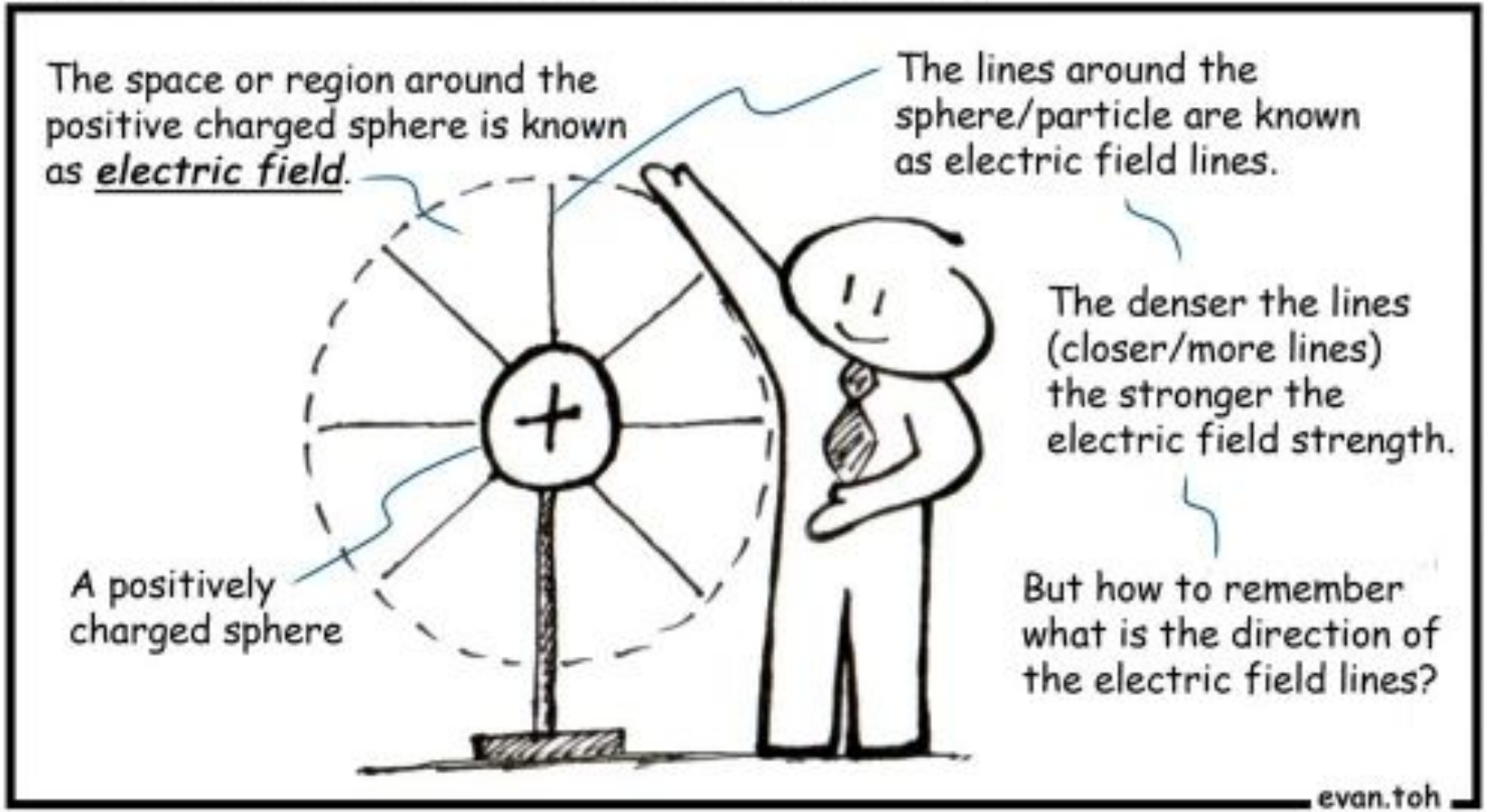
Physics Education Laboratory
Lecture 12
Content Knowledge for Electricity

Francesco Longo - 22/11/21

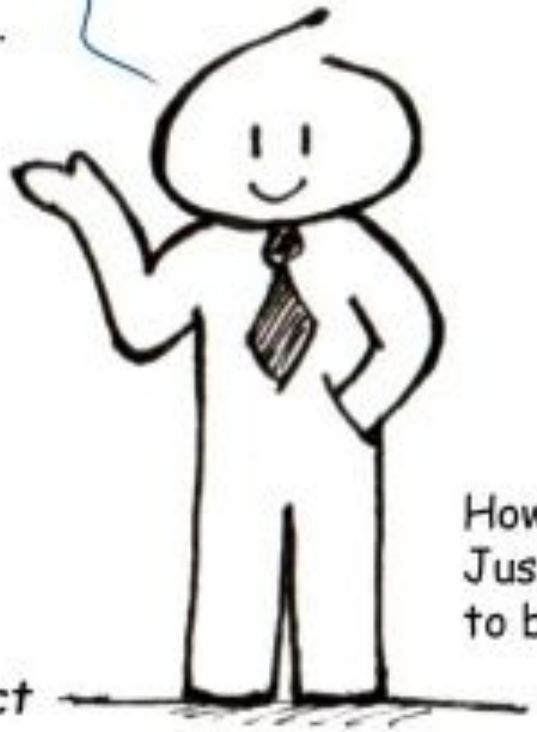
Electric Field, Electric Field Lines and Direction



To know the direction of the electric field lines ...

Just image you always have a tiny ***positive charge*** in your pocket ...

... and recall the Laws of Electrostatic
- ***Like charges repel***
- ***Unlike charges attract***



How to remember it is positive? Just remember that you want to be a 'positive' person!

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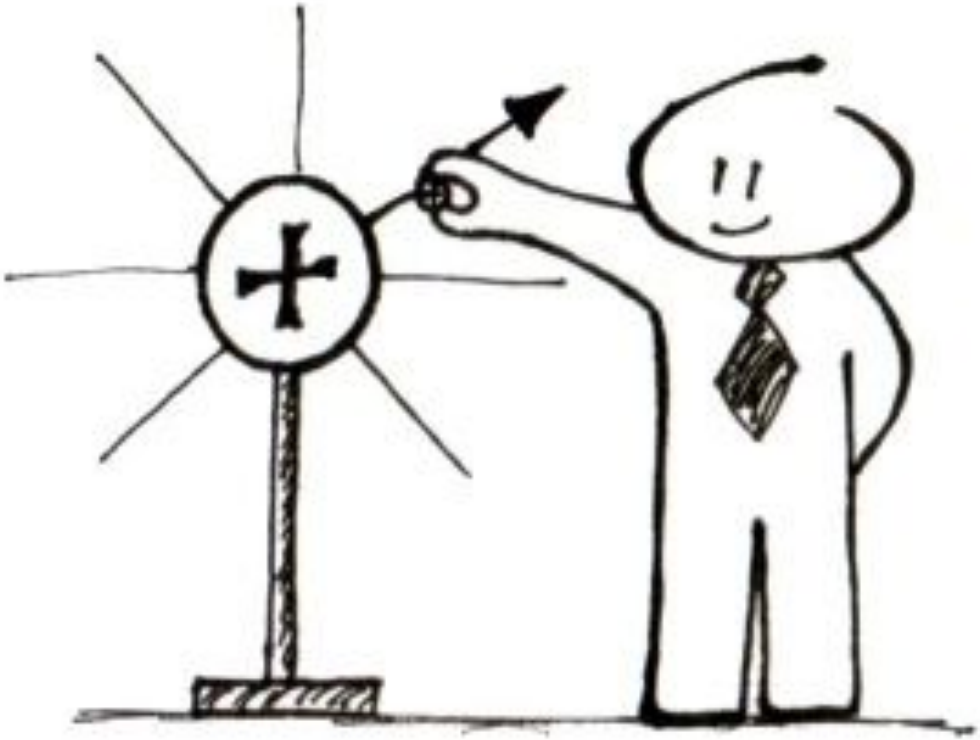

Using the positive test charge, place it in the electric field of the positive sphere in this case.

