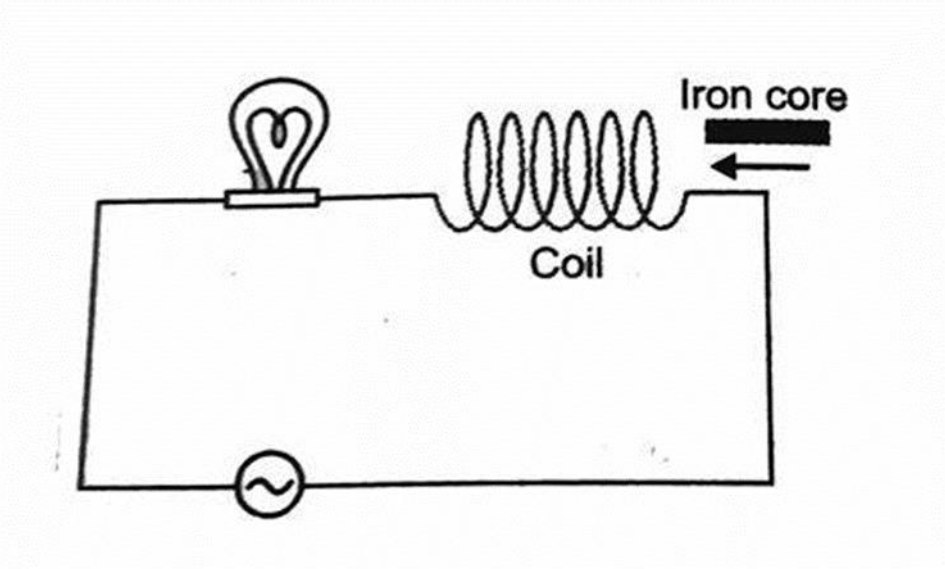

Conduction in water

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.

Investigate the effect of:
-- adding more salt
--- changing the surface area of electrodes

Electroplating
Silver plating or copper plating
would be a good extension activity if suitable materials are available.

