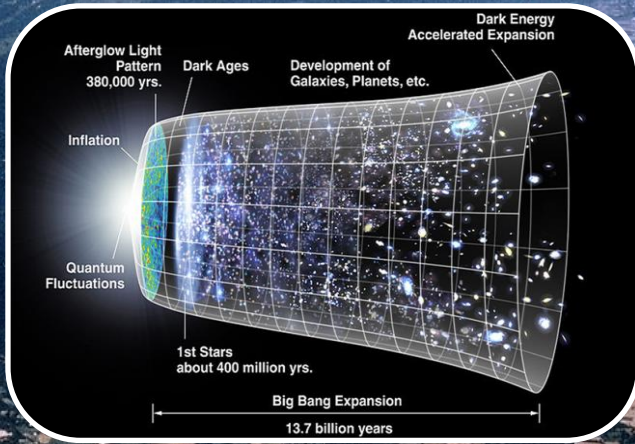


Bringing CERN to the School Classroom

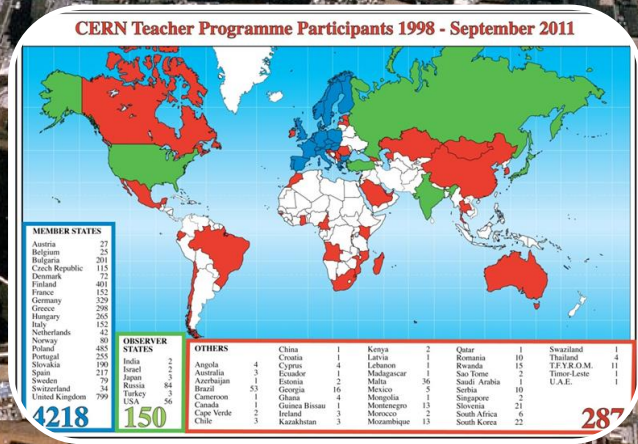
Dr. Angelos Alexopoulos

Greek Teachers Programme, 25-29 Sep 2013



Research

Technology



Collaboration

Education

Inspire my students & answer their questions

Share my enthusiasm & knowledge with my colleagues & students

Upgrade my enthusiasm & knowledge of Particle Physics

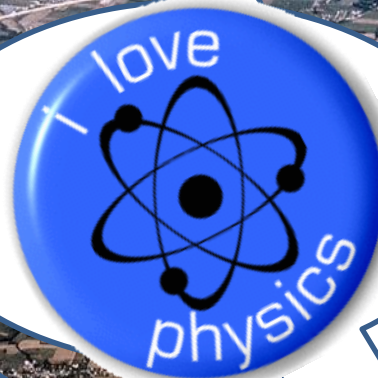
Why am I here?

