Bringing CERN to the School Classroom

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Norwegians Teachers Programme 2013
Why am I here?

- Inspire my students & answer their questions
- Make science more attractive to my students
- Prepare citizens to make decisions about science
- Upgrade my enthusiasm & knowledge of Particle Physics
- Share my enthusiasm & knowledge with my colleagues & students
- Learn a method for teaching physics to my students that is not boring
- Science is not dead
- Science is not dead
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
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

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

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

Holmes, N. (n.d) Mindset graphic  

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

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)

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

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


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

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

Powers of Ten™ (1977)

The Scale of the Universe 2

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)
From Telescopes to Accelerators

15 partners
9 countries

Lawrence Berkeley National Laboratory
CERN
Technische Universität Dresden
Universidad Complutense Madrid
Liverpool John Moores University
Astrophysics Research Institute
IoA
University of Cambridge
NUCLIO
Núcleo Interactivo de Astronomía
University of Birmingham
BM:UK
Bundesministerium für Unterricht, Kunst und Kultur
e-Infrastructures

Particle Physics
- LHC
- ATLAS
- CMS

Astronomy
- Gaia
- The Liverpool Telescope
- The Faulkes Telescope

www.discoverthecosmos.eu
e-Science Applications

Particle Physics
- Hypatia
- Minerva
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Astronomy
- SalsaJ
- LTImage
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http://portal.discoverthecosmos.eu/

www.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

Simulation = Traditional instruction + Virtual lab-based inquiry learning

Traditional = Traditional instruction + Extra (traditional) instruction
Results

• Post-test:
  – Total score

\[(p < .01; \text{Cohen’s } d = 0.98)\]
What Go-Lab offers

- For students
  - Go-Lab organizes the work according to an inquiry cycle
  - Go-Lab offers (adaptive) guidance specific for each phase

- For teachers
  - A searchable database of online labs
  - (Limited) authoring facilities to adapt the guidance for their students
What Go-Lab offers

Lab Type

- Virtual Lab (14)
- Remote Lab (2)
- 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?
Thank you!

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