



e-Infrastructures for an Engaging Science Classroom

Greek Teachers Programme

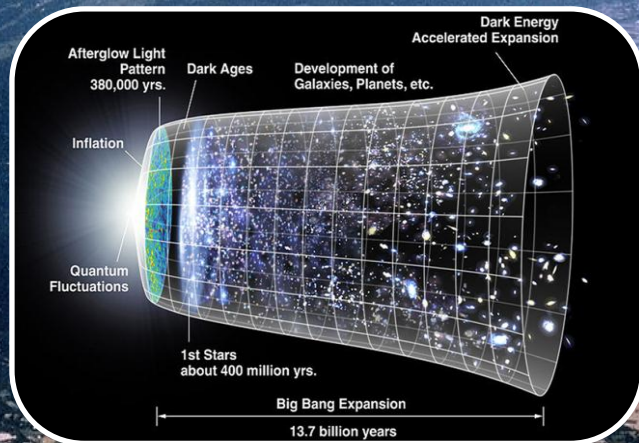
August, 2012

Angelos Alexopoulos

PH- EDU

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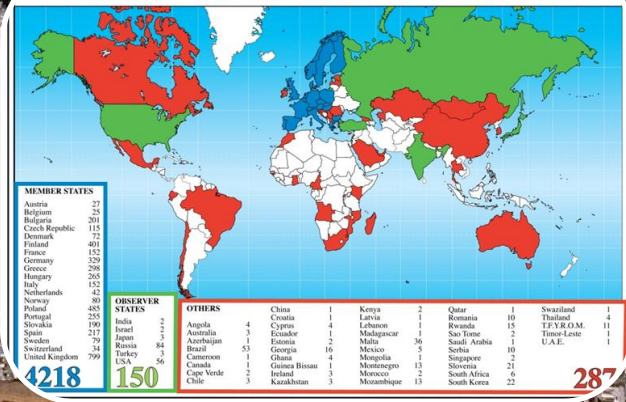


Research

Technology



CERN Teacher Programme Participants 1998 - September 2011



Collaboration

Education

Inspire my students & answer their questions

Share my enthusiasm & knowledge with my colleagues & students

Upgrade my enthusiasm & knowledge of Particle Physics

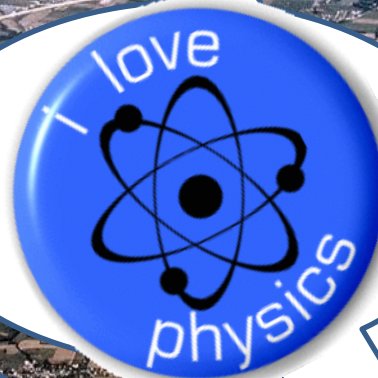
Why am I here?

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



CERN Teacher Programmes



- Experience the atmosphere of frontier research in physics
- Interact with scientists and understand “how science works”
- Share knowledge and experience with each other



- Develop useful ideas and skills on how to bring out the best in:
 - You
 - Students
 - Future teachers and colleagues





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

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”

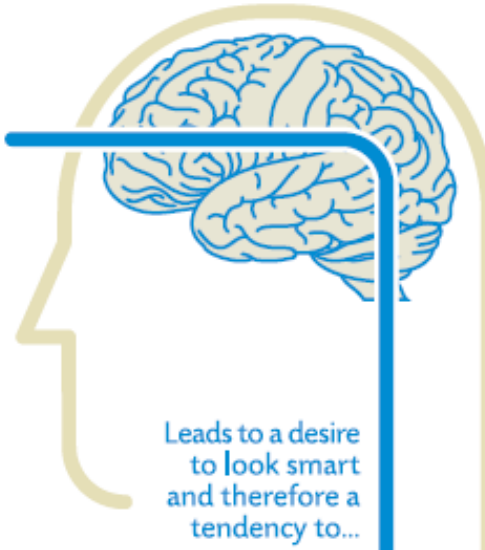
Vincente del Bosque
[Spain’s football team coach]



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

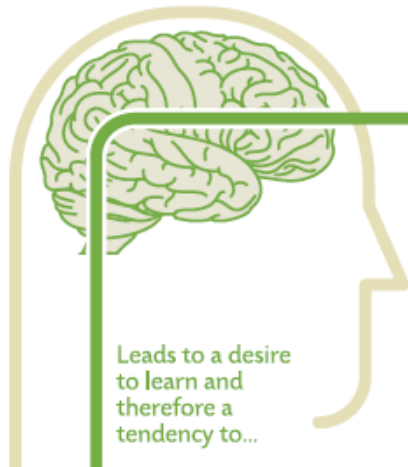
...feel threatened
by the success
of others