Make science more attractive to my students

Prepare citizens to make decisions about science

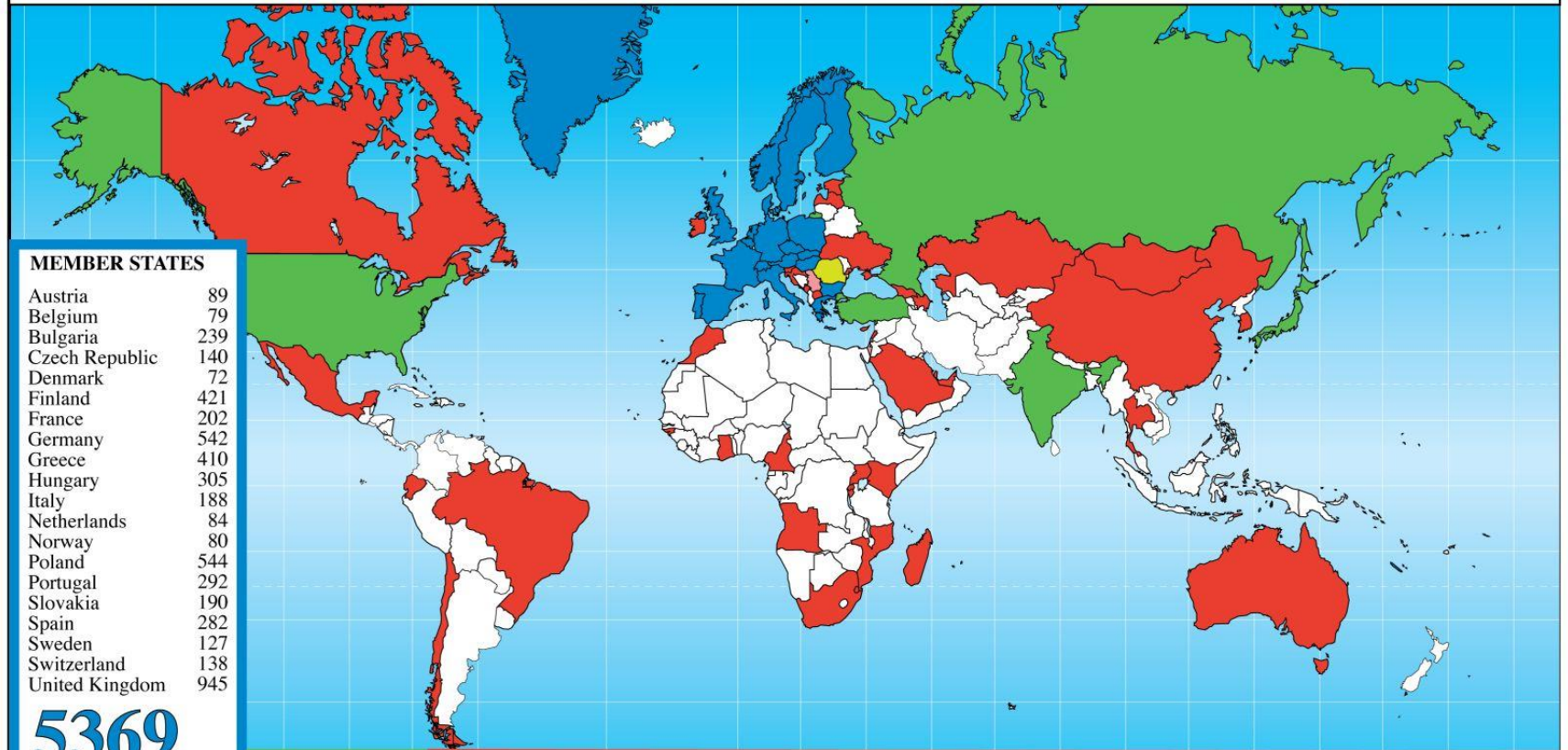
Science is not dead

Learn a method for teaching physics to my students that is not boring



Teachers @ CERN

Teacher Programme Participants 1998 - 2012



MEMBER STATES

Austria	89
Belgium	79
Bulgaria	239
Czech Republic	140
Denmark	72
Finland	421
France	202
Germany	542
Greece	410
Hungary	305
Italy	188
Netherlands	84
Norway	80
Poland	544
Portugal	292
Slovakia	190
Spain	282
Sweden	127
Switzerland	138
United Kingdom	945

5369

CANDIDATE FOR ACCESSION

Romania	11
---------	----

ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP

Israel	4
Serbia	12

OBSERVER STATES

India	2
Japan	4
Russia	163
Turkey	3
USA	61

233

OTHERS

Angola	4	Chile	3	Kazakhstan	3	Mozambique	17	Thailand	6
Australia	3	China	1	Kenya	2	Qatar	1	T.F.Y.R.O.M.	11
Azerbaijan	1	Croatia	1	Latvia	1	Rwanda	15	Timor-Leste	4
Brazil	83	Cyprus	8	Lebanon	1	Sao Tome	3	Uganda	1
Burundi	1	Ecuador	2	Madagascar	2	Saudi Arabia	1	Ukraine	57
Cameroon	3	Estonia	35	Malta	36	Singapore	2	U.A.E.	1
Canada	2	Georgia	55	Mexico	5	Slovenia	21		
Cape Verde	3	Ghana	6	Mongolia	1	South Africa	6		
		Guinea Bissau	1	Montenegro	13	South Korea	44		
		Ireland	3	Morocco	2	Swaziland	1		

472



CERN Teacher Programmes

2011 – 2012

- >60 3-day workshops
- 2150 participants from 76 countries
 - *86% from 20 member states (1747)*
 - *14% from 56 non-member states*
- Lectures, visits, hands-on activities, knowledge sharing and networking
- All materials and archived video recordings are publicly available
- All workshops incl. “Building a Cloud Chamber” and some “HYPATIA”
- Workshops are validated internally and externally

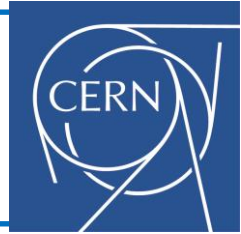


Students @ CERN



Polish high school students at CERN

The Challenge

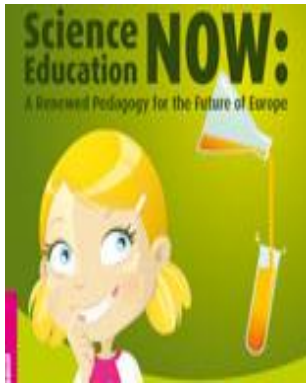


What can I bring back to my school from CERN & **how** can I do it best?

