Supercomet Workshop

Modelling of phenomena Related to Learning about Superconductivity …the teaching-learning sequence…

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Supercomet project …

is based on simulation using **magnetic field lines**

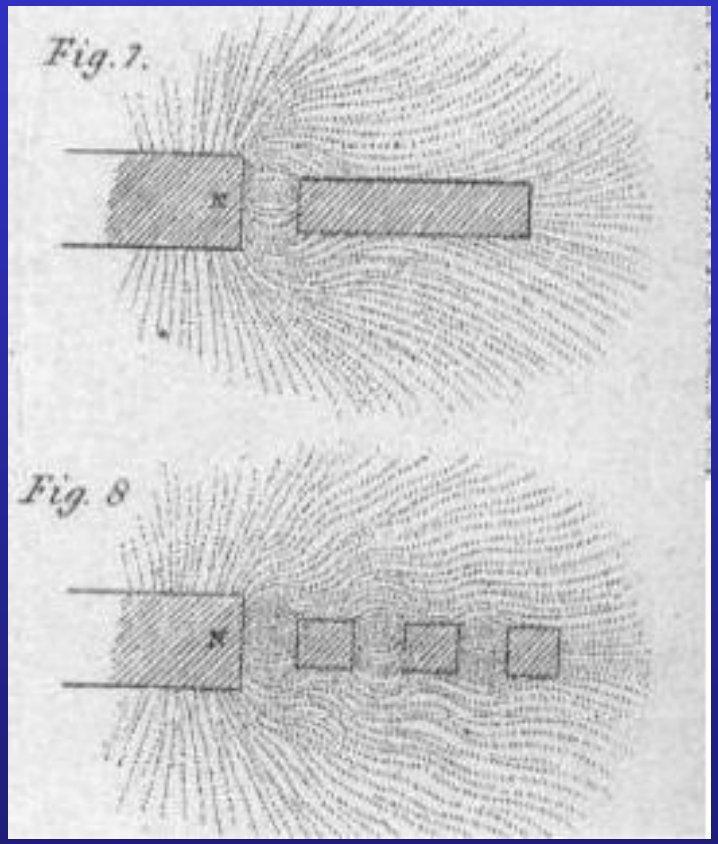
to construct prerequisits to

paramagnetism, diamagnetism, superconductivity

Historically Field lines …

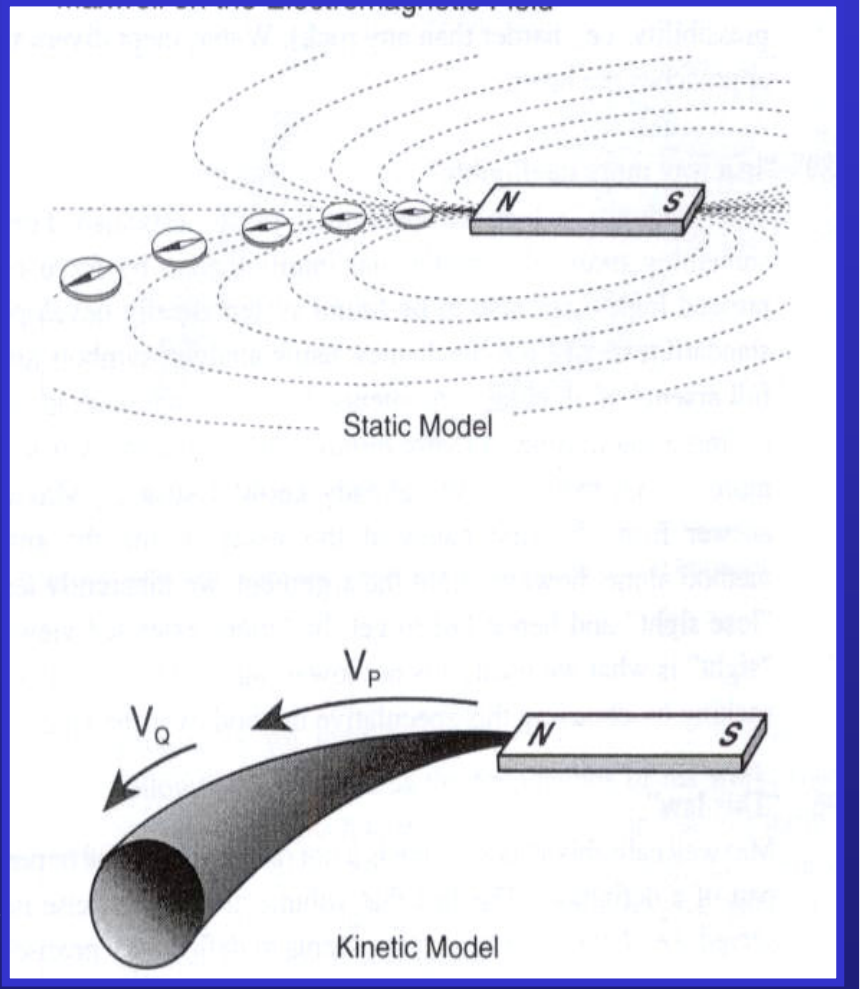
Lines of force:

".. to consider **magnetic power** as represented by lines of force", "**the lines of forces**, well represent the "**nature**", "**condition**", "**direction**", and "**amount**" of the **magnetic forces**" *Faraday*

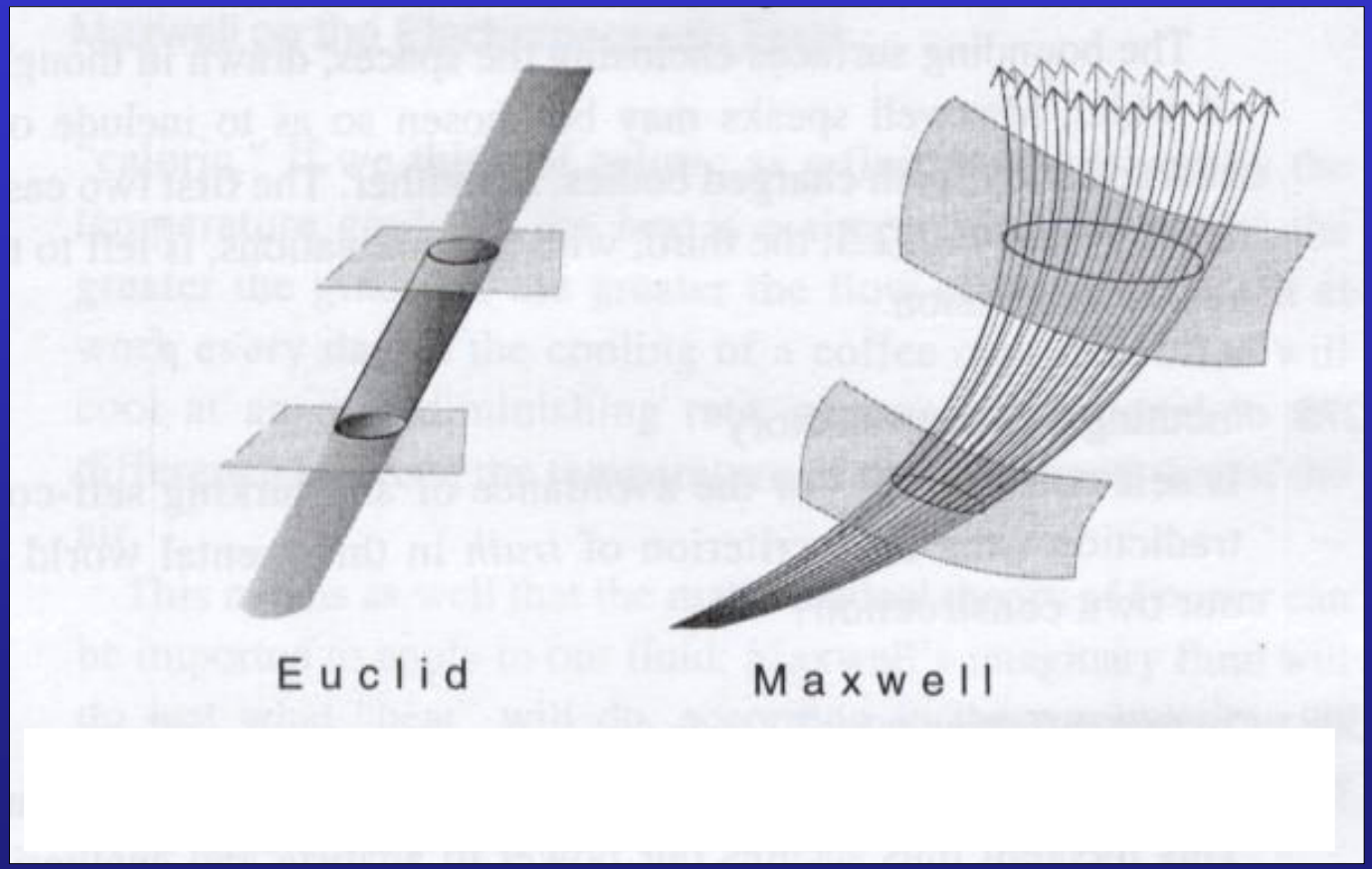


Field lines … and tubes of flux

"If we consider these curves not as mere lines but as **fines tubes of variable section** carrying an incompressible fluid, then since the velocity of the fluid is inversely as the section of the tube,… by regulating the section of the tube, … we might **represent the intensity of the force as well as the direction** by the motion of the fluid in these tubes.." Maxwell



