aggiornaMenti
teaching physics in middle school

Andrea Beraudo on behalf of the collaboration

Istituto Nazionale di Fisica Nucleare - Sezione di Torino

Giornate di Studio sulla fisica teorica
Santo Stefano Belbo, 15-16 Novembre 2025

aggiornaMenti LABORATORIO DI DIDATTICA DELLA SCIENZA INFN FONDAZIONE CESARE PAVESE

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  - Students are in a critical phase of their lives, where they must choose the type of school that will shape their future, and are influenced by the educational experiences they've had. However, this stage also offers the opportunity to have an impact on a minimum-bias sample of students!

Initial situation at the start of the project (pre-2017)

The course originated in Turin from occasional activities in individual schools, based on direct relationships with teachers. The situation encountered: science classrooms were

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Turning a limitation into an opportunity by proposing a hands-on teaching approach using objects that anyone can find at home or buy cheaply. Advantages for students:

- not passive observers of experiments that can only be done at school, but active participants, building what they need themselves;
- they can repeat the experiments at home
- and bring out skills (crucial for doing science!) that are rarely valued in traditional lessons (manual dexterity, creative problem solving, teamwork...)
- Students with special educational needs (SEN) are more easily engaged in this type of activity than in traditional lectures

All this led to a national INFN teacher training project

AggiornaMenti: who are we?

12 INFN sections with 68 staff members involved (researchers, technologists, and technical-administrative staff).
Partial complementarity in training offer, with the possibility to participate in multiple local editions. In addition to basic physics:

- Ferrara: coding and robotics
- LNF: modern physics
- Trieste: teaching methodologies (Inquiry-Based Science Education, Investigative Science Learning Environment)

Partnerships with other educational organizations (Fondazione Golinelli, Next-Land, Laboratorio Scienza)

Teachers at work...

Approach applied to the teaching of all areas of physics

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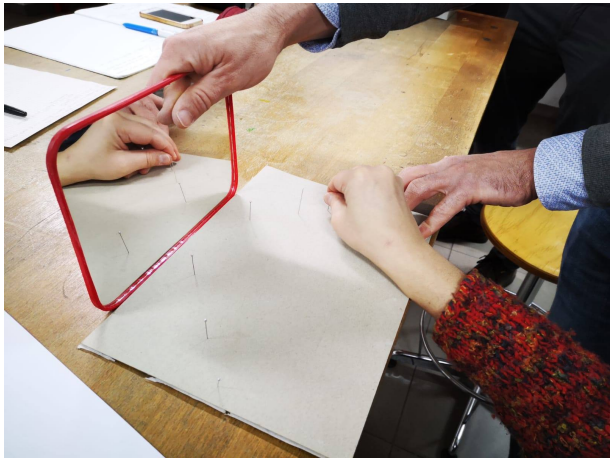

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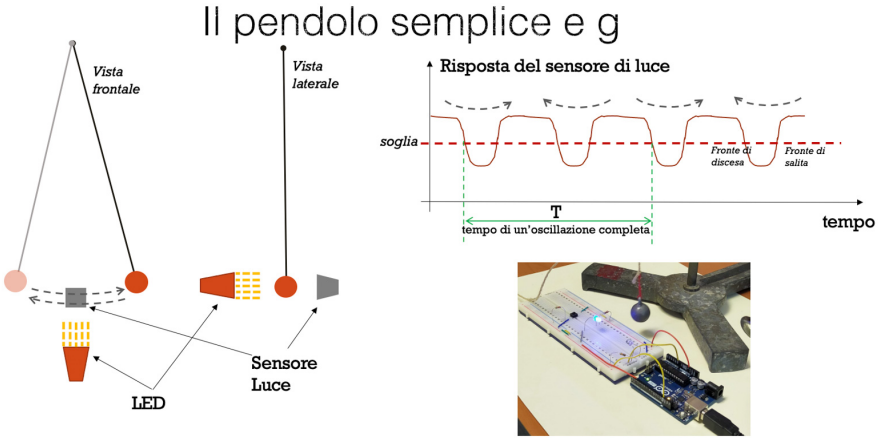

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Educational Resources: Videoclips

Thematic learning paths (optics, fluids, heat...) through video clips (edited by M. Passaseo, INFN-PD):

- Simple materials, easily replicable experiments (science is everywhere!)

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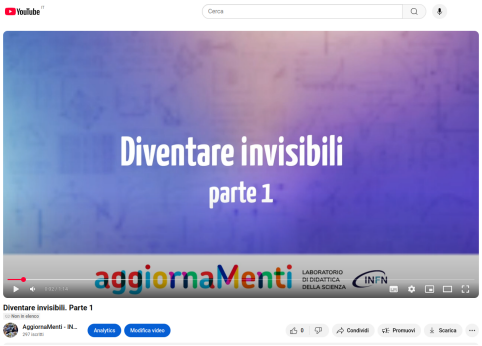

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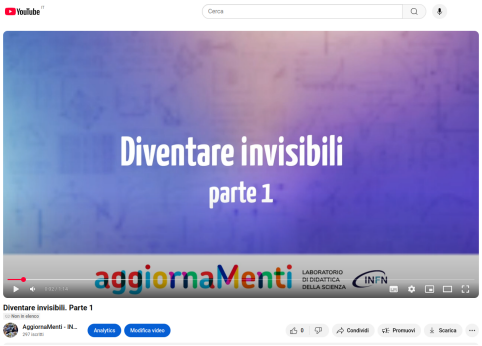