Science Education in Europe: Challenges & Opportunities



Rocard et al. 2007



Osborne & Dillon 2008

- **Reverse** declining student interest in Science
- **Re-imagine** the science classroom of tomorrow
- **Realise** the potential of eScience for engaging students in scientific inquiry

Change of Mindsets & Mindsets of Change



“Smart people don’t learn...because they have too much invested in proving what they know and avoiding being seen as not knowing”

Chris Argyris
[Business theorist]

“I didn’t really want to be the coach who wins but the coach who educates. I want to keep preparing them for the future”

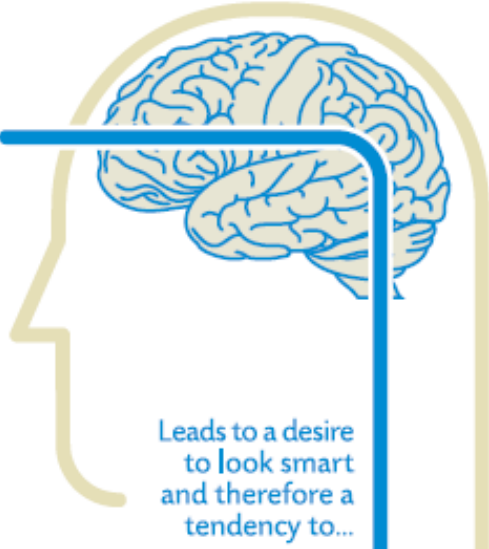
Vincente del Bosque
[Spain’s football team coach]





The “Fixed” Mindset (Dweck, 2008)

Fixed Mind-set
Intelligence is static



Leads to a desire to look smart and therefore a tendency to...

A Fixed Mindset saying:
“I don’t do physics (or maths or...science)”

Holmes, N. (n.d) Mindset graphic
http://www.stanfordalumni.org/news/magazine/2007/marapr/images/features/dweck/dweck_mindset.pdf
Richard, M. G. (n.d.) “Fixed mindset vs. growth mindset: which one are you?” <http://michaelgr.com/2007/04/15/fixed-mindset-vs-growth-mindset-which-one-are-you/>

CHALLENGES

...avoid challenges



OBSTACLES

...give up easily



EFFORT

...see effort as fruitless or worse



SUCCESS OF OTHERS

...feel threatened by the success of others

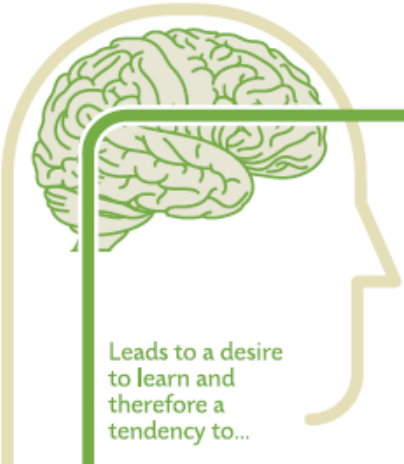


As a result, they may plateau early and achieve less than their full potential.

All this confirms a **deterministic view of the world.**



The "Growth" Mindset (Dweck, 2008)

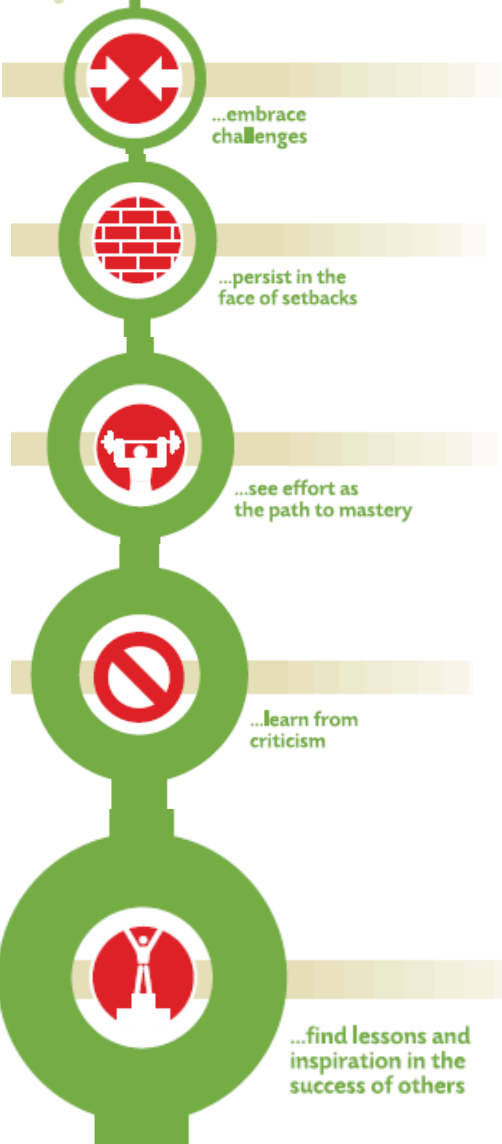


Growth Mind-set
Intelligence can be developed

Leads to a desire to learn and therefore a tendency to...