# Self Inductance



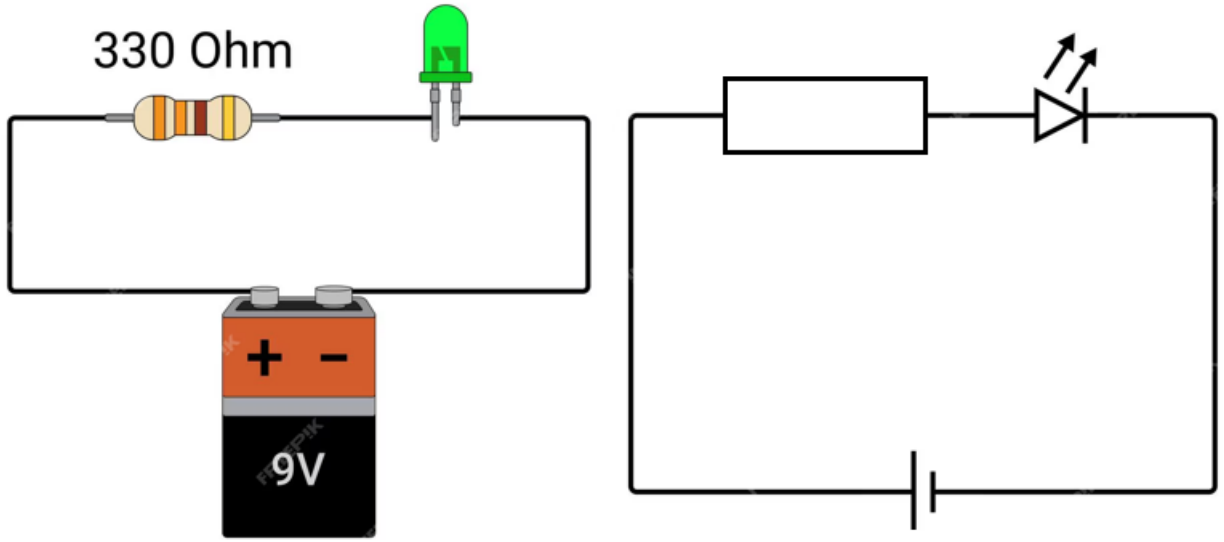

Dimmer switch

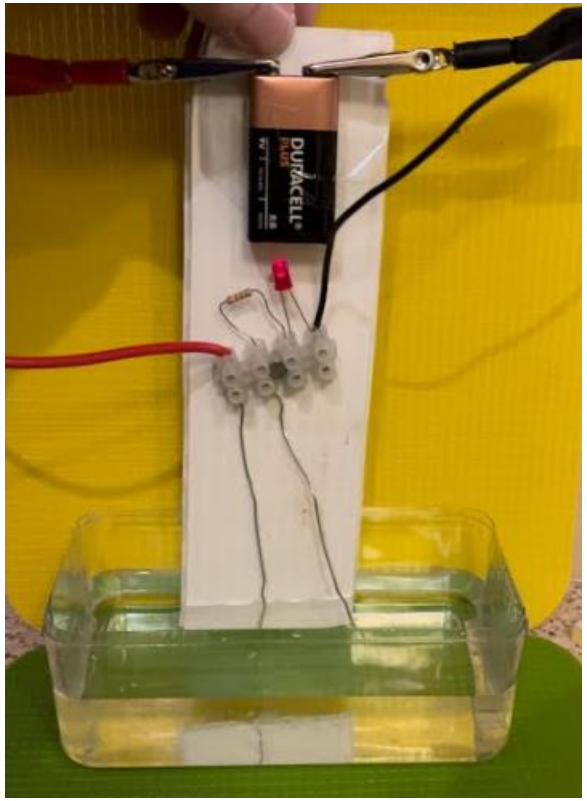
Impedance

Investigate:

Voltage values…..
Different cores
Different number of turns of coil
Different bulbs

# Simple water level detector




When the water level rises above the ends of bare wire, the circuit is complete and the LED illuminates.

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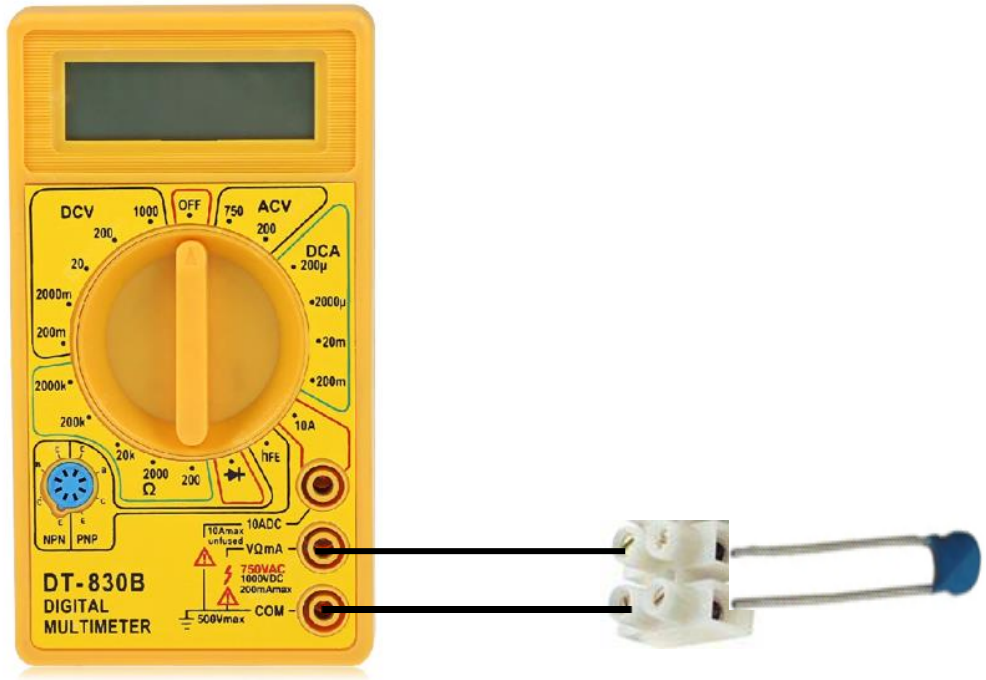
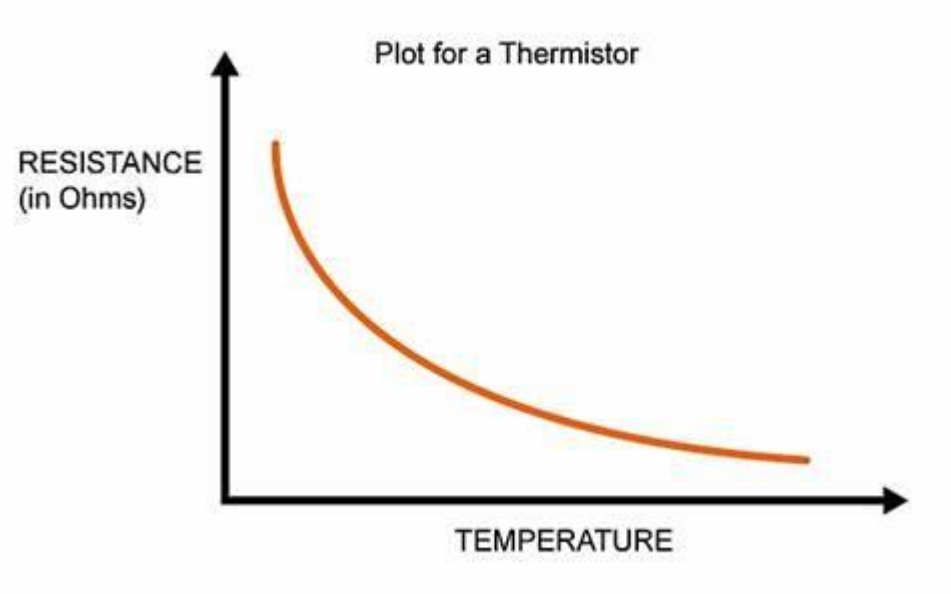
# Thermistor




A simple circuit to explore how resistance changes with temperature

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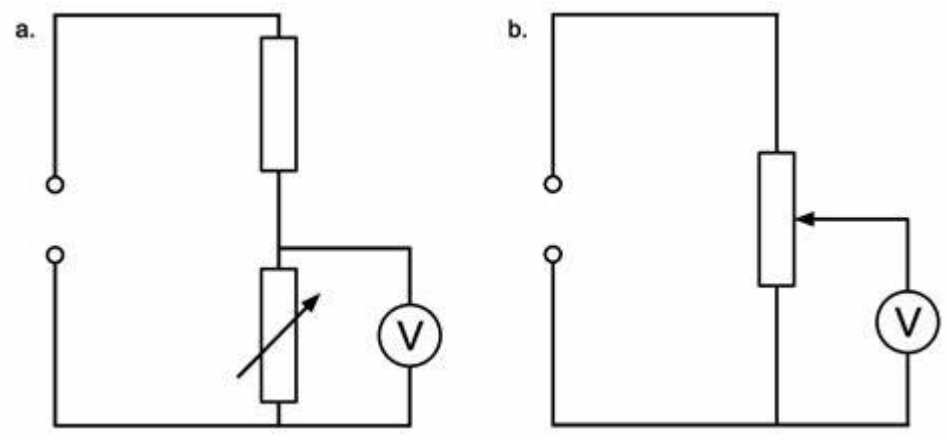
# Potential divider



Upcoming events

# IOP Spring Conference, 6 April 2024 Dublin

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Home Register Rosse Medal Programme Venue Contacts

# Ireland Spring Conference 2024

**Rosse Medal competition, showcasing postgraduate research,**
**Keynote speaker: Prof. Lorraine Hanlon Director of C-Space (UCD)**
Dr. Luca Matra, TCD, Excomets researcher
Prof. Sinéad Ryan, TCD, Theoretical High Energy Physics.
Themes: membership of ESO and associate membership of CERN.
**Plus, networking opportunities and an evening dinner**.

## 6 April 2024

Royal College of Surgeons, Dublin, Ireland

# Electronics workshop: An introduction to simple circuits

Oide

## Upcoming Elective Workshop

### Electronics Workshop 1:
### An Introduction to Simple Circuits

| Date | Venue | Time |
|---|---|---|
| Thursday 7th March | Monaghan EC<br>Athlone EC | 19:00 – 21:00 |
| Tuesday 19 March | Galway EC<br>Dublin West EC | 19:00 – 21:00 |
| Thursday 21st March | Limerick Education Support Centre<br>Cork Education Support Centre<br>Kilkenny EC | 19:00 – 21:00 |

Attendees will receive an electronic components resource kit.

No. of Places: **25**

https://oide.ie/apply-book-now/teachers/

Tacú leis an bhFoghlaim Ghairmiúil i measc Ceannairí Scoile agus Múinteoirí

Supporting the Professional Learning of School Leaders and Teachers

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https://oide.ie/apply-book-now/teachers/

# ACT NOW FOR SDGs Workshop Galway Ed Centre Wed Mar 20th

SCIENCE ON STAGE EUROPE

Back to main page

## Act Now for the UN Sustainable Development Goals

SDGs in STEM Education


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Supporting the Professional Learning of School Leaders and Teachers

SCIENCE ON STAGE IRELAND

# Sustainable Development Goals in STEM Education

https://bit.ly/SDGbooking

**This face-to-face evening workshop will afford all STEM teachers the opportunity to engage in a practical workshop relating to the Sustainable Development Goals (SDG's) in STEM education in a collaborative setting. This event will allow teachers of STEM subjects to discuss and share ideas to best support their students in areas relating to the SDG's in STEM education in a practical way.**