Tubes of flux



Field lines are important for the conceptualization and formalization of field concept

1) Graphic models

- mental models and physics models have also graphic nature (*D. Hestenes*)

2) language and models

- relation between language and modelling *H. Fuchs*
- *Hesteness* "language does not refer directly to the world, but rather to mental models or components thereof"

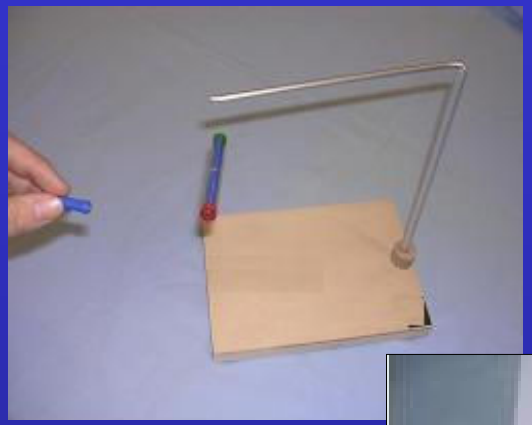
→ it's important to distinguish between

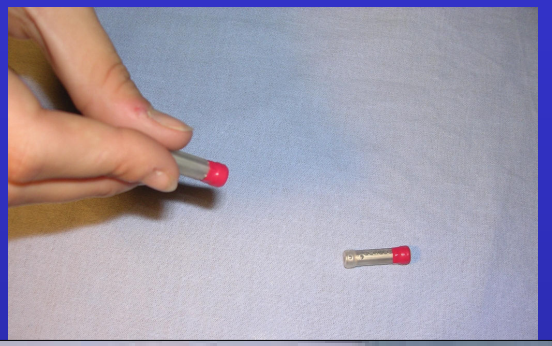
lines of field and lines of force

Teaching sequence on magnetic field:

1) Introduction to magnetic interaction

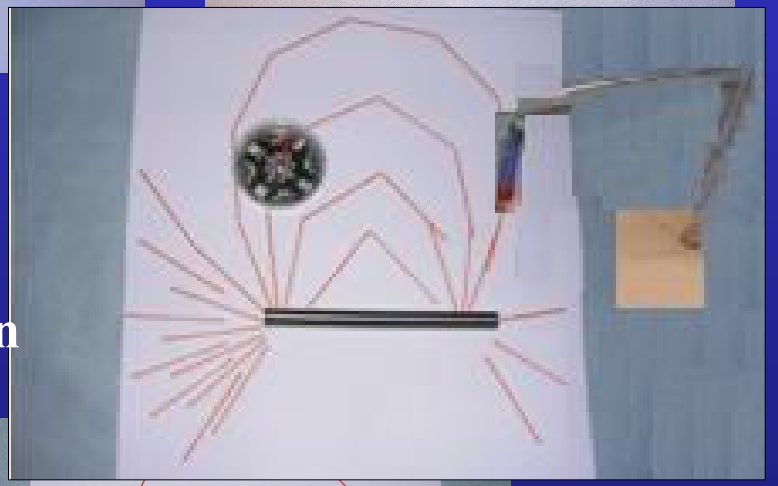
Identify:
attraction / rotation

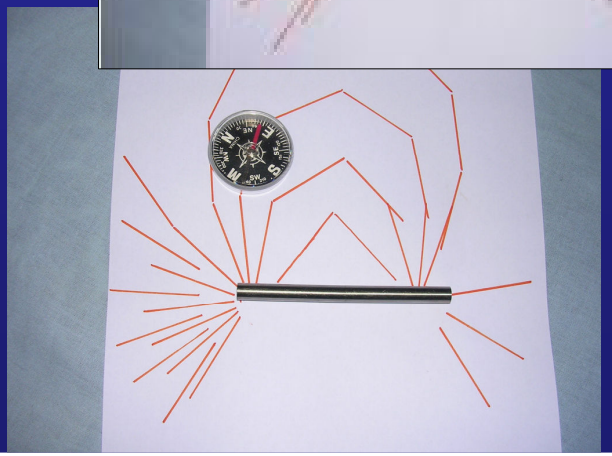




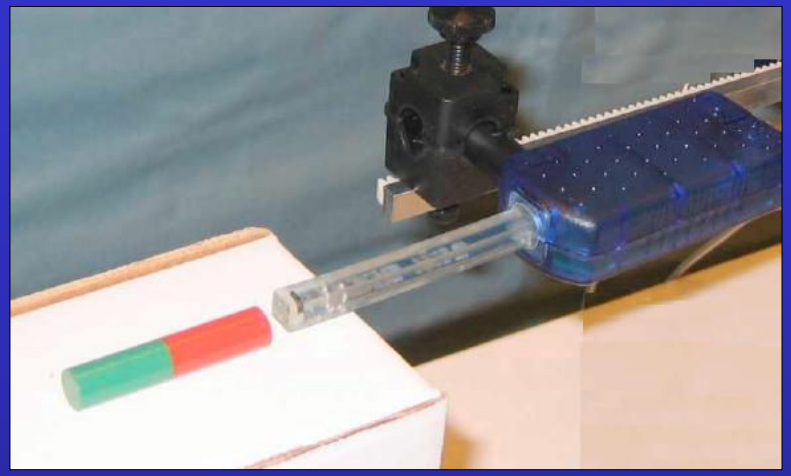
2) Constructing field lines

Lines of momentum / of orientation

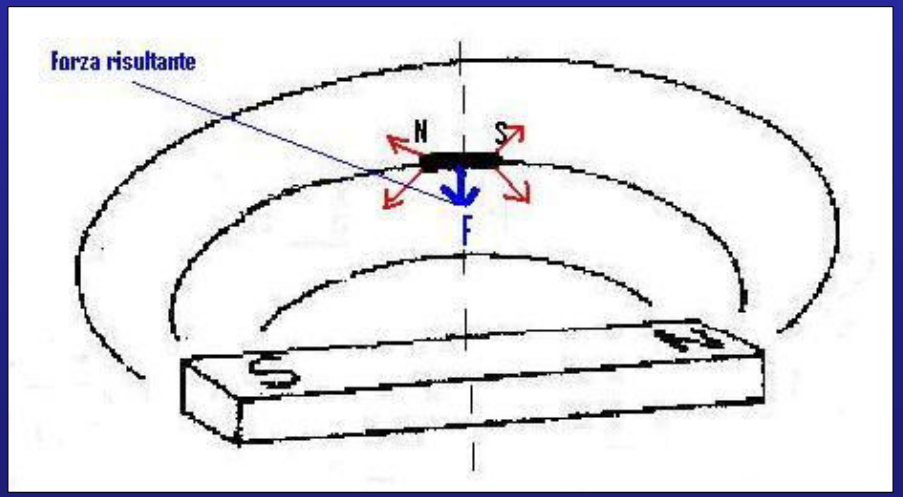




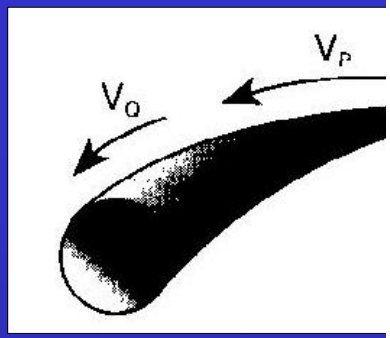
3) Measuring intensity of field vector

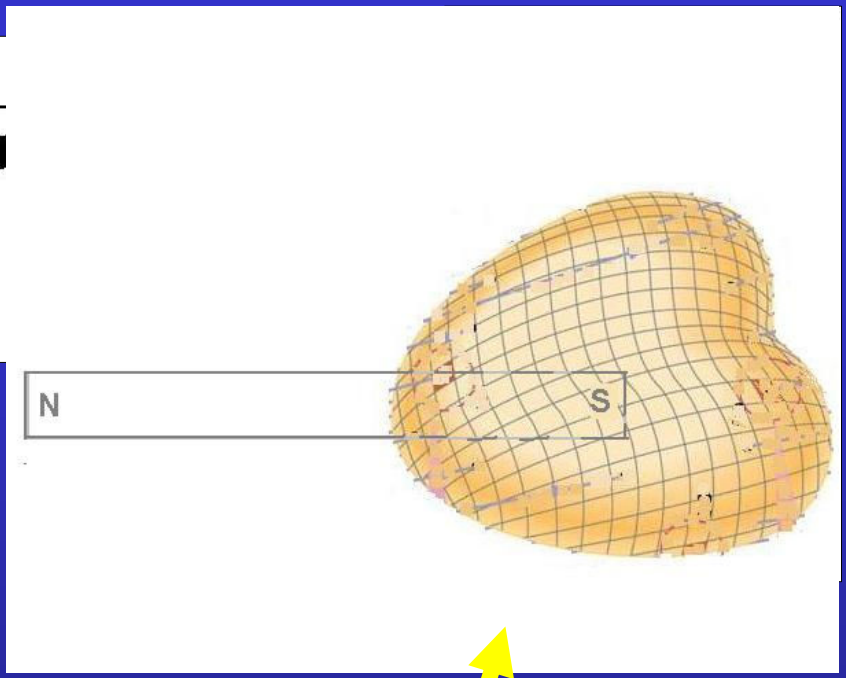


4) Differentiation between field and force vectors

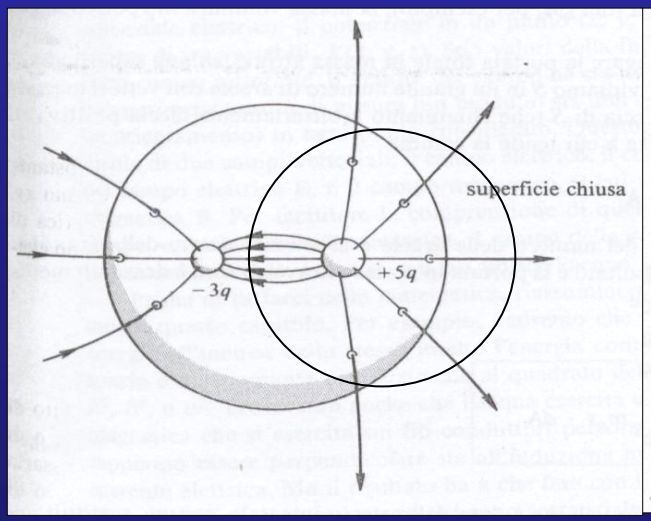


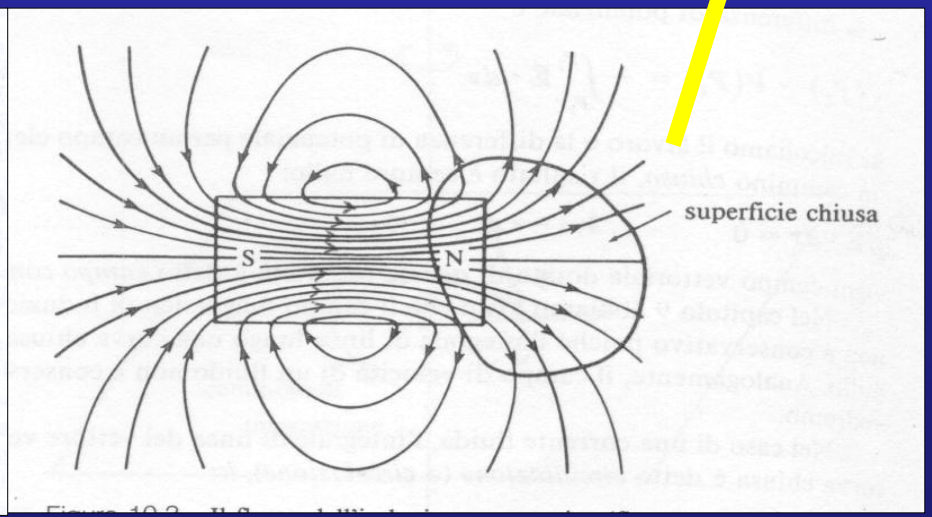
5) Tubes of flux

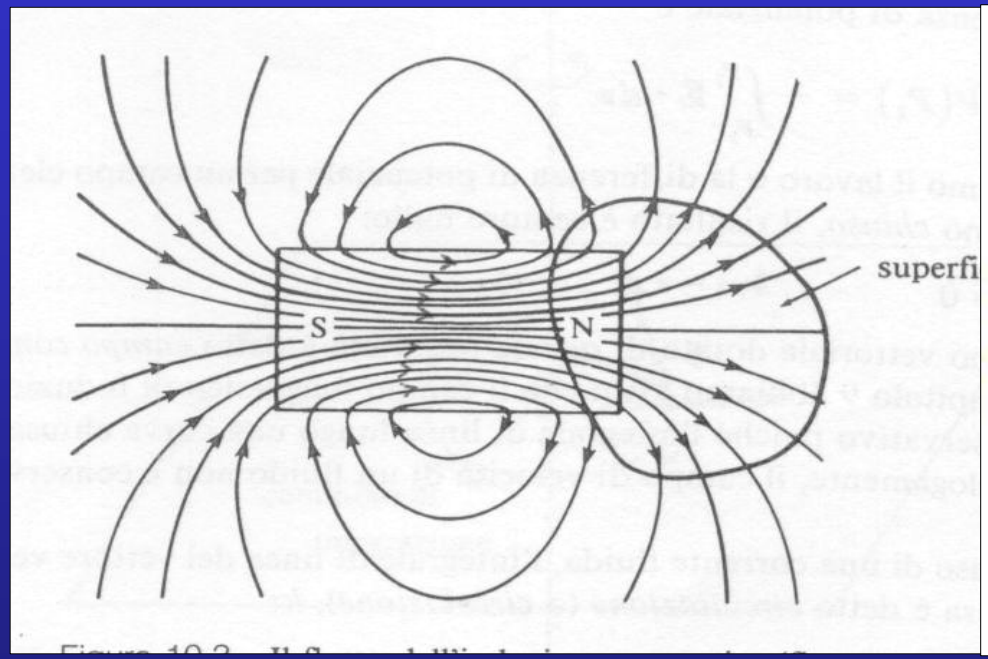




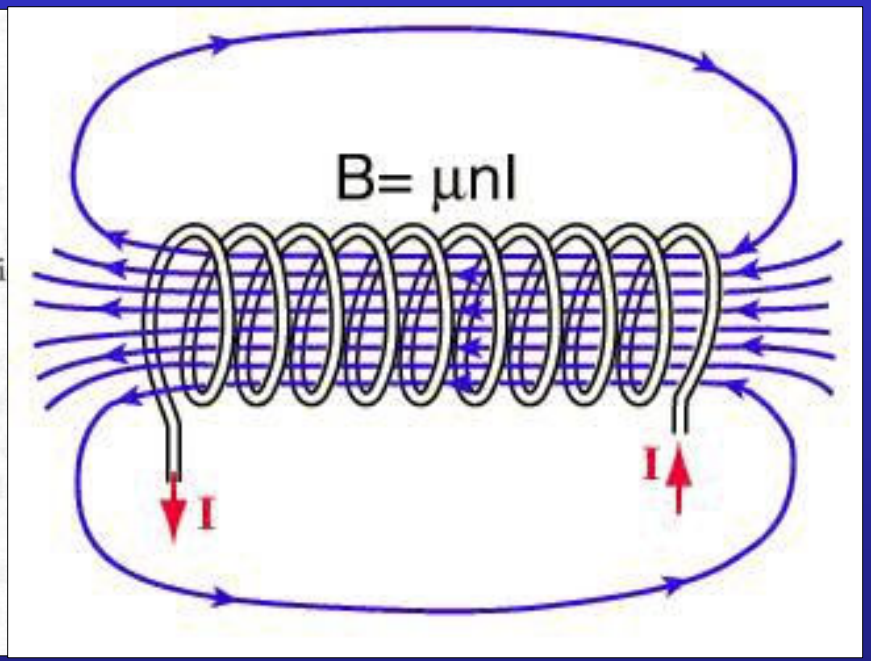
4) Gauss Theorem





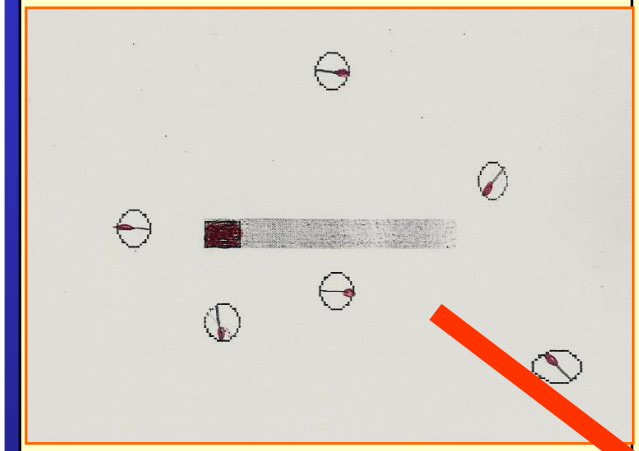
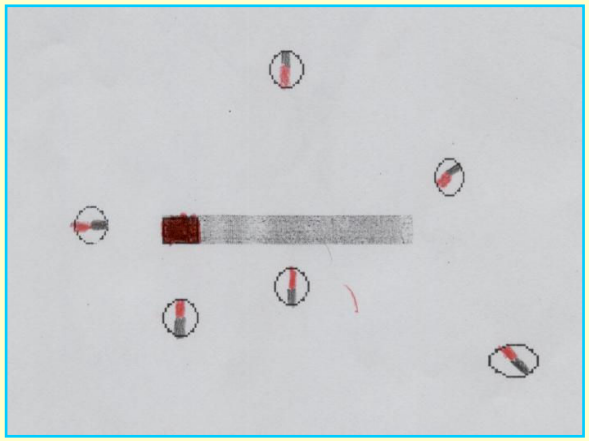
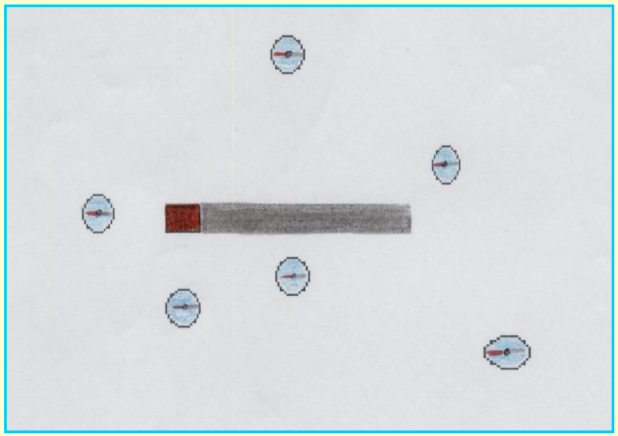