As a result, they reach ever-higher levels of achievement.

All this gives them a greater sense of free will.



Holmes, N. (n.d) Mindset graphic
http://www.stanfordalumni.org/news/magazine/2007/marapr/images/features/dweck/dweck_mindset.pdf accessed [02/01/12]
 Richard, M. G. (n.d.) "Fixed mindset vs. growth mindset: which one are you?" <http://michaelgr.com/2007/04/15/fixed-mindset-vs-growth-mindset-which-one-are-you/> accessed [02/01/12]

Learning Objectives of Science Education



→ Students need to:

- learn the principles and concepts of science
- acquire the reasoning and procedural skills of scientists
- understand the nature of science as a particular form of human effort





Inquiry-based Science Education (IBSE)

- The **learning activities** in which students develop:
- knowledge and skills (i.e. abilities) to do scientific inquiry
 - an understanding of how scientists study the natural world

Inquiry can be defined as *“the intentional process of diagnosing problems, critiquing experiments, and distinguishing alternatives, planning investigations, researching conjectures, searching for information, constructing models, debating with peers, and forming coherent arguments”*

(Linn, Davis & Bell, 2004: 4)



Why Inquiry-based Learning?

→ Engagement

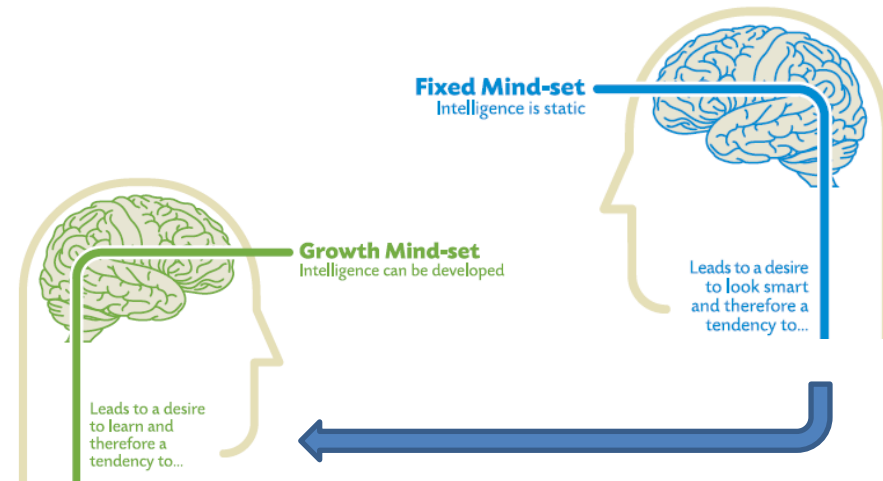
- Students work together
- Students choose which areas to explore and which questions to answer
- Students are active in the learning process

→ Focus

- Towards the student
- Towards the subject
- Towards the learning process

→ But

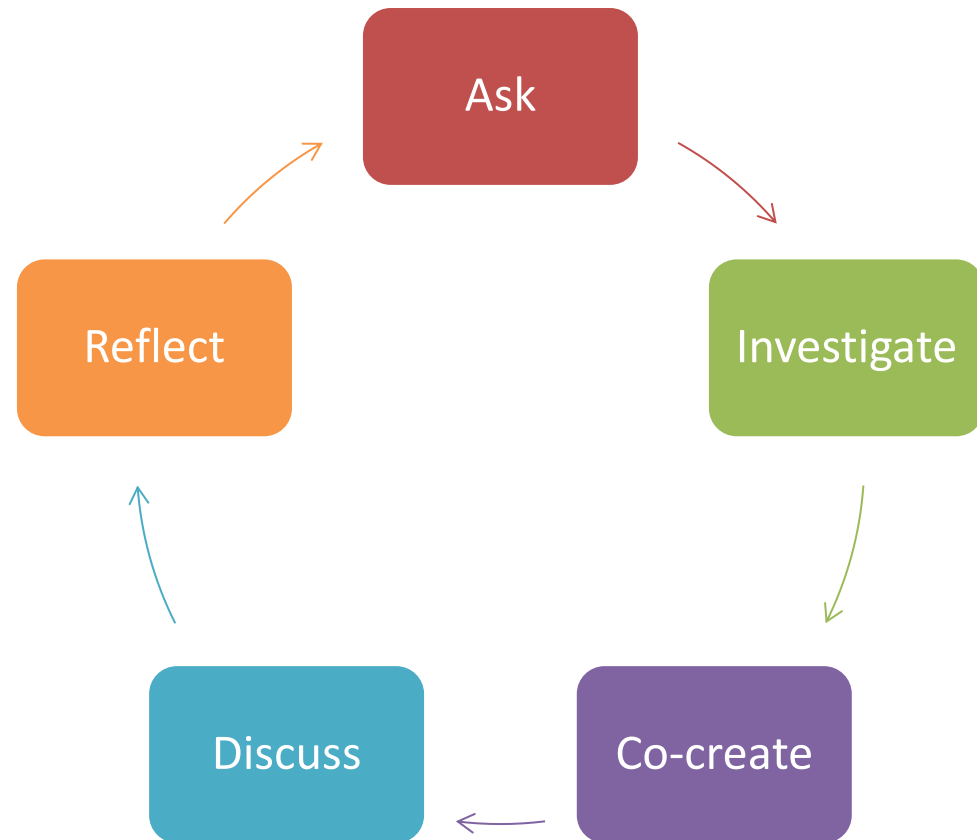
- Requires preparation
- Requires confidence to allow students to explore