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.**



...embrace challenges



...persist in the face of setbacks



...see effort as the path to mastery



...learn from criticism



...find lessons and inspiration in the success of others

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

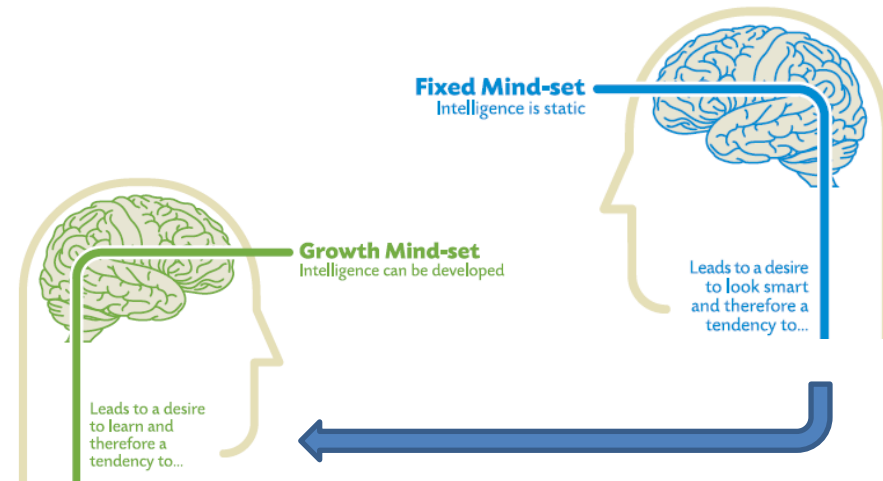
- Students work together
- Students choose which areas to explore and which questions to answer
- Students are active in the learning process

→ Focus

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

→ But

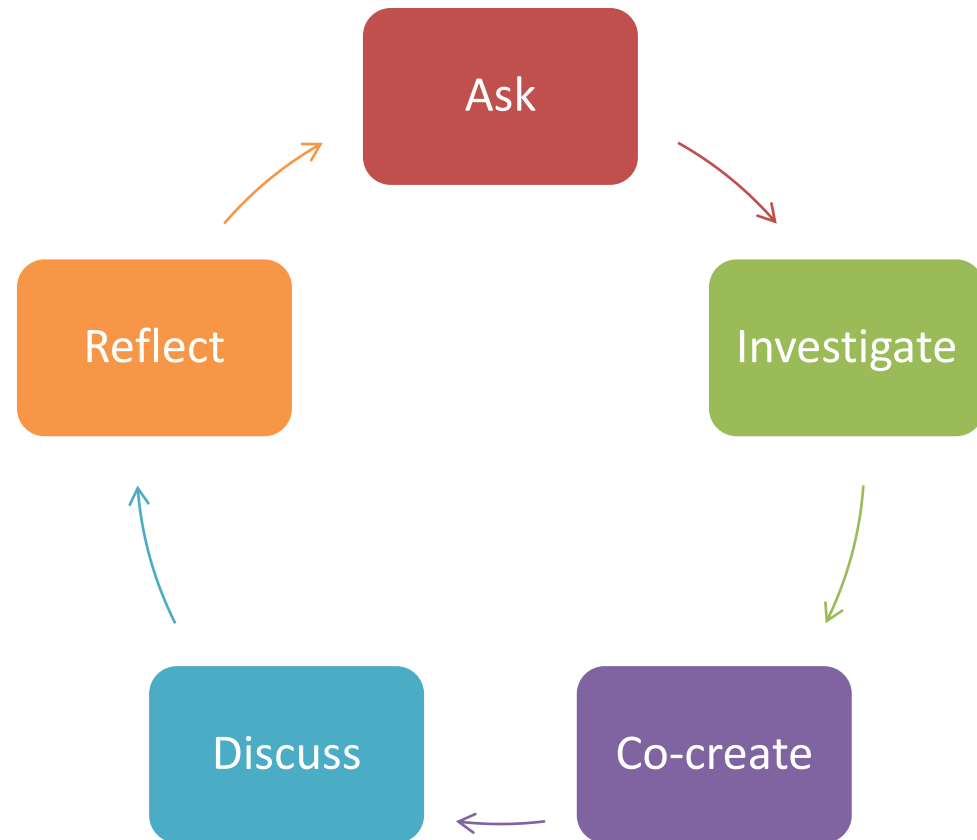
- Requires preparation
- Requires confidence to allow students to explore



Five Features of Inquiry Learning & Teaching



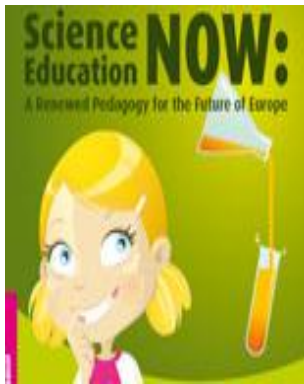
- i. Students engage with a scientific question, event or phenomenon.
- ii. Students explore ideas through hands-on observations and create explanations of what they observe.
- iii. Students gather evidence from observations and clarify concepts and explanations.
- iv. Students extend their understanding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