As like charges repel, the positive charge will be repelled by the positive sphere. Hence it will move outwards.

The direction of the force experiences by the positive charge indicates the direction of the field lines.

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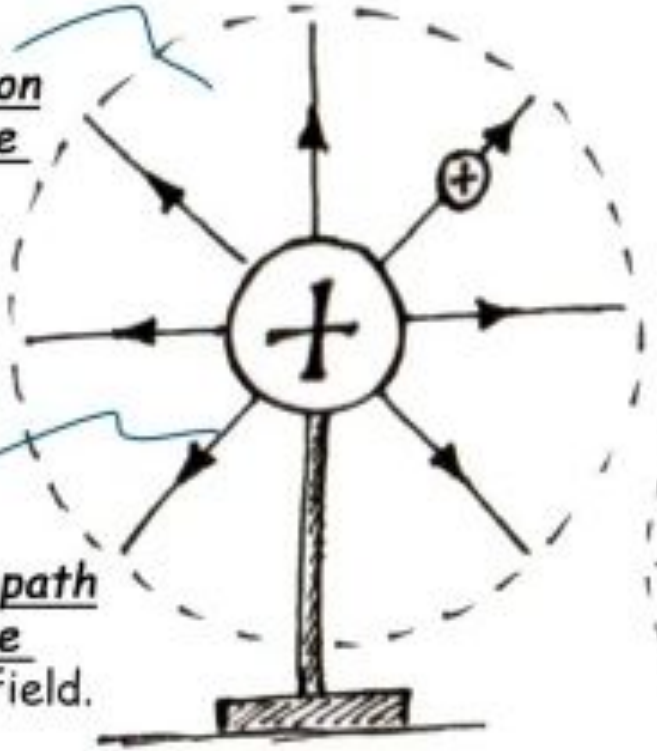
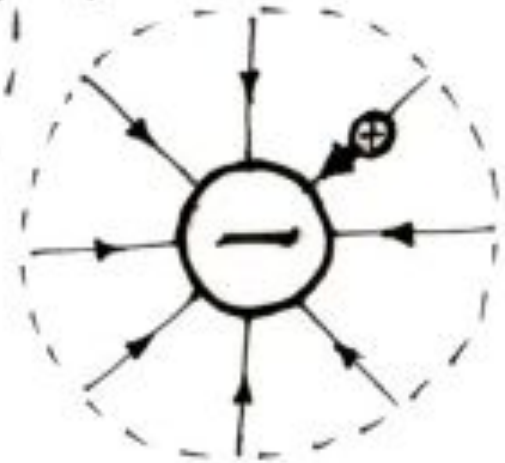
Definition of the terms...

Electric field is the ***region*** in which an ***electic charge*** ***experiences a force*** (attraction or repulsion).

Electric field line is the ***path*** in which ***a positive charge*** would take in an electric field.



Concepts apply for electric field around a negatively charged sphere.



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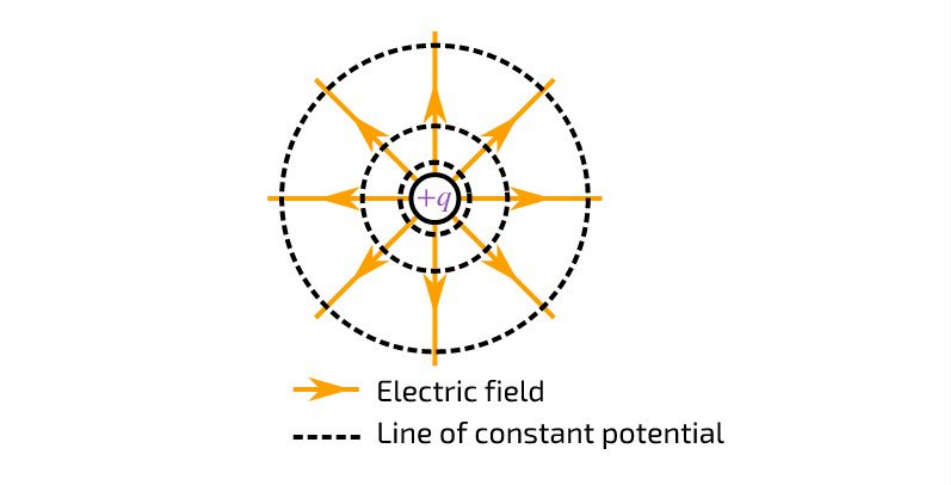
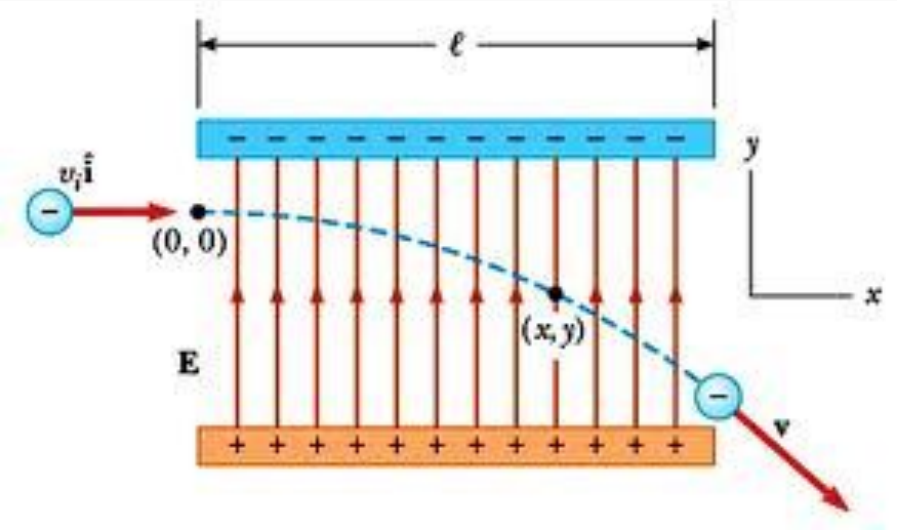
Key concepts in Electrostatics

- The electric charge (with opposite signs)
- The Coulomb law
- The Electric field
- The Electric potential



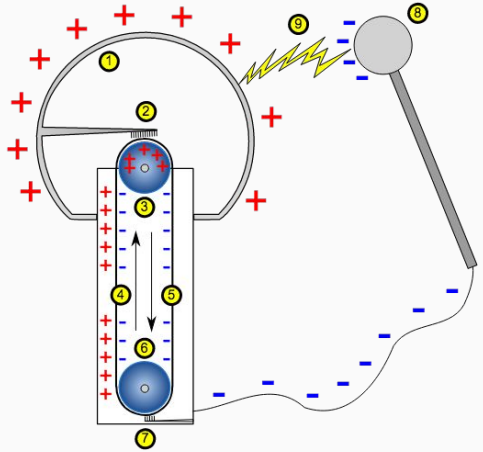
Key concepts in Electrostatics

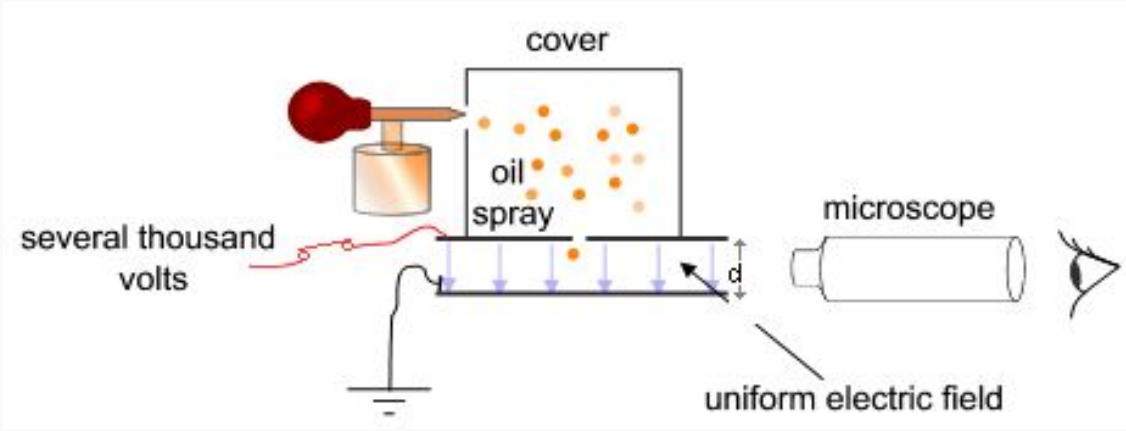
- Motion of particles in Electric field



Key concepts in Electrostatics

- The electric charge



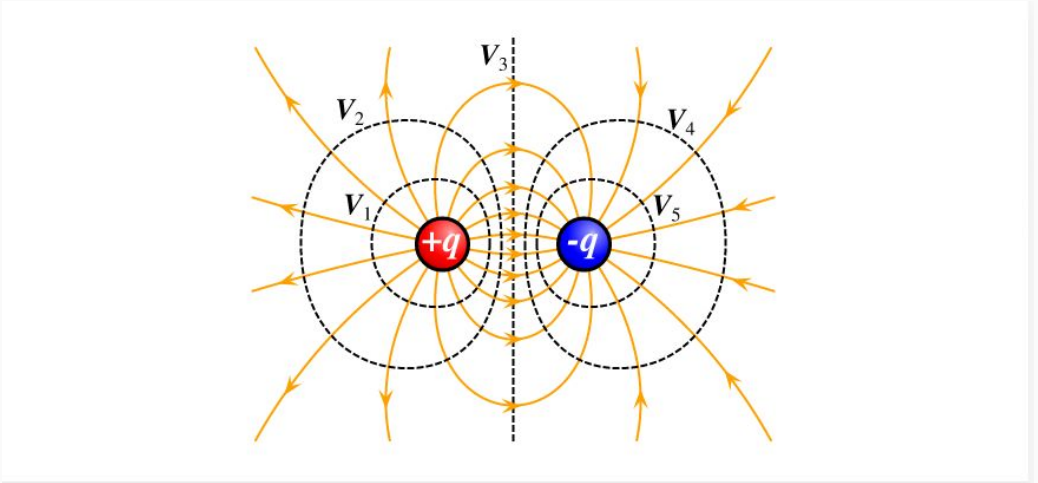


Key concepts in Electrostatics

- The electric charge

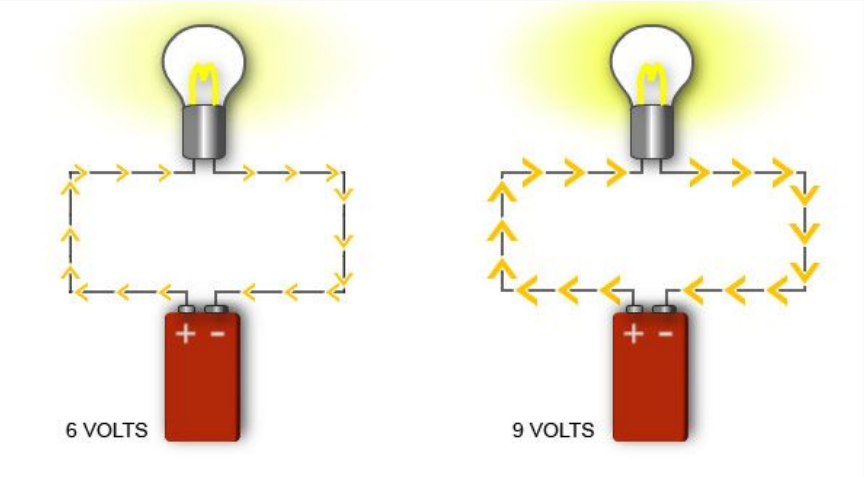
Key concepts in Electrostatics

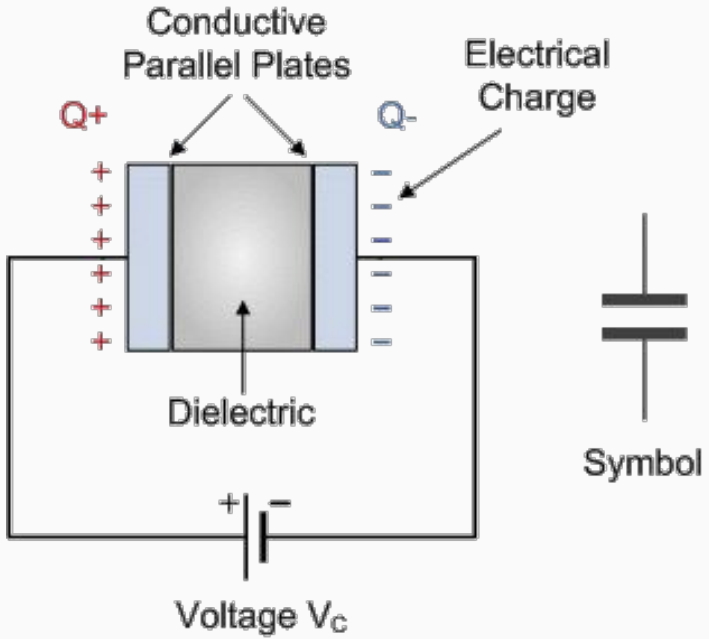
- The Electric field as a vector
- The Potential as a scalar field
- How to “see” them?