Five Features of Inquiry Learning & Teaching

- i. Students engage with a scientific question, event or phenomenon.
- ii. Students explore ideas through hands-on observations and create explanations of what they observe.
- iii. Students gather evidence from observations and clarify concepts and explanations.
- iv. Students extend their understanding and identify applications of their findings to other situations.
- v. Students reflect on what they have learned and how they have learned it.





References

Dweck, C. (2008) “Mindset: The New Psychology for Success”, Ballantine Books, Random House, New York.

Holmes, N. (n.d.) Mindset graphic

http://www.stanfordalumni.org/news/magazine/2007/marapr/images/features/dweck/dweck_mindset.pdf

Linn, M.C., Davis, E.A., and Bell, P. (2004) “Internet Environments for Science Education” Lawrence Erlbaum Associates, Mahwah, New Jersey.

Richard, M. G. (n.d.) “Fixed mindset vs. growth mindset: which one are you?”

<http://michaelgr.com/2007/04/15/fixed-mindset-vs-growth-mindset-which-one-are-you/>

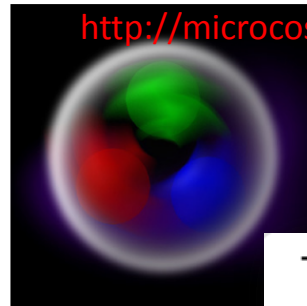
Where to find interesting stuff?



 Zehnerpotenzen  zum ANFANG

10^{-15} meter = 0.000 000 000 000 001 meter

<http://microcosm.web.cern.ch/microcosm/P10/german/welcome.html>



Protonen und Neutronen im Kern bestehen aus jeweils drei Quarks. Im CERN werden die Wechselwirkungen der Quarks untersucht, um zu ergründen, wie bei der Geburt des Universums die elementaren Teilchen entstanden sind.

The Scale of the Universe 2



Use the scroll bar to zoom in and out.



Click on objects to learn more.

By Cary Huang

Technical support by Michael Huang
Copyright © 2012 Cary and Michael Huang (<http://htwins.net>)
Music - "Frozen Star" by Kevin MacLeod (<http://incompetech.com>)





Start



Powers of Ten™ (1977)

EamesOffice  Subscribe 4 videos



 Like  Add to  Share 

1,469,710 

9,423 likes, 81 dislikes

As Seen On:
[adafruit industries blog](#)

Uploaded by [EamesOffice](#) on 26 Aug 2010

Powers of Ten takes us on an adventure in magnitudes. Starting at a picnic by the lakeside in Chicago, this famous film transports us to the outer edges of the universe. Every ten seconds we view the starting point from ten times farther out until our own galaxy is visible only a speck of light among

From Telescopes to Accelerators

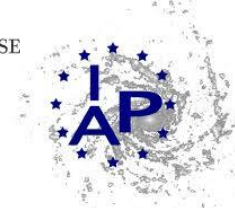


15 partners

9 countries



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LIVERPOOL JOHN MOORES UNIVERSITY
ASTROPHYSICS RESEARCH INSTITUTE



NUCLIO
NÚCLEO INTERACTIVO DE ASTRONOMIA



UNIVERSITY OF
BIRMINGHAM



bm:uk Bundesministerium für
Unterricht, Kunst und Kultur



e-Infrastructures



www.discoverthecosmos.eu



Particle Physics



LHC

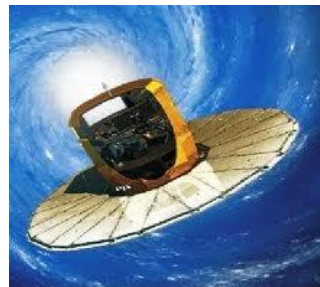


ATLAS



CMS

Astronomy



Gaia



The Liverpool Telescope



The Faulkes Telescope



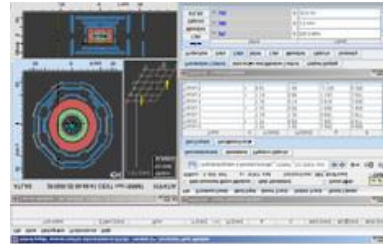
e-Science Applications



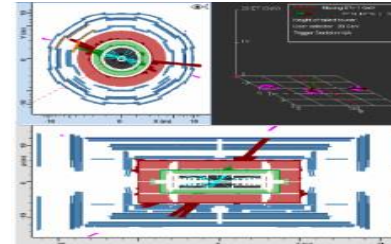
www.discoverthecosmos.eu



Particle Physics



HYPATIA



MINERVA



AMELIA

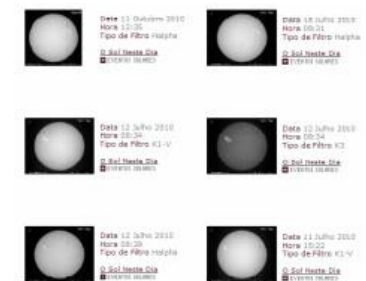
Astronomy



SalsaJ



LTImage



Sun for All



Discover the COSMOS Portal



www.discoverthecosmos.eu



<http://portal.discoverthecosmos.eu/>



We need engaging science instruction



Attractive science instruction

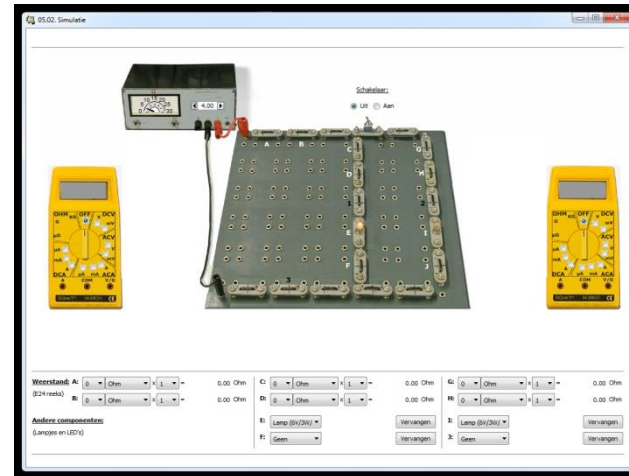
- Constructive (inquiry) learning
 - Computer simulations/games
 - Virtual laboratories
 - Modeling (design) environments
- Collaborative learning
 - Shared objects
 - Chats, video conferencing
- Situated learning
 - Remote/virtual laboratories
 - Simulators (e.g., medicine)

Is there a “best of both worlds”?

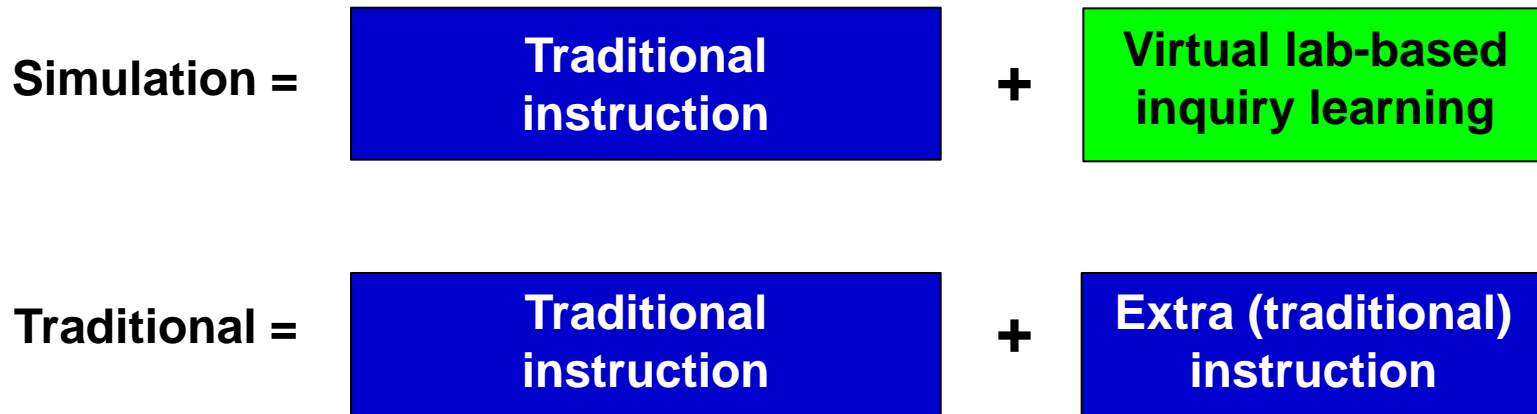
- Students learning in a sequence (parallel or sequential) of simulation and real laboratory outperform the simulation and/or laboratory
 - Zacharia & Anderson, 2003
 - Zacharia, 2007
 - Jaakkola & Nurmi, 2008
 - Zacharia, Olympiou, & Papaevripidou, 2008
 - Jaakkola, Nurmi, & Veermans, 2011
 - Zacharia & de Jong, submitted

Example study

- Participants:
 - Vocational education
 - $n = 43$
 - intermediate level vocational engineering training
 - boys; age 16-22 year ($M = 19,17$; $SD = 1,39$)
 - High prevalence of dyslexia (34,9%)



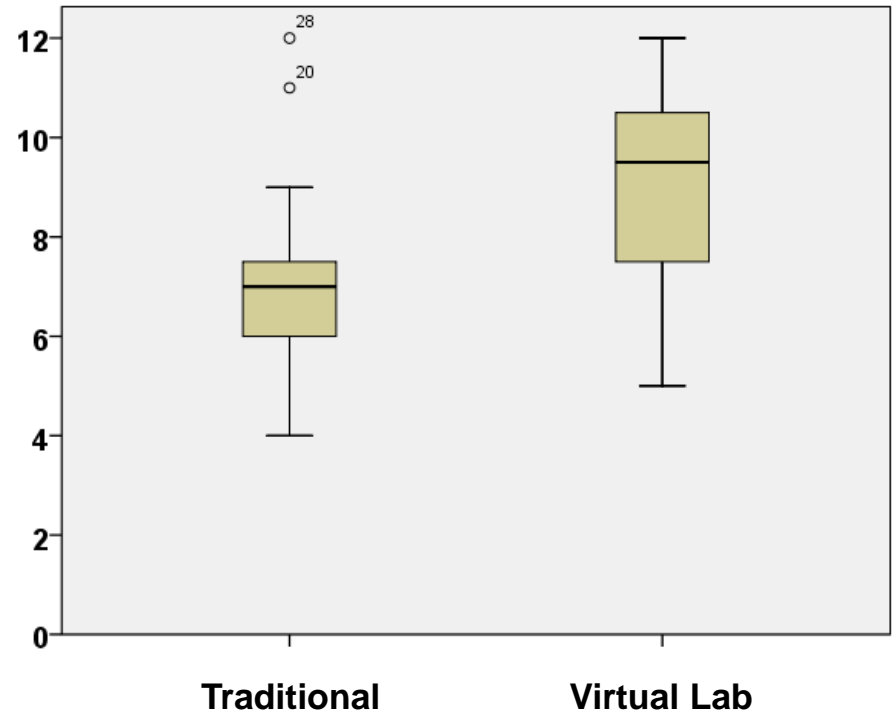
Method



Results

- Post-test:
 - Total score

($p < .01$; Cohen's $d = 0,98$)





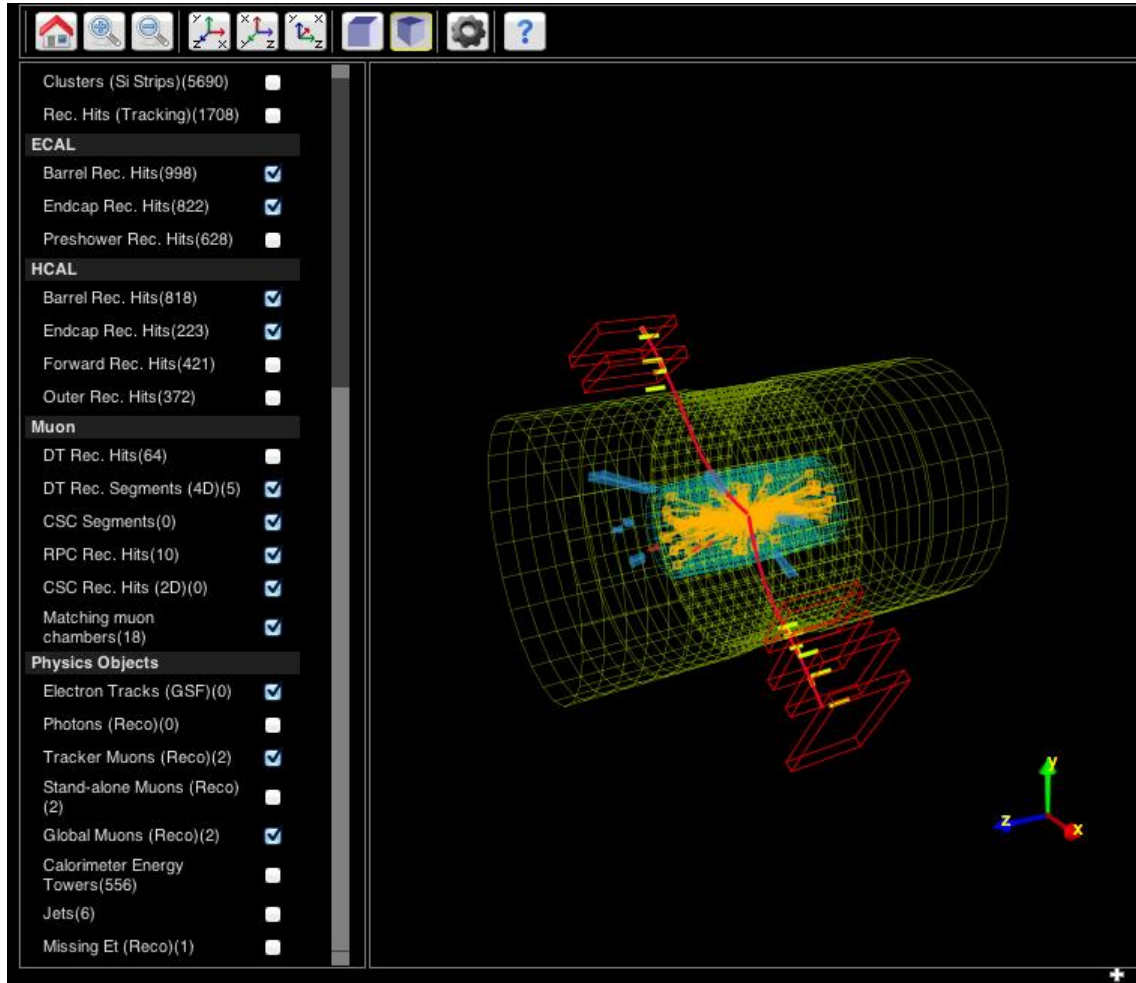
What Go-Lab offers



the
 opti
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 (Limited) authoring fa
 for their students



What Go-Lab offers



Lab Type

- [Virtual Lab \(14\)](#)
- [Remote Lab \(7\)](#)
- [Database \(6\)](#)

Filter by subject:

- [Astronomy \(9\)](#)
- [Particle Physics \(5\)](#)
- [Physics \(4\)](#)
- [Biology \(2\)](#)
- [Electronics \(2\)](#)
- [Environmental Science \(2\)](#)
- [Geography \(2\)](#)
- [Mathematics \(2\)](#)
- [Multiple \(2\)](#)
- [Astrophysics \(1\)](#)
- [Electromagnetism \(1\)](#)
- [Engineering \(1\)](#)
- [Environmental Sciences \(1\)](#)

What's up @ CERN?

CERN OPENDAYS

Our Universe is Yours
Notre Univers est le vôtre



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ATLAS LIVE

ATLAS Virtual Visits

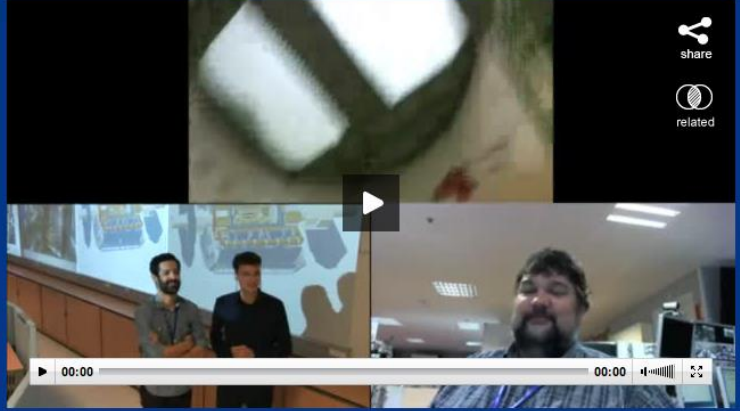
Sofia Science Festival, Bulgaria

Share on

Sofia

10 May - 11:00 CET

Have you ever imagined that you could have access to CERN, one of the world's largest and most respected centres for scientific research? Have you ever imagined that you could have access to science educational material with just one click? The Discover the COSMOS project goes to this year's Sofia Science Festival and provides a dedicated Open Science workshop for teachers and students. The use of virtual reality will spark young scientists and inspire them to follow in the footsteps of the ATLAS Hadron



share related

Angelos Alexopoulos and George Salukvadze in the ATLAS Control Room and participants of the workshop in Sofia.

CERN opens its doors September 28th - 29th

CMS LHCb ALICE



Hangouts with CERN

by CERN

▶ Play all



Thank you!

angelos.alexopoulos@cern.ch