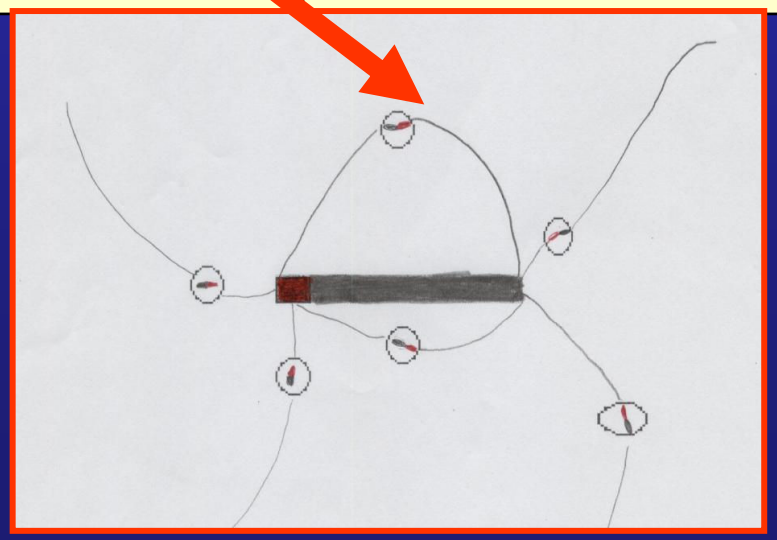
superfi



primary school

Diposition of compasses orientation around a magnet

Correct disposition (9)	Obstacle of attraction (all needles towards the magnet 8)	All needles paralel to the magnet (3)
		