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



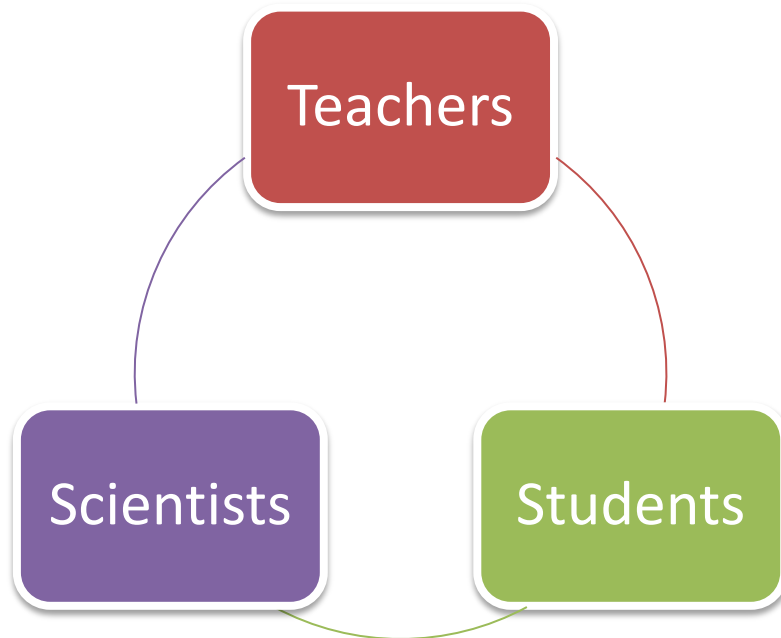
Discover the Cosmos Contribution



To demonstrate how Europe's e-infrastructures could provide powerful tools for scaling-up current pilot implementations for effective introduction of eScience in the school curriculum and development of effective outreach programmes.



Aim I: Community Building



Aim III: Effective Practices Roadmap



From Telescopes to Accelerators

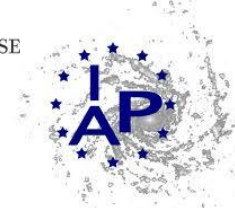


15 partners

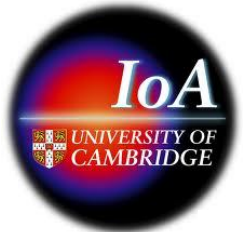
9 countries



UNIVERSIDAD COMPLUTENSE
MADRID



LIVERPOOL JOHN MOORES UNIVERSITY
ASTROPHYSICS RESEARCH INSTITUTE



• U • C •
NUCLIO
NÚCLEO INTERACTIVO DE ASTRONOMIA



UNIVERSITY OF
BIRMINGHAM



bm:uk Bundesministerium für
Unterricht, Kunst und Kultur



e-Infrastructures



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Particle Physics



LHC

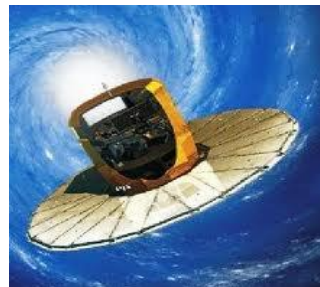


ATLAS



CMS

Astronomy



Gaia



The Liverpool Telescope



The Faulkes Telescope



e-Science Applications



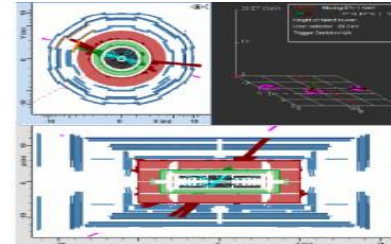
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Particle Physics



HYPATIA



MINERVA



AMELIA

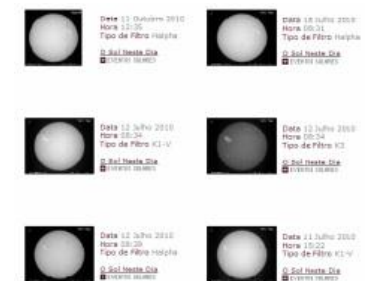
Astronomy



SalsaJ



LTImage



Sun for All



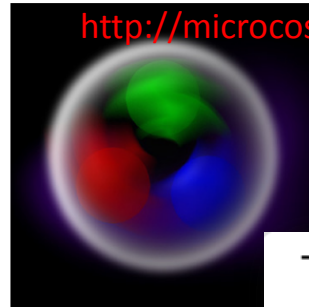
Where to find interesting stuff?



 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



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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

Discover the COSMOS Portal



www.discoverthecosmos.eu



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





Education & Outreach Activities



Local

- Demonstrations and training workshops in schools and Universities for teachers
- eScience school-based activities

National

- Training/Demonstrations and e-Masterclasses
- Contests for secondary school teachers/students

International

- Competitions for teachers/students
- Training seminars (e.g. winter/summer schools)
- Masterclasses/e-Masterclasses
- Annual Conferences

Activities: Example 1



Physics Teacher Training Workshop

Germany, