

Physics Education Laboratory Lecture 17 PCK for Electrostatics

Francesco Longo - 17/11/25





Electric Field, Electric Field Lines and Direction

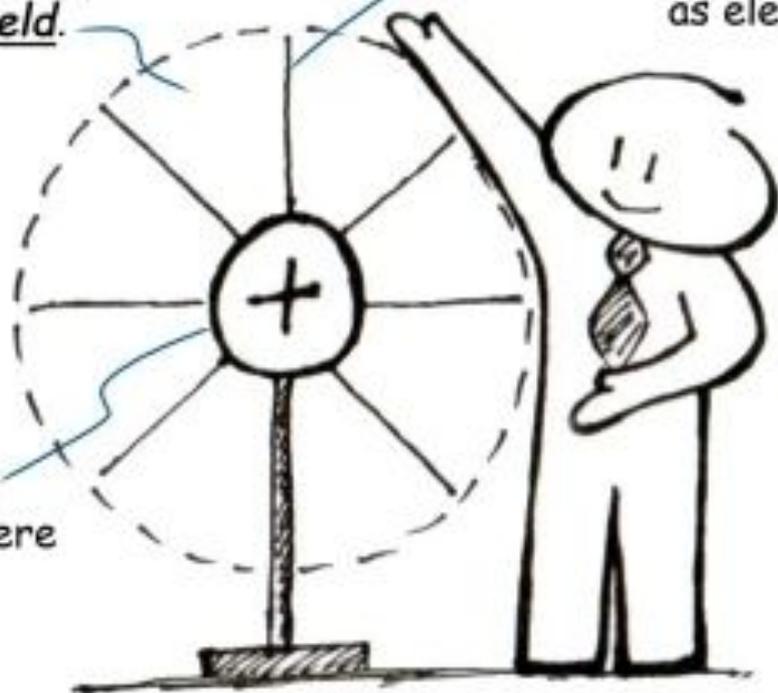
The space or region around the positive charged sphere is known as electric field.

The lines around the sphere/particle are known as electric field lines.

The denser the lines (closer/more lines) the stronger the electric field strength.

But how to remember what is the direction of the electric field lines?

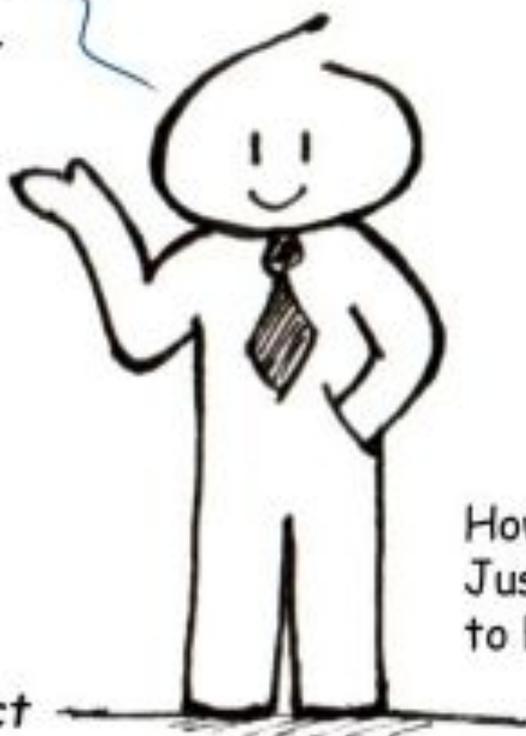
A positively charged sphere



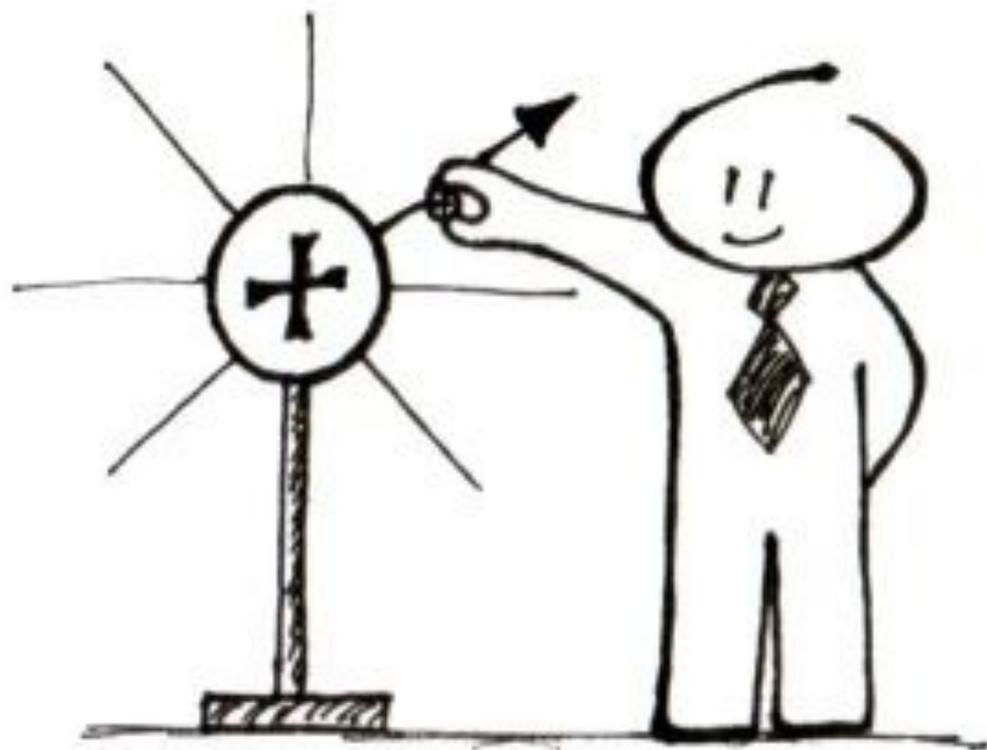
To know the direction of
the electric field lines ...

Just imagine 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!



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

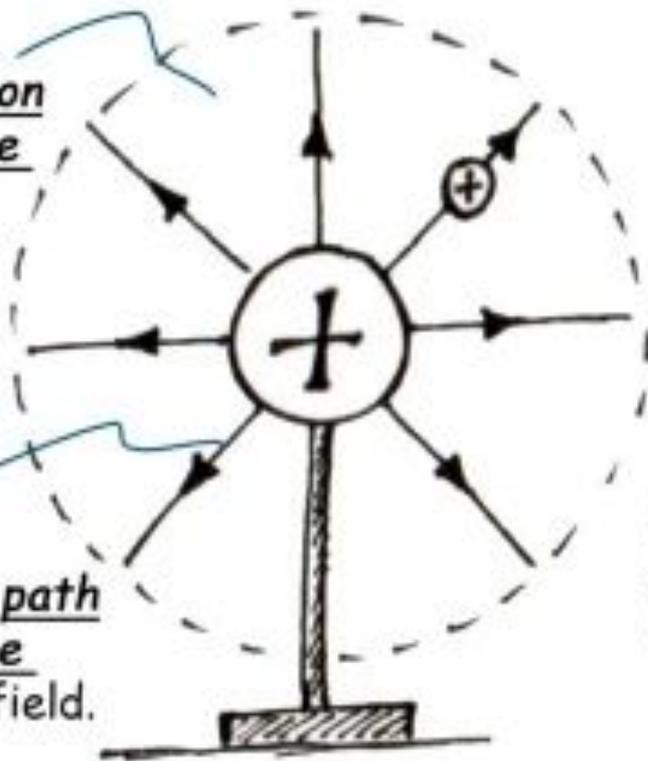
As like charges repel, the positive charge will be repelled by the positive sphere. Hence it will move outwards.

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

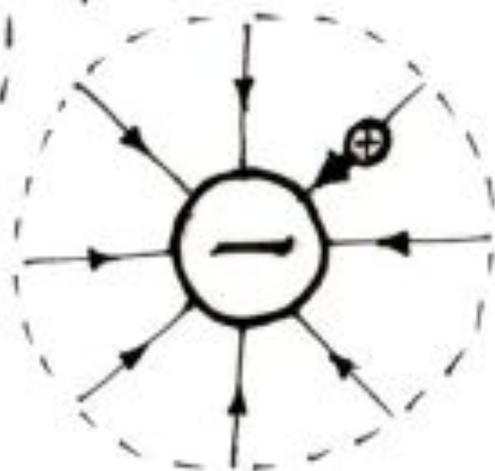
Definition of the terms...

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

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

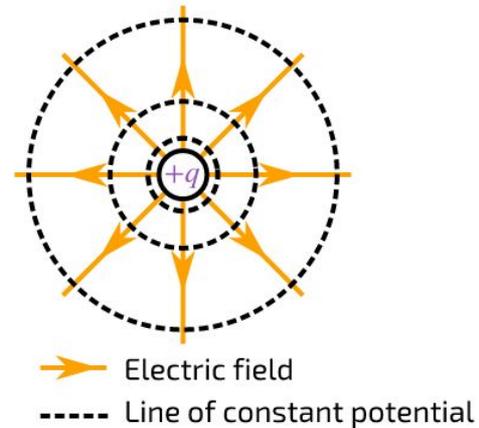


Concepts apply for electric field around a negatively charged sphere.



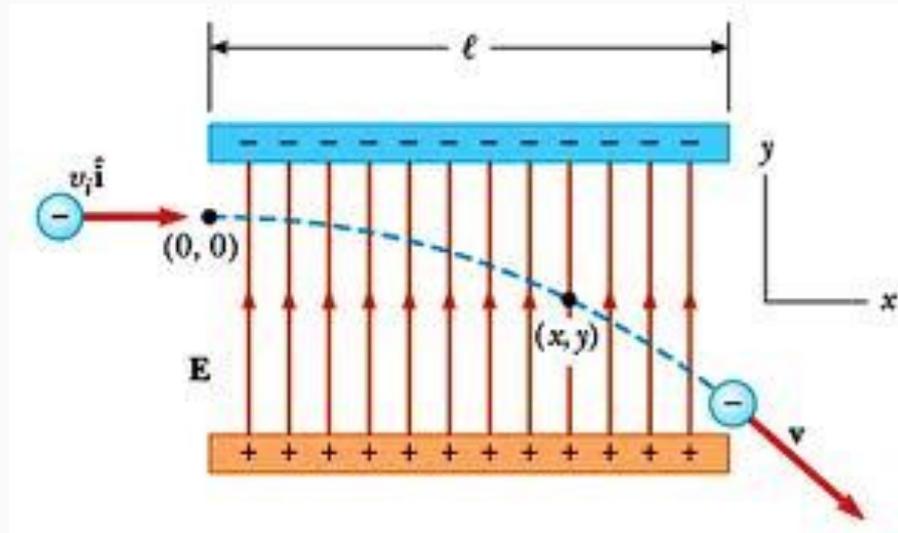
Key concepts in Electrostatics

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



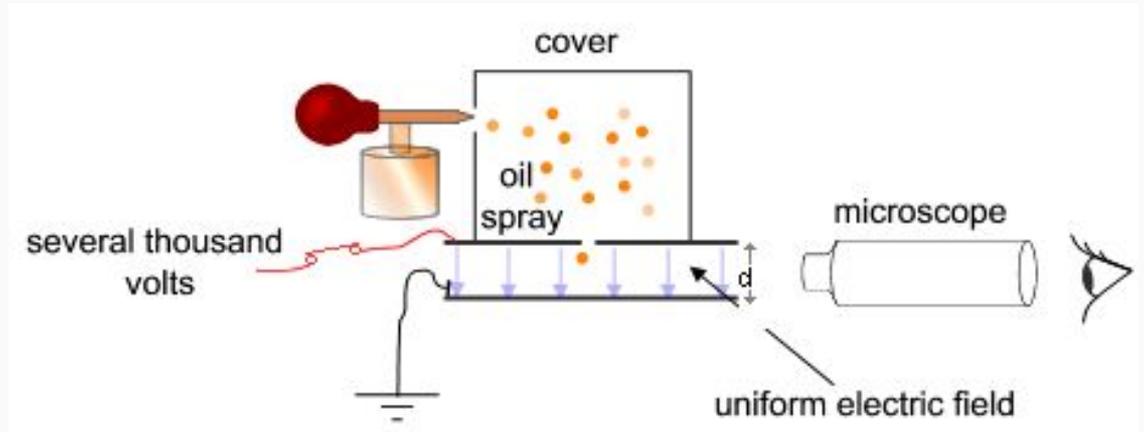
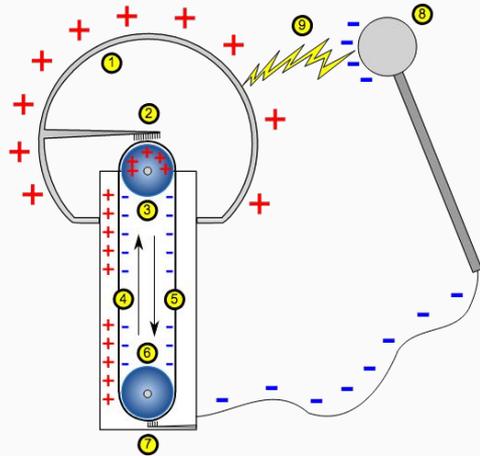
Key concepts in Electrostatics

- Motion of particles in Electric field



Key concepts in Electrostatics

- The electric charge



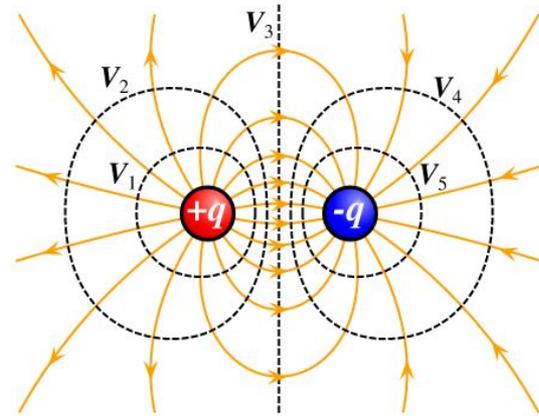
Key concepts in Electrostatics

- The electric charge



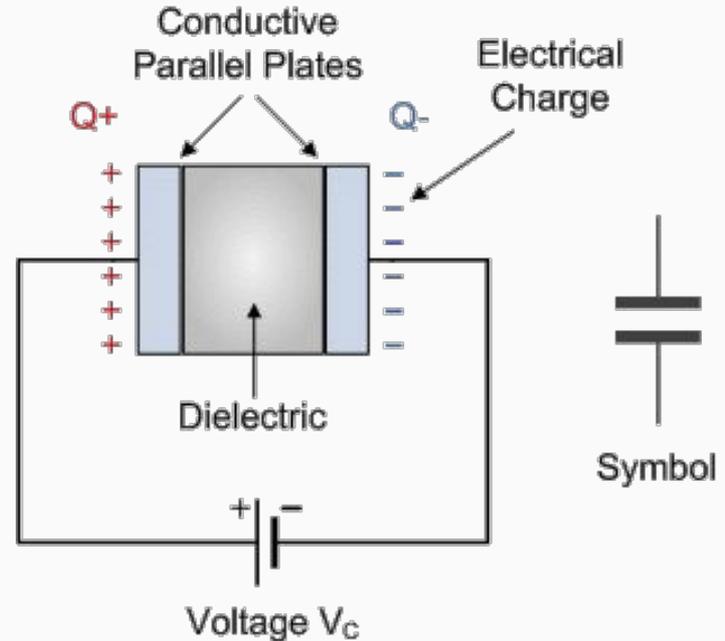
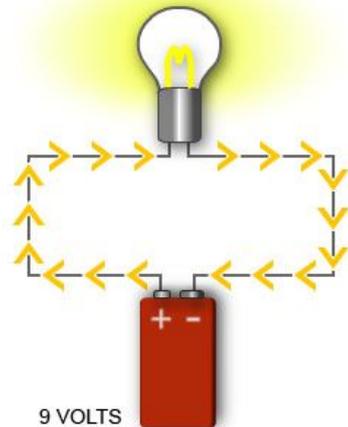
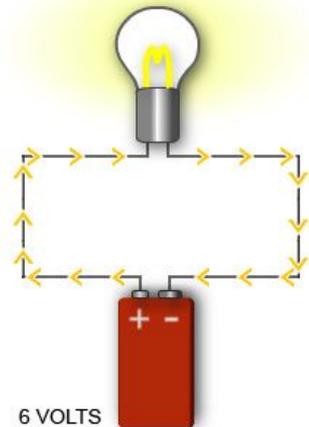
Key concepts in Electrostatics

- 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



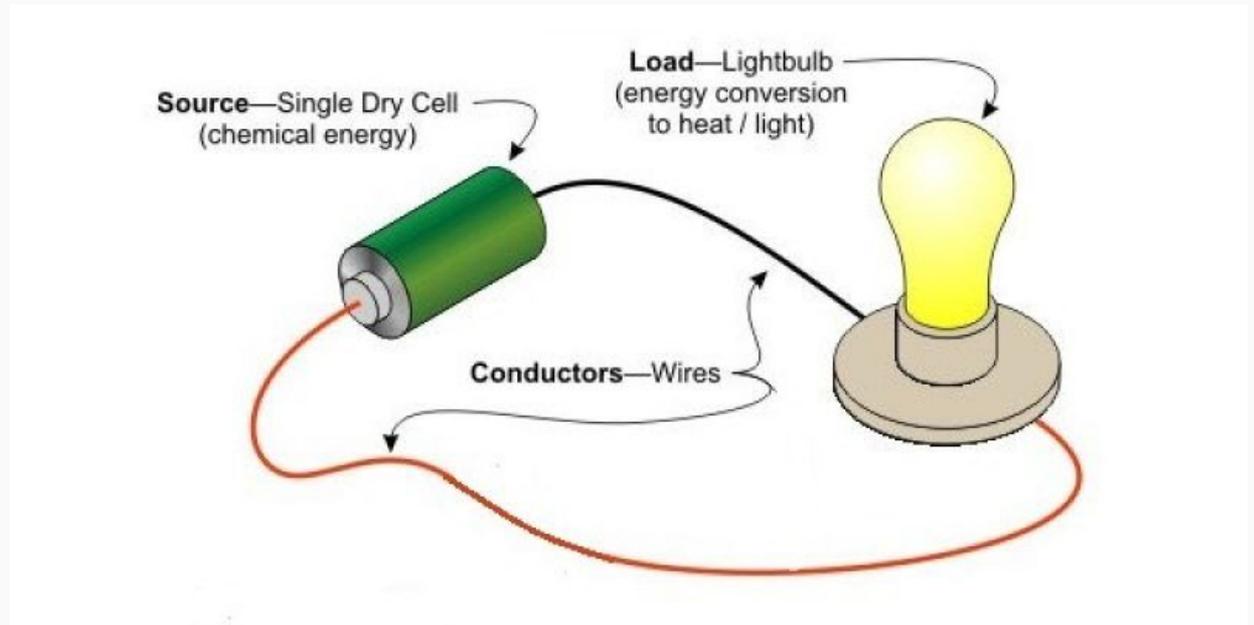
Key concepts in Electrostatics

- Voltage and capacitors



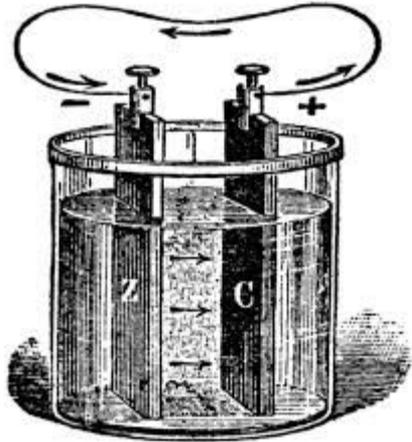
Key concepts in Electrostatics

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



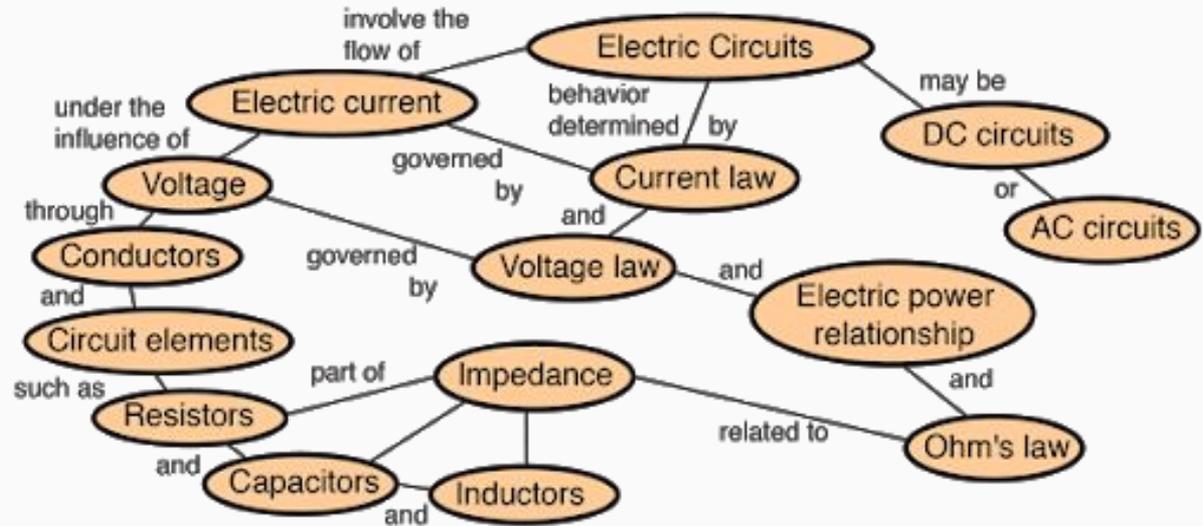
Key concepts in Electrostatics

- Batteries



Key concepts in Electrostatics

- Electric circuits



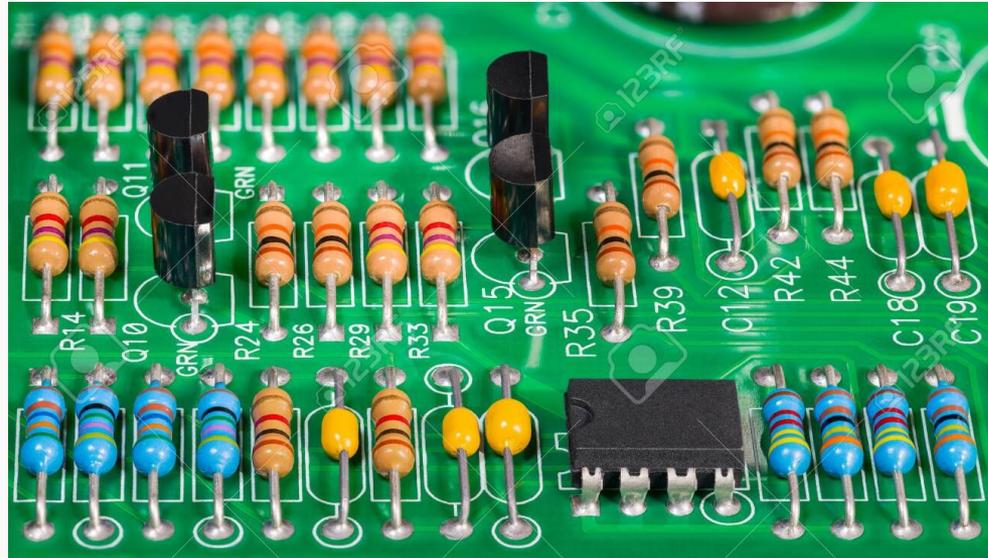
Key concepts in Electrostatics

- 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	$V = \sqrt{P \cdot R}$	$I = \sqrt{P/R}$	---	---

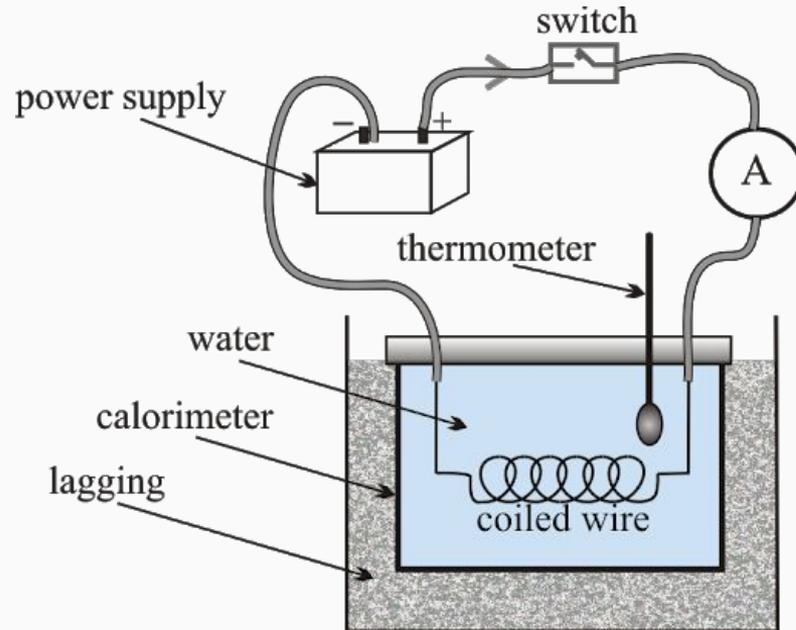
Key concepts in Electrostatics

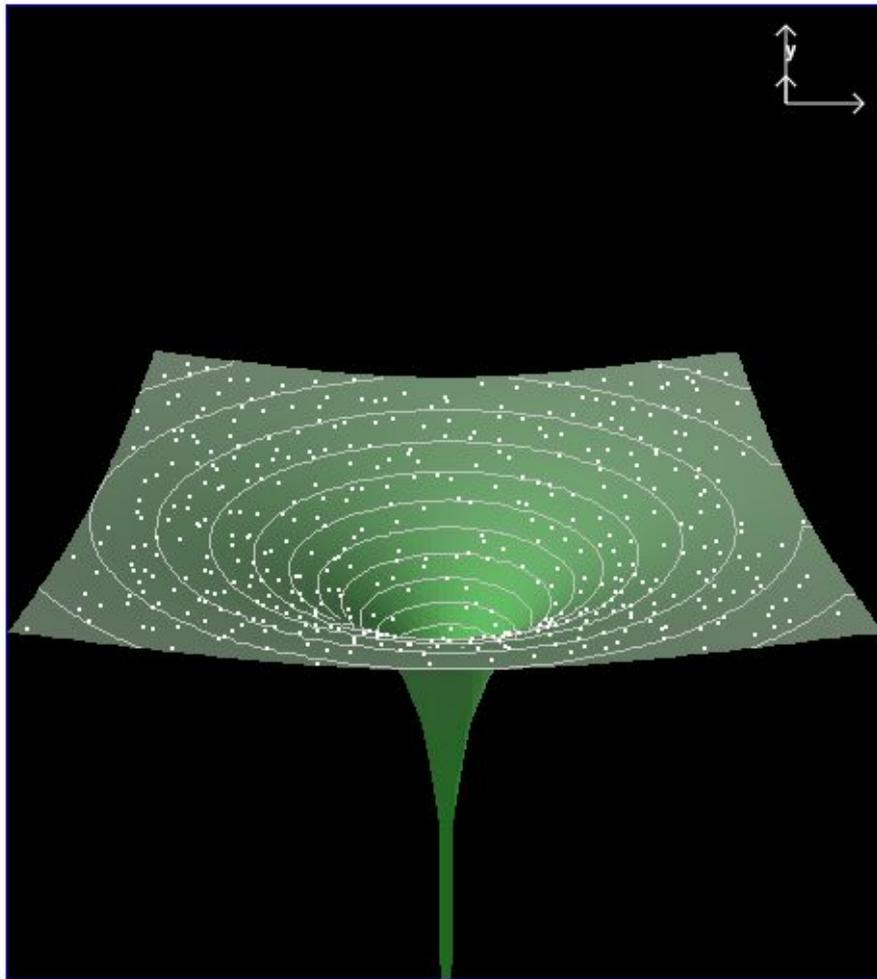
- The resistors



Key concepts in Electrostatics

- The power in Electric fields





Setup: charged line

Color: field magnitude

Floor: equipotentials

Flat View

Display: Particles (Vel.)

Mouse = Adjust Angle

Stopped

Reverse

Reset

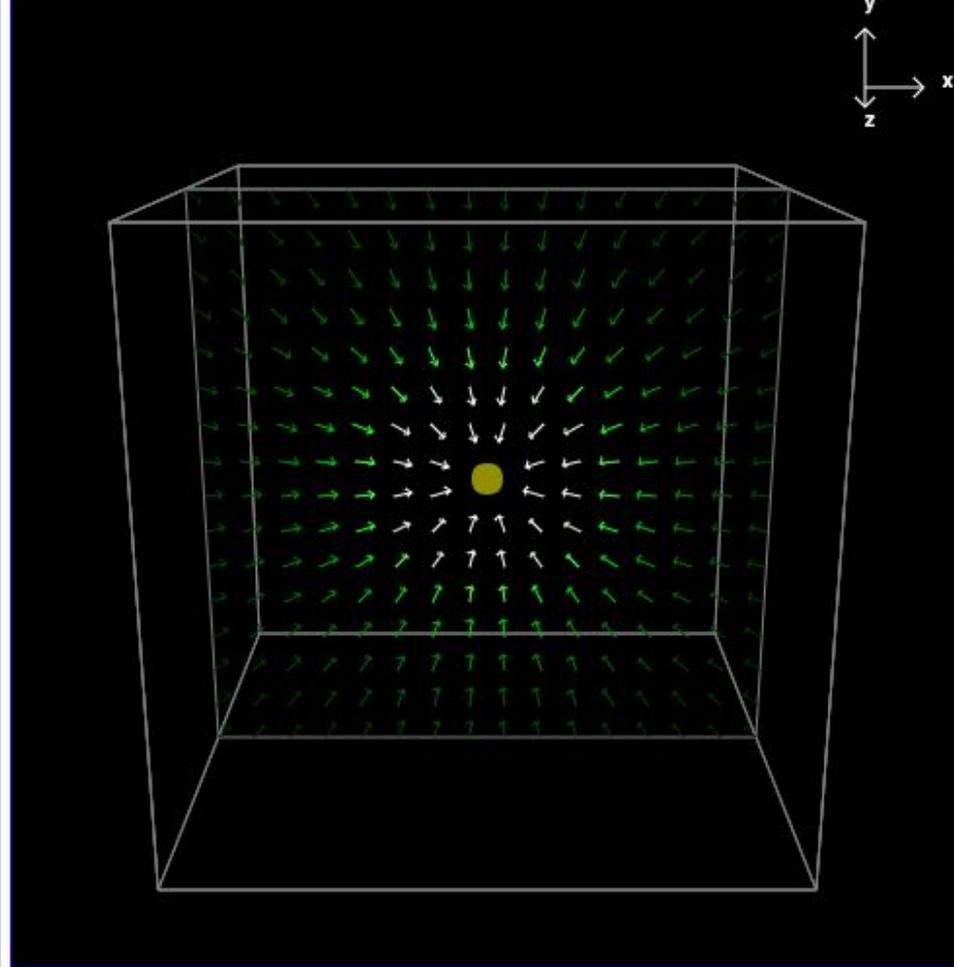
Kick

Field Strength

Number of Particles

<http://www.falstad.com>

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



Field selection:
point charge

Display: Field Vectors

Mouse = Adjust Angle

Show Z Slice

Stopped

Reverse

Reset

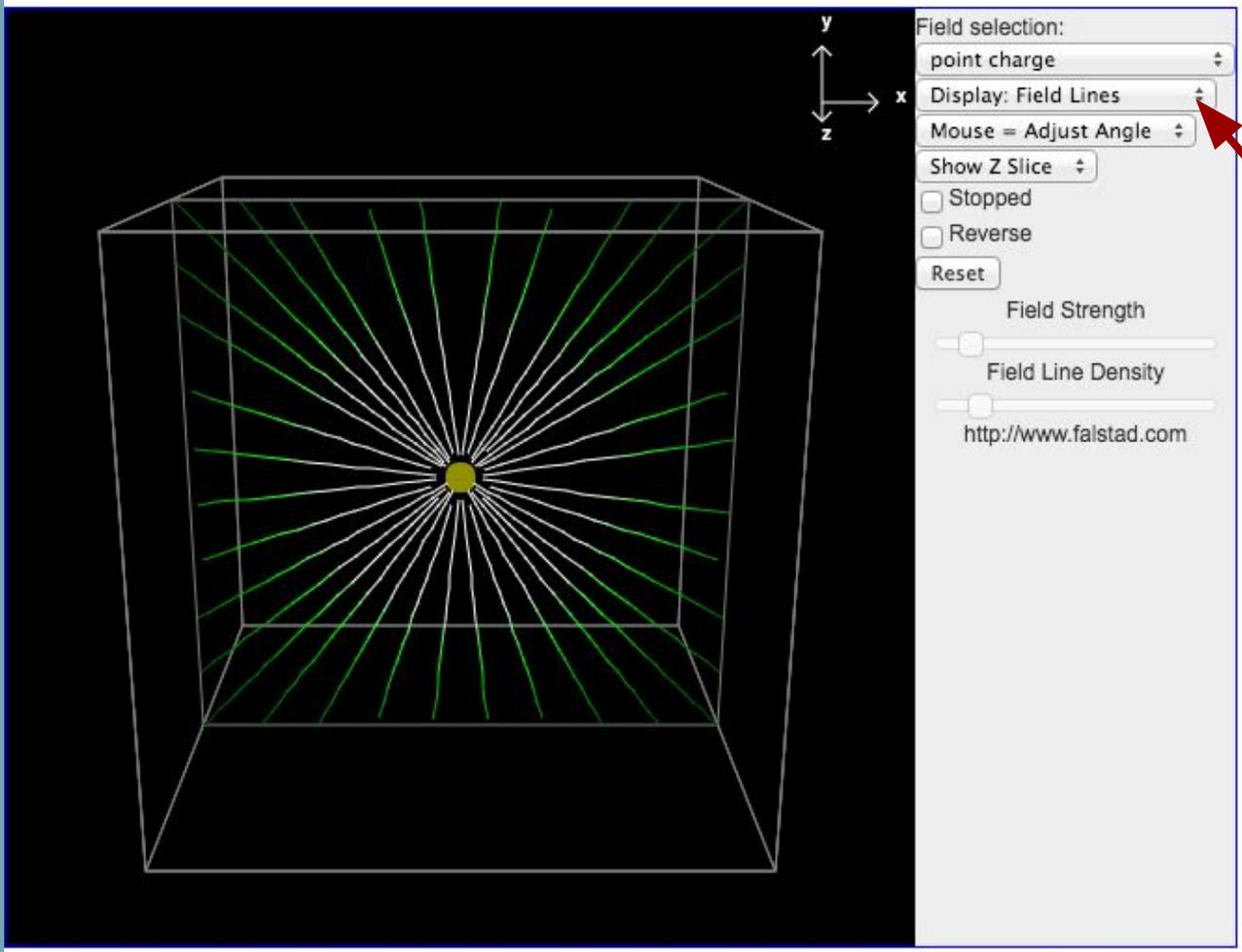
Field Strength

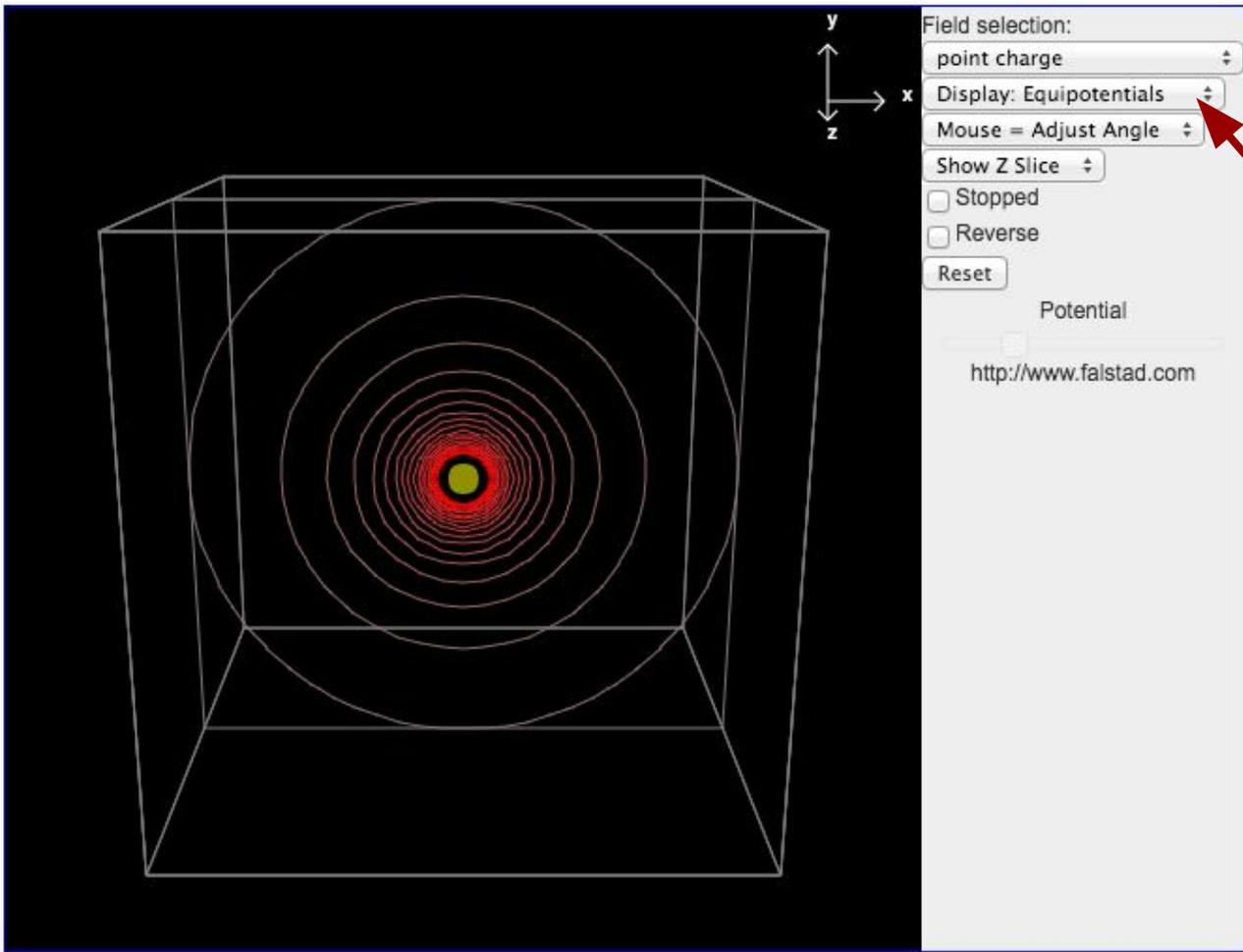
Vector Density

<http://www.falstad.com>



<http://www.falstad.com/vector3de/>

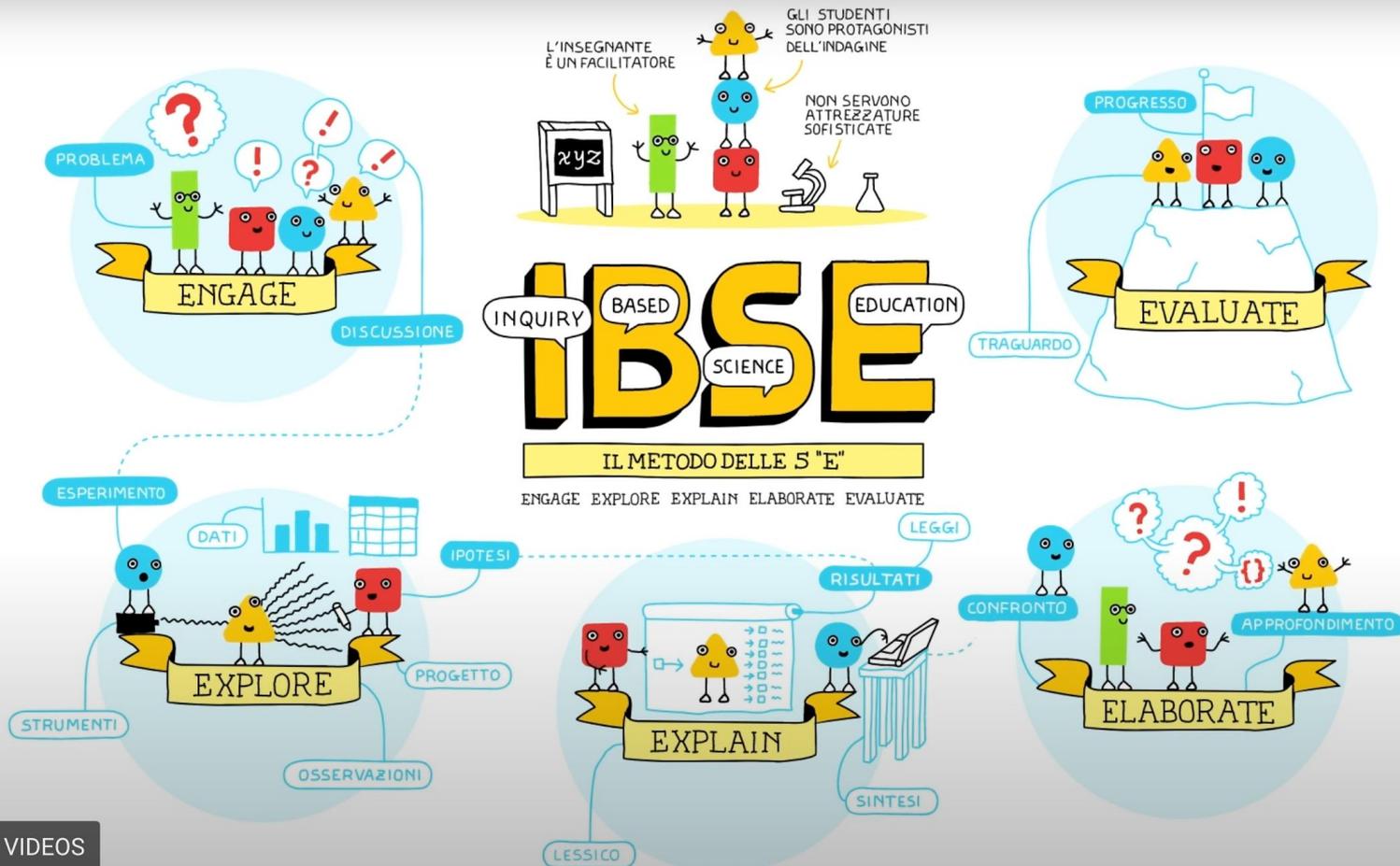




Misconceptions in Electrostatics

- 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
- Ohm law inversion

Inquiry Based
Science Education
(IBSE approach)





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<http://www.establish-fp7.eu/home.html>



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Direct current electricity

In the unit DIRECT CURRENT ELECTRICITY students study electric current and the basics of direct electric circuits.

They will learn about basic concepts such as:

- simple electric circuit;
- conductivity of different materials;
- how to measure current and voltage;
- batteries and other energy sources.

Unit Navigation

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Del espacio al aula

La Oficina Europea de Recursos para la Educación Espacial en España (ESERO Spain)

Con el tema «del espacio al aula» y aprovechando la fascinación que el alumnado siente por el espacio, tiene como objetivo principal proporcionar recursos a docentes de primaria y secundaria para mejorar su alfabetización y competencias en materias CTIM (Ciencias, Tecnología, Ingeniería y Matemáticas).



Este proyecto educativo de la Agencia Espacial Europea está liderado en España por el Parque de las Ciencias de Granada y cuenta con la colaboración de instituciones educativas tanto nacionales como de ámbito regional en las distintas Comunidades Autónomas.

<https://esero.es/>