Key concepts in Electrostatics

- Concept of “Voltage”
- Voltage and currents
- Voltage and capacitors



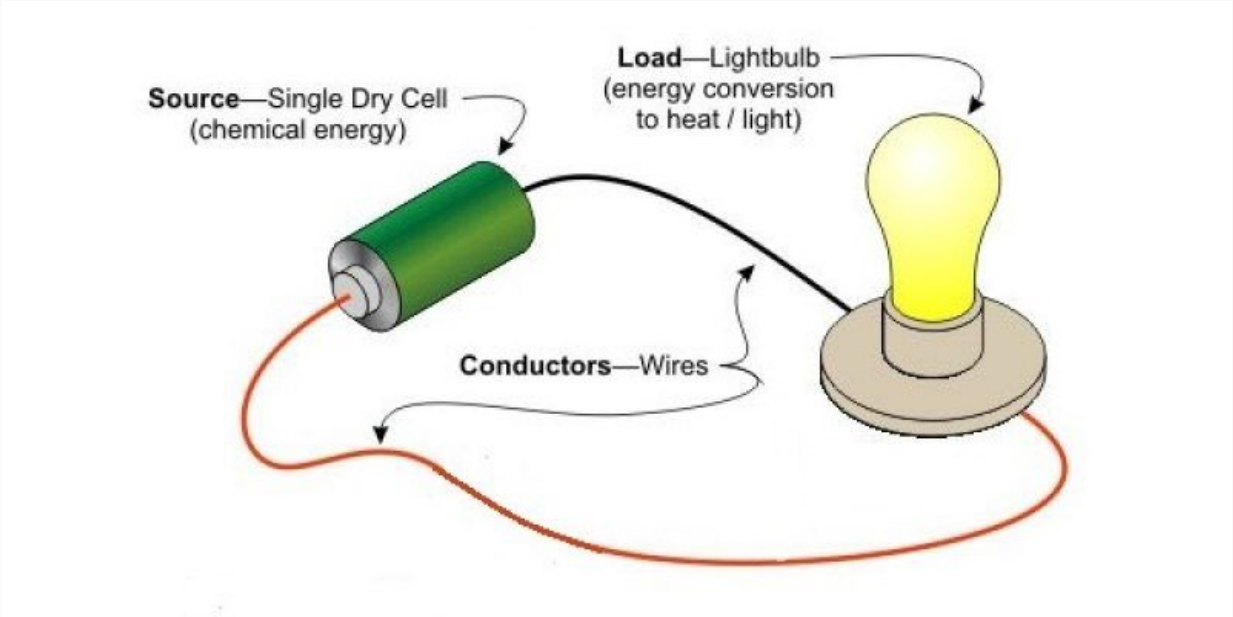


Key concepts in Electrostatics

- Voltage and capacitors

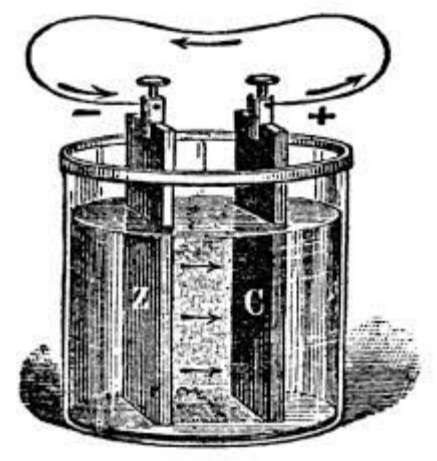
Key concepts in Electrostatics

- The electric current
- Electric resistance
- Circuits in CC
- Ohm’s law
- Batteries



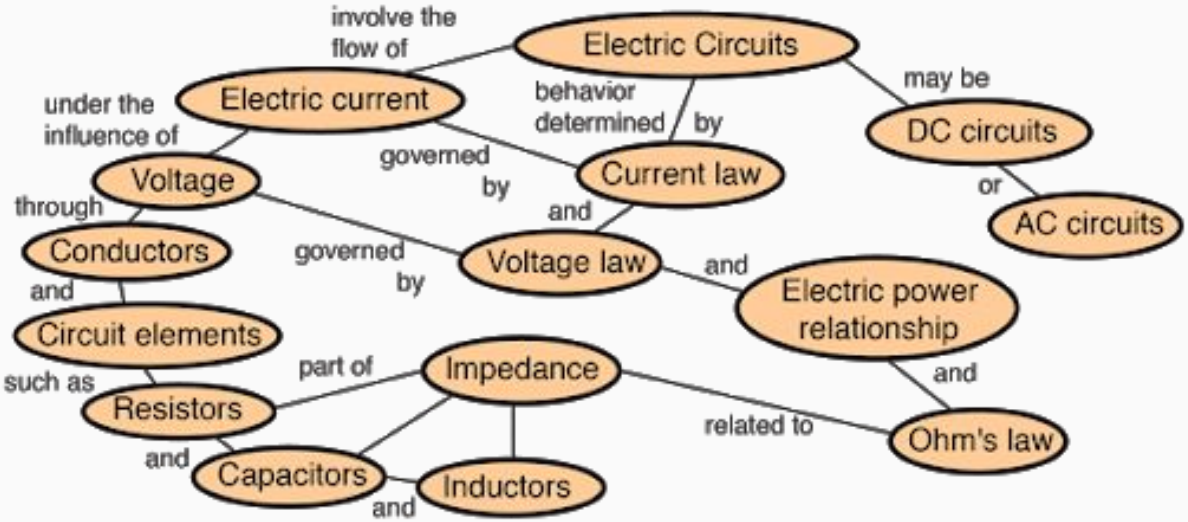
Key concepts in Electrostatics

- Batteries



Key concepts in Electrostatics

- Electric circuits



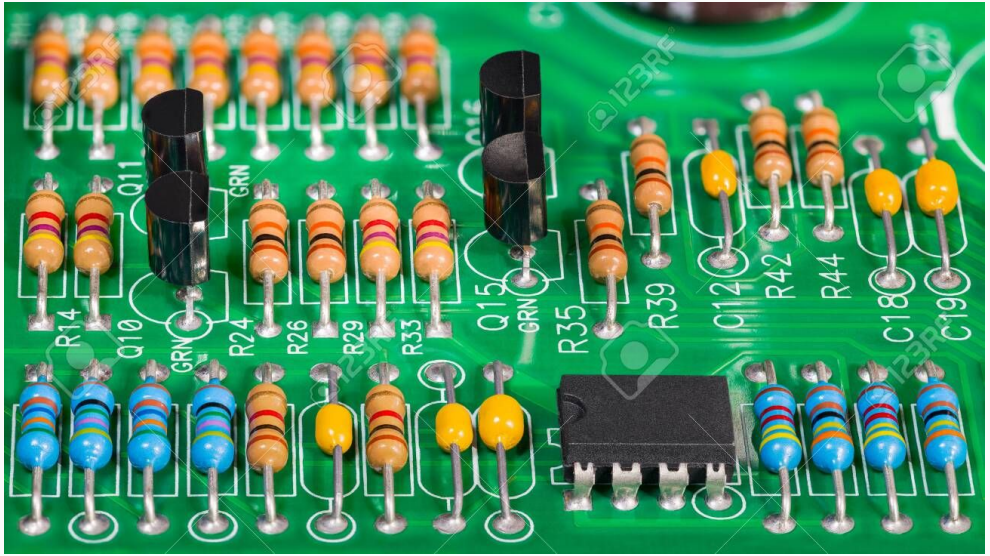
Key concepts in Electrostatics

- The Ohm's law

Ohm's law formulas www.ohmlaw.com		To Calculate			
		Voltage (V)	Current (I)	Resistance (R)	Power (P)
Given parameters	Current & Resistance	$V = IR$	---	---	$P = I^2R$
	Current & Power	$V = \frac{P}{I}$	---	$R = \frac{P}{I^2}$	---
	Voltage & Current	---	---	$R = \frac{V}{I}$	$P = VI$
	Voltage & Resistance	---	$I = \frac{V}{R}$	---	$P = \frac{V^2}{R}$
	Voltage & Power	---	$I = \frac{P}{V}$	$R = \frac{V^2}{P}$	---
	Power & Resistance	$V = \sqrt{P.R}$	$I = \sqrt{P/R}$	---	---

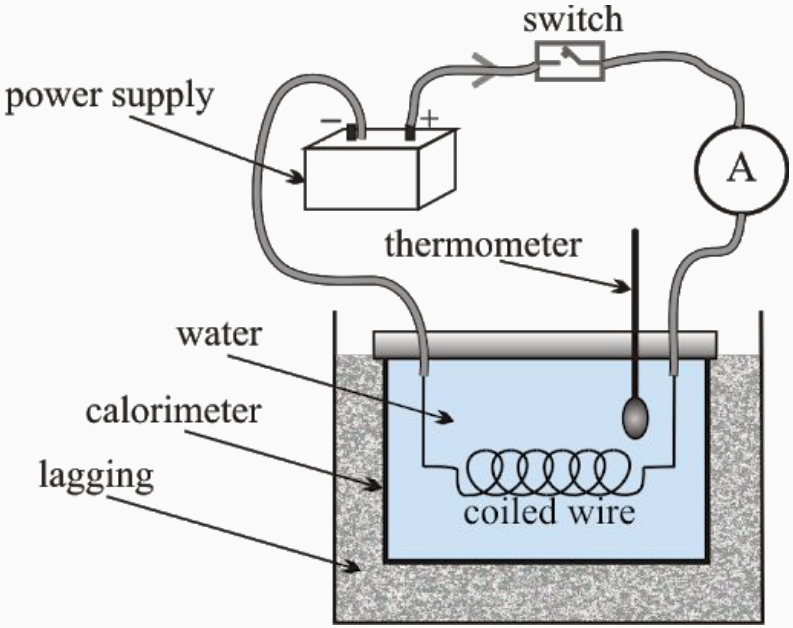
Key concepts in Electrostatics

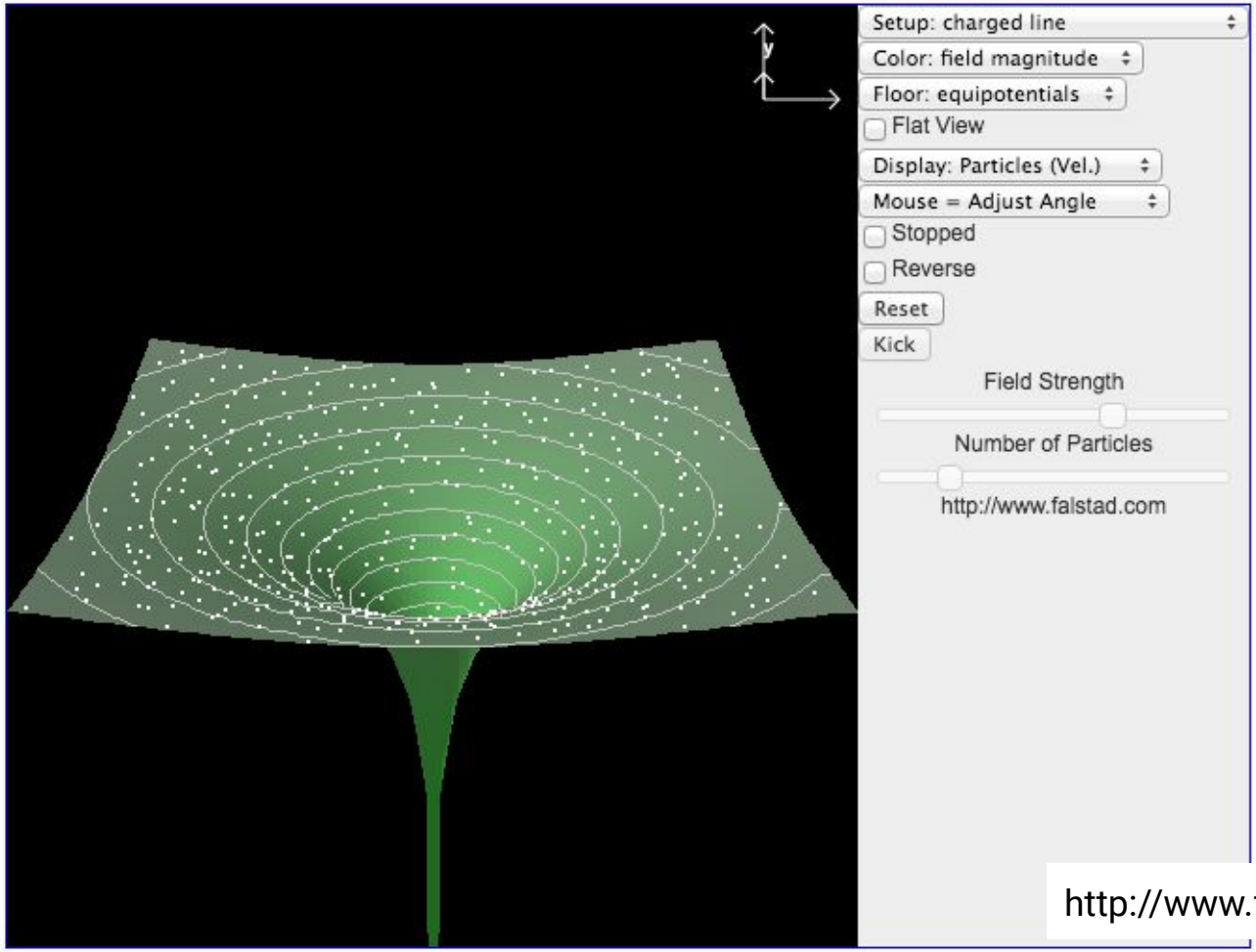
- The resistors



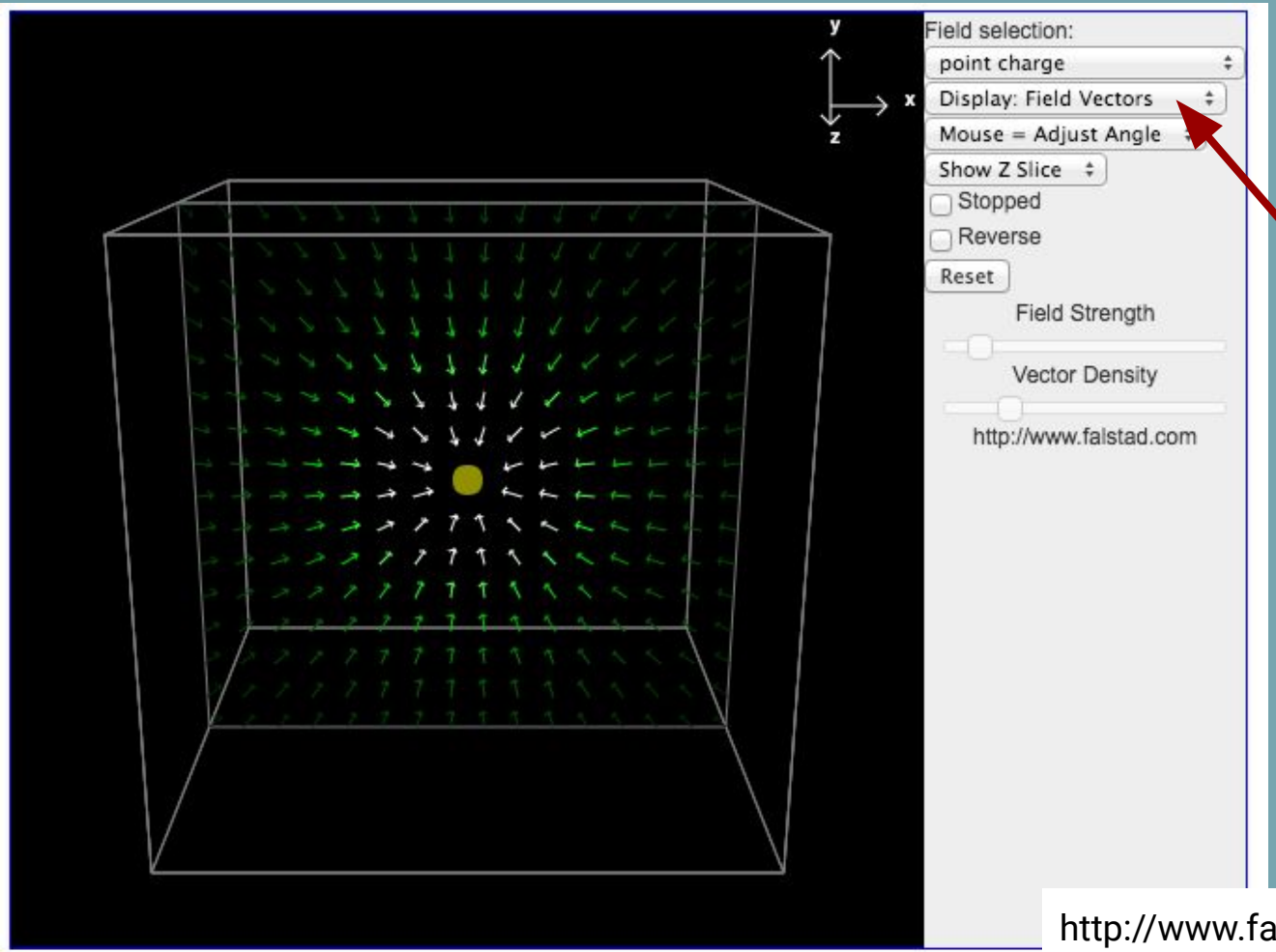
Key concepts in Electrostatics

- The power in Electric fields





http://www.falstad.com/vector2de/



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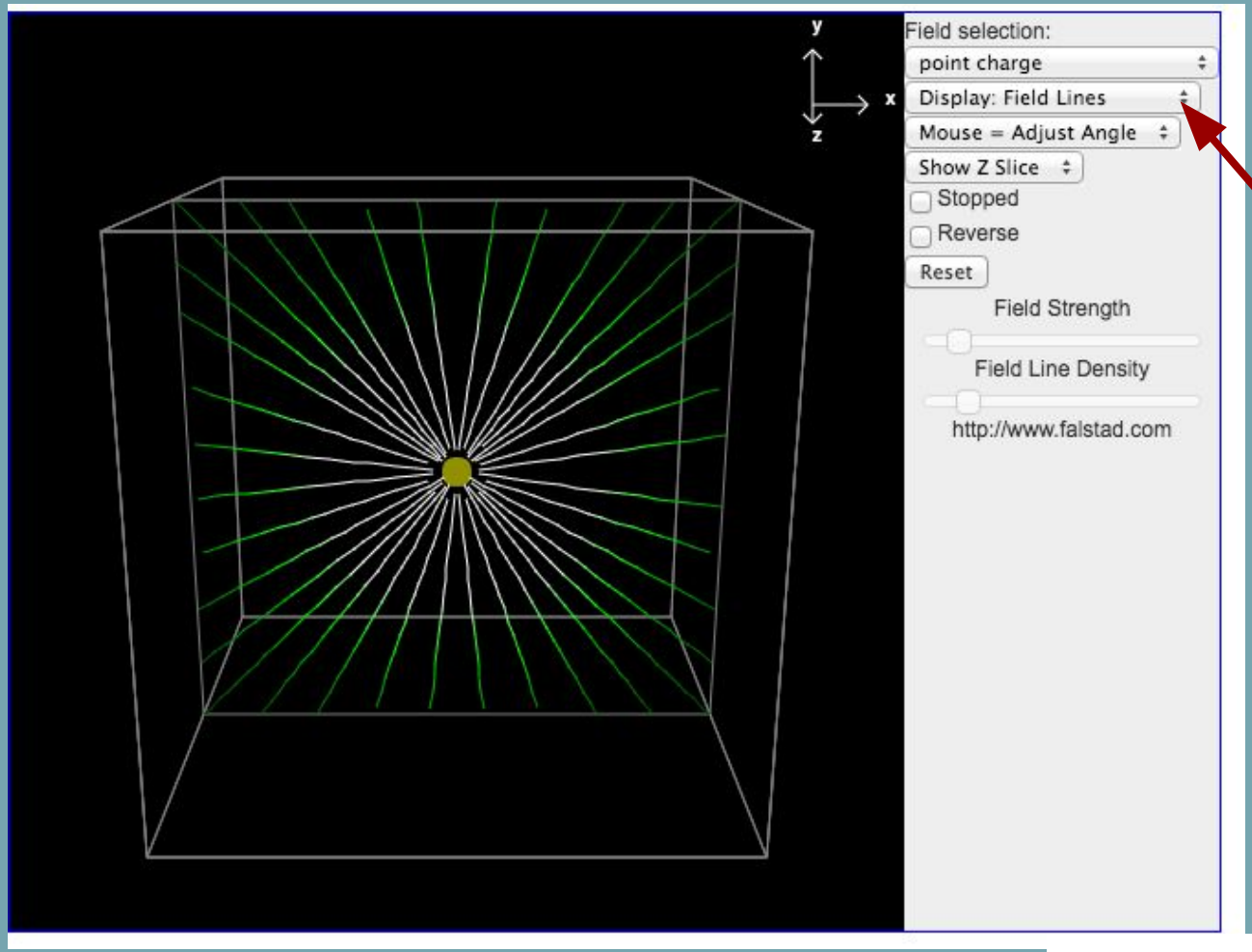

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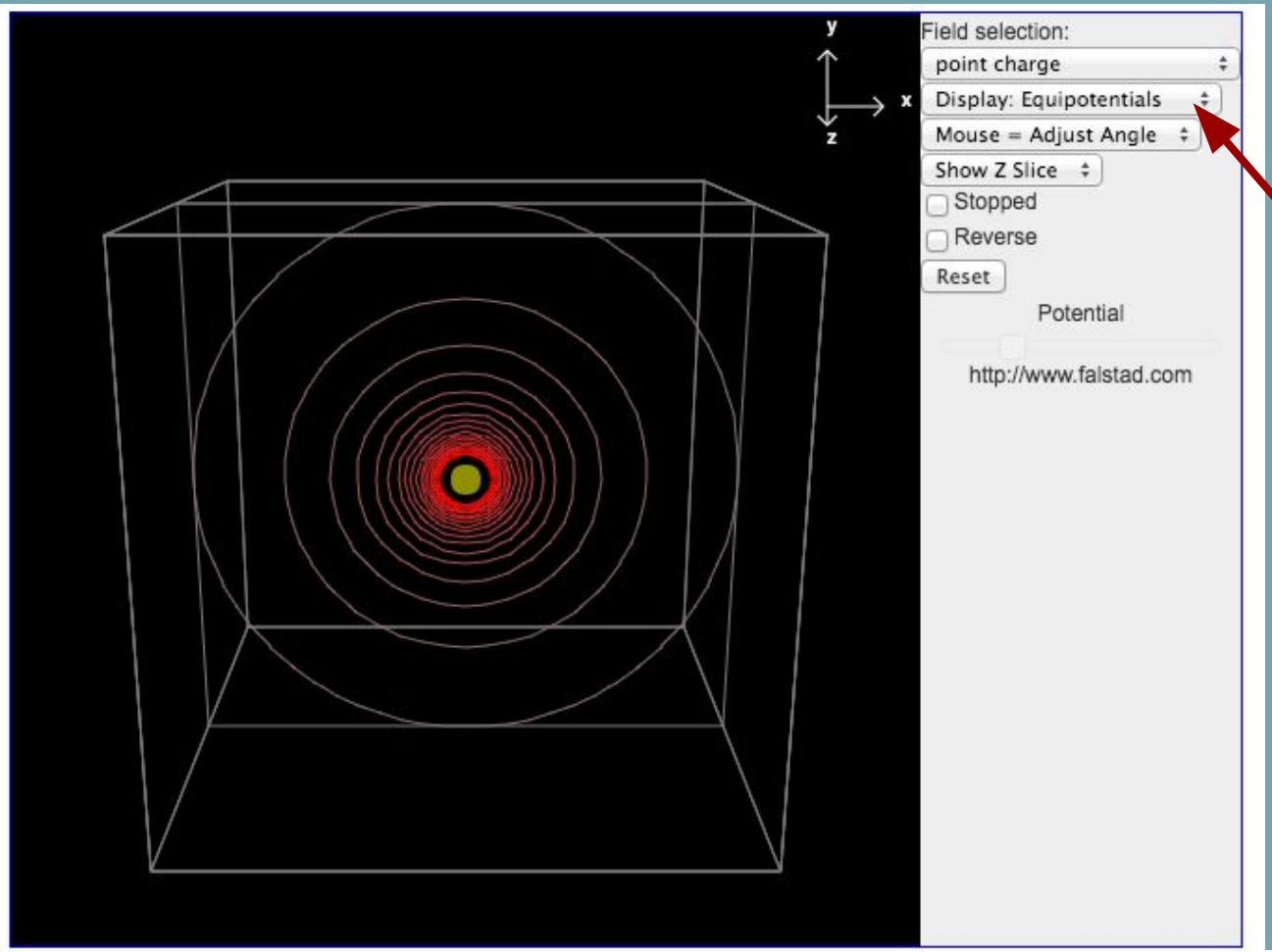

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Misconceptions in Electrostatics

- Current flows in one direction and charges move in the other one
- Electric field is a scalar field
- Potential field is a vector field -- which relation to electric field ?
- The elementary charge
- Neutrality of matter and electricity …
- Potential and Potential energy
- Capacitors treatment - Voltage and charge relationships
- Potential - Voltage

Let’s add …

Inquiry Based Science Education (IBSE approach)

Inquiry is a multifaceted activity that involves: making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.

(National Research Council, 1996)

What is Inquiry-Based Learning?

https://www.youtube.com/watch?v=QIwkerwaV2E&list=RDCMUCRmWJULBr4CIP5xUucVgOvw&index=1

https://www.youtube.com/watch?v=kYap39FNFv8

IBSE DESCRIPTION

Il metodo IBSE (Inquiry Based Science Education)