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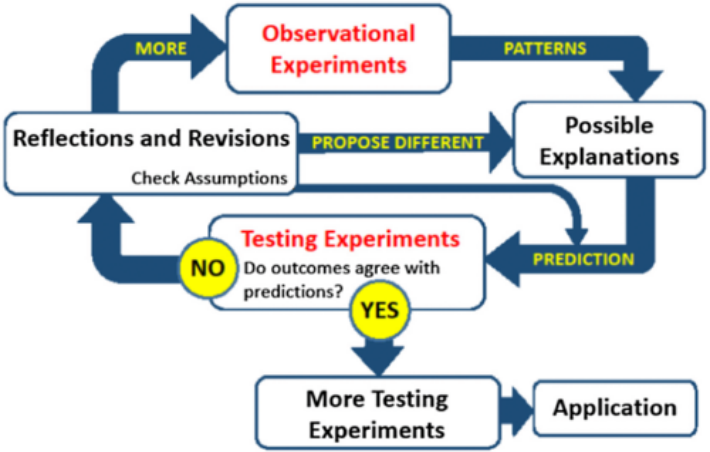
More videos on our YouTube channel.

Educational Resources: Worksheets

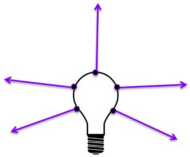
Development of educational worksheets currently underway, coordinated by Grazia D'Agostino (LNS). For some of them, implementation of the ISLE approach under the supervision of Valentina Bologna (INFN-Trieste). Activity carried out with the support of 3 tutors (CA, LNS, TO), some of whom are currently teaching in middle/high school.

ISLE in a nutshell

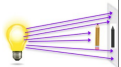
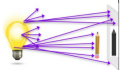
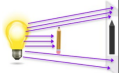
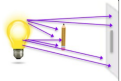


From J.P. Canright and Suzanne White Brahmia, Phys. Rev. Phys. Educ. Res. 20, 010146

Worksheets with ISLE Approach



Modello di molteplici raggi emessi da ogni punto:

a un metro. 	sullo schermo, perché i raggi del bulbo non arrivano allo schermo 	sullo schermo, perché i raggi del bulbo non arrivano allo schermo 	
2 Illuminare una matita posta a distanza inferiore a un metro. 	Si prevede un'ombra nera e netta della matita sullo schermo, perché i raggi del bulbo non arrivano allo schermo, come per l'esperimento 1 	Si prevede che lo schermo sia praticamente illuminato uniformemente con un accenno di ombra. 	Si vede un'ombra sfocata e tenue (diversa dall'esperimento 1)

Experiment Worksheets

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I fluidi

La spinta di Archimede nell'aria

Obiettivo: Osservare l'azione della spinta di Archimede in aria.

Difficoltà di esecuzione (da 1 a 5): 2

Materiali:

- Una bottiglia
- Un palloncino
- Aceto
- Bicarbonato
- Una bilancia.

Esecuzione: Inserire il bicarbonato nel palloncino e l'aceto nella bottiglia. Agganciare il palloncino al bordo della bottiglia e posizionarla sulla bilancia, registrando il peso iniziale. Versare il bicarbonato nella bottiglia e aspettare che avvenga la reazione. Misurare nuovamente il peso una volta che la reazione è terminata.

Riflessioni: Il sistema bottiglia-palloncino è isolato rispetto all'ambiente esterno, per cui la massa al suo interno si conserva (è un sistema chiuso). Dopo la reazione però, il palloncino si gonfia aumentando il suo volume e spostando un volume di aria maggiore rispetto a quello spostato dal sistema prima della reazione. Questo fa si che il sistema sia sottoposto ad una spinta di Archimede maggiore al termine della reazione, per cui il peso registrato dalla bilancia sarà minore rispetto a quella registrato all'inizio.

Se si immagina di eseguire l'esperimento nel vuoto, ci si aspetta che il peso misurato rimanga lo stesso prima e dopo la reazione.

Si consiglia di lasciare formulare agli studenti le ipotesi sul risultato aspettato.

Approfondimenti/collegamenti con la realtà (se previsto):

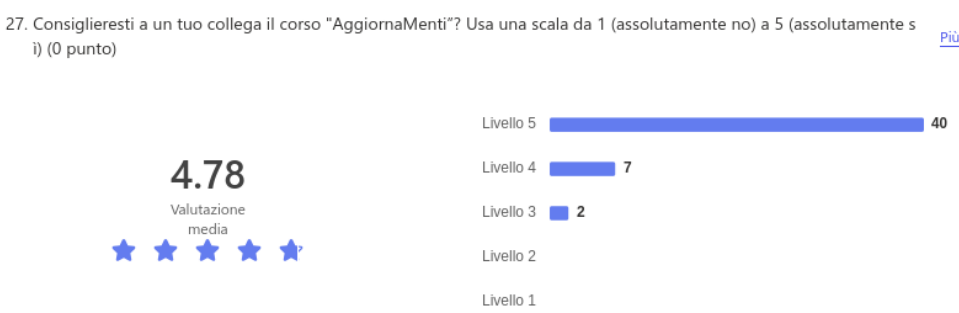
Collegamento con altre discipline (se previsto):

Chimica: legge di conservazione della massa nelle reazioni chimiche.

Riassumendo… L'esperimento evidenzia il ruolo della spinta di Archimede anche nell'aria. Nonostante la massa resti conservata, il maggiore volume occupato dal sistema bottiglia-palloncino dopo la reazione sposta una maggiore quantità d'aria, facendo in modo che questo senta una spinta verso l'alto più grande e di conseguenza un peso minore misurato dalla bilancia.

Project impact

Since 2017, approximately 800 participants have attended the various local editions. Actual impact on teaching was assessed through a national questionnaire administered at the end of the school year.



To learn more about us...

Visit our national webpage

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Call to action: still a lot of work to do, e.g. preparation of further educational resources for online editions. Feel free to join us!