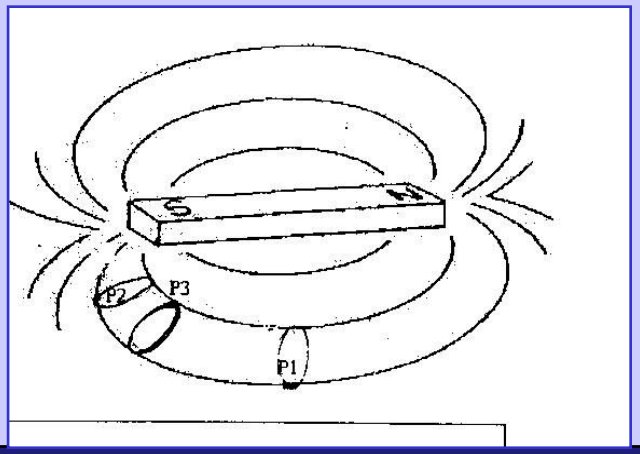
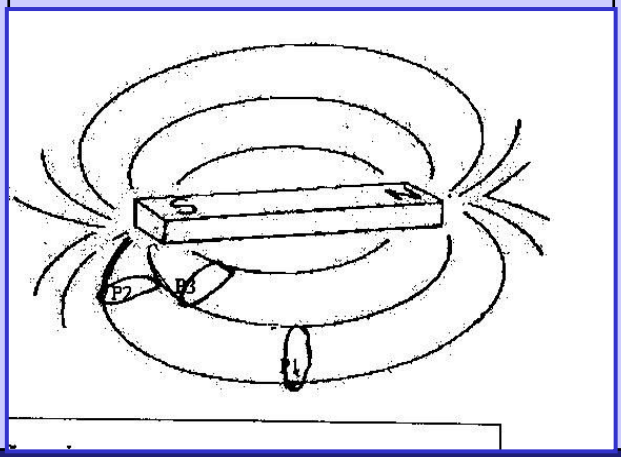
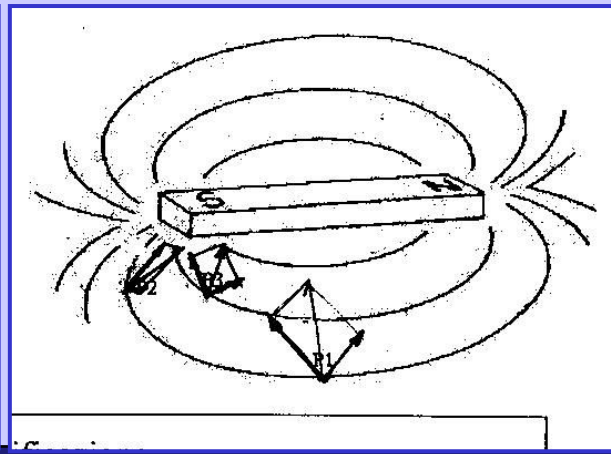
→children's capacity to **<u>remember and reproduce the configuration of field lines</u>**

which in some cases is explicitly evoked

Secondary school

Field lines → **visualising agents for the flux of the field (flux tubes)**

Tubes of flux → **conceptual references for the description of intensity of B**

Using tubes of flux to identify field intensity (9 students don't do any drawing)		
A (7): shows two (5) or three (2) surfaces all on the same tube of flux	B (2): shows 3 surfaces, but S3 appears on another tube of flux	C (1): indicates the components of forces of the two poles
		

The written explanations make reference to:

a) **the tubes of flux** (5/19):*"B(P1)=E1, B(P2)=E2 Since being E1S1=E2S2 and being S2<S1 results that it must be E1<E2. All of which explains the law of the tubes of flux"*

b) **to the number of entry and exit lines** (3/19): *"They belong to the same field line and all lines enter at BP2 , exit at BP1 , however the intensity at BP2 is greater because the area of the concentration of lines is smaller"*

c) **to the distance from the source** *(6/19)"P1 is further away with respect to the source, therefore its field is inferior with respect to that of the closer P1"*

d) **to the distance from the poles** *(5/19)"because it is further from pole S"*