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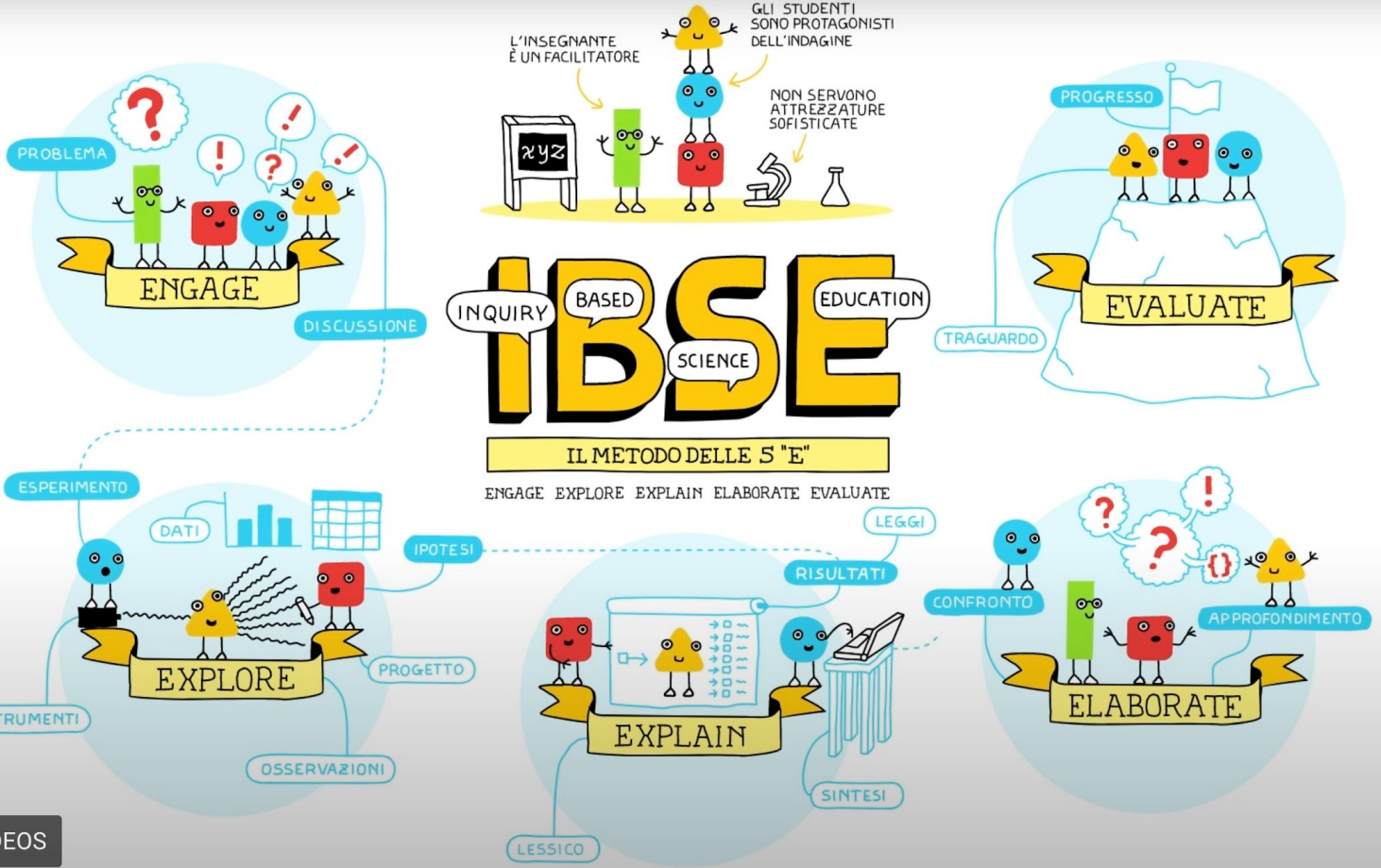
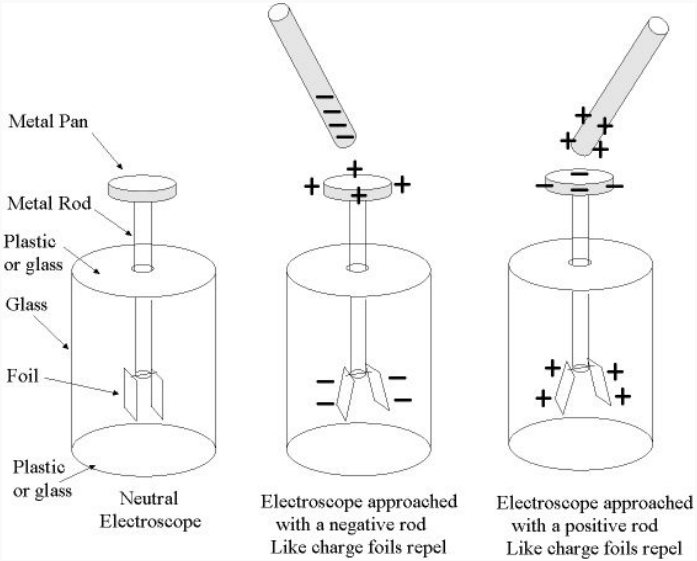


MORE VIDEOS

IBSE example for Electrostatics

- ENGAGE students in Electrostatics : find few examples …



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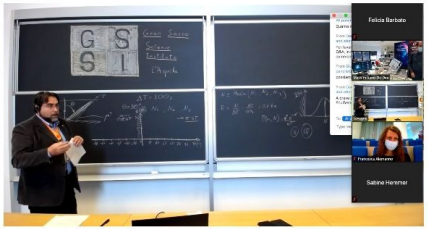

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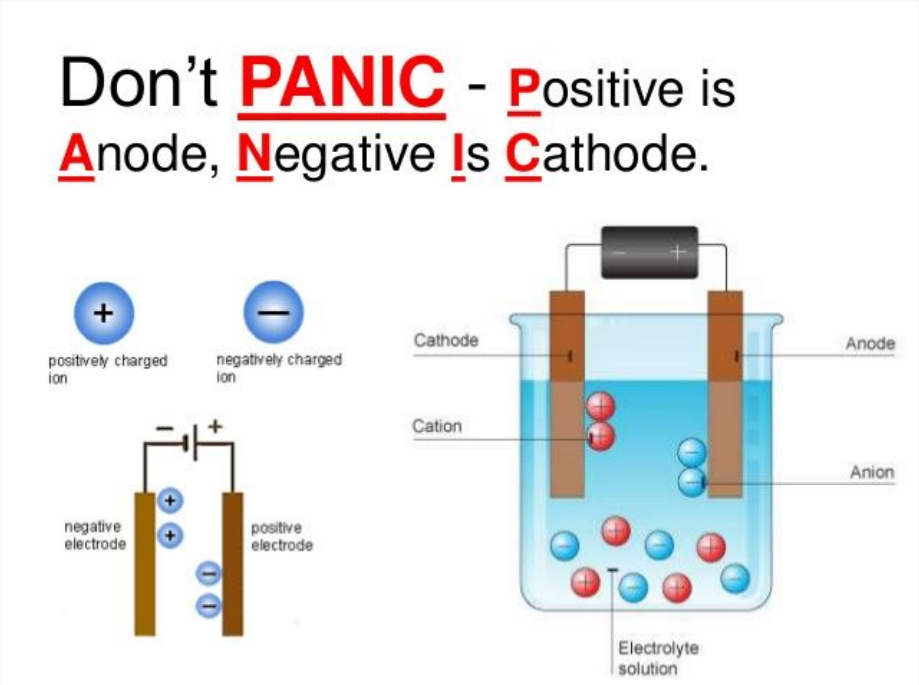

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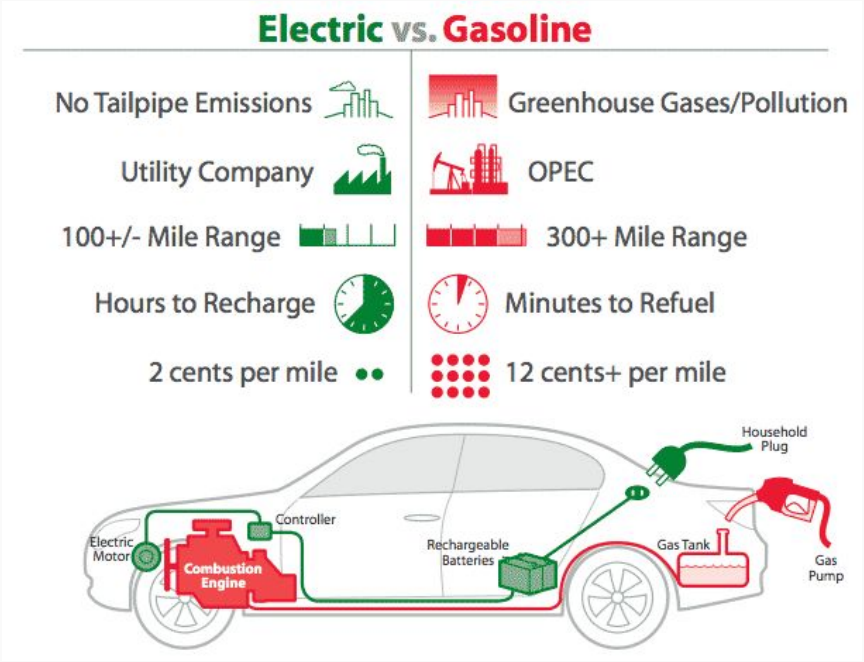

Engage examples

- Carica cellulare - Wifi - Piastra induzione
- Fulmine in Auto
- Scossa in giornate secche
- La scossa
- Display pixel
- Carica e scarica batteria