**This workshop will take place on each of the following dates:**

## Galway Ed Centre Wed Mar 20th 7-9pm

## Attendees will receive a BBC microbit

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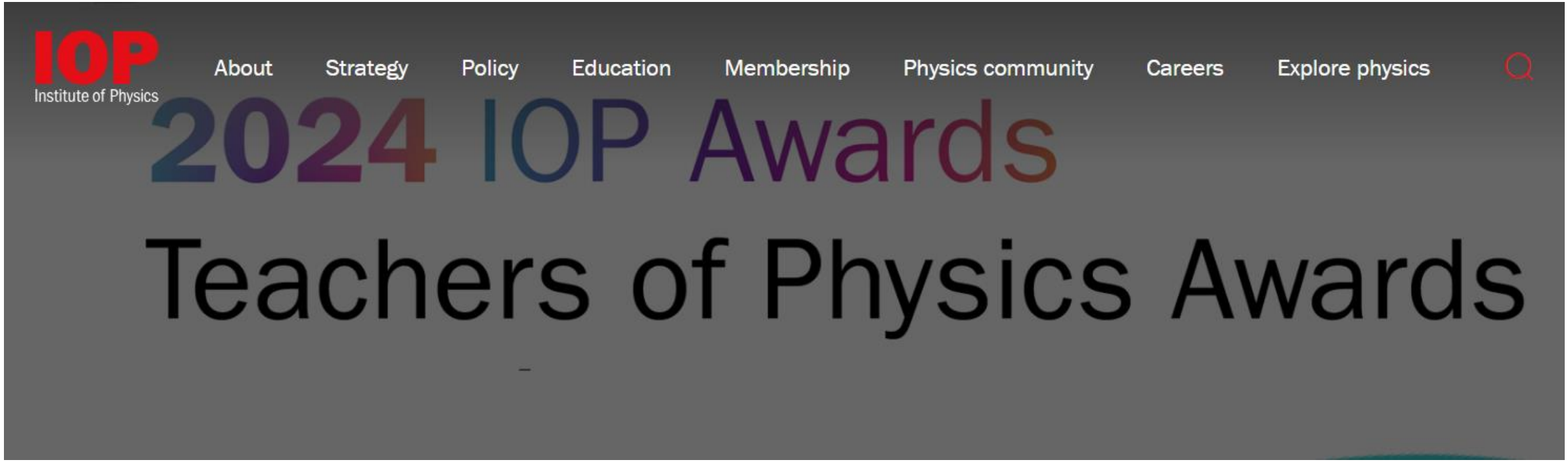
# IOP Teacher of Physics Award




https://www.iop.org/about/awards/teachers-physics-awards

The winners receive a prize of £1,000, an engraved glass paperweight and a certificate.
The nominations for the 2024 IOP Teacher of Physics Awards close at midday
on Saturday 30 March 2024

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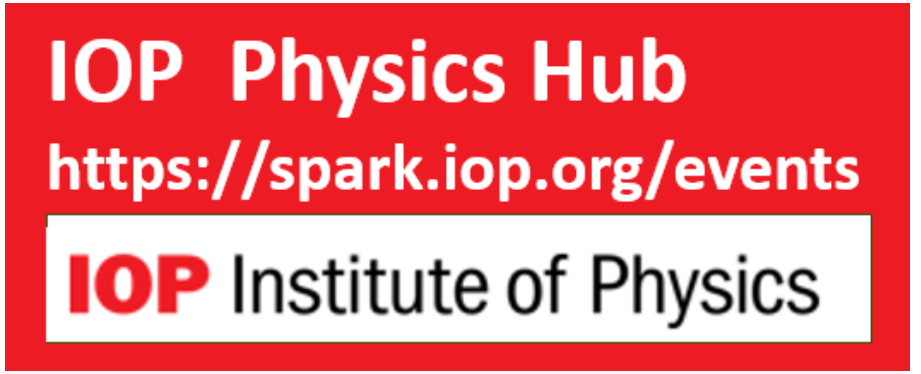
# The next IOP Physics Hub

Next IOP Physics Hub will be after Easter

Booking at:

https://spark.iop.org/events




Resources including Notes, Weblinks & presentations
are available at the following link will be emailed to attendees

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# The Eurekas https://theeurekas.co.uk/

The Eurekas
A Limit Less Challenge

https://theeurekas.co.uk/

The Eurekas, is a competition for 11-16 year olds in the UK and Ireland,
The competition open on 4 March.
This year, our question is: ‘Can physics help us solve mysteries?’
The question can be answered in any format
- singing, painting, writing or even skating!
Our inspiring prizes this year include €1,200 for the winner (plus €300 for their school), two runners up prizes of €600 and six prizes of €300 for an outstanding entry from someone at every age, from 11 to 16.
Whether you’re a student, teacher, parent or carer, there are a number of ways that you can get involved and inspire a young person to see physics differently.
Check out The Eurekas website for more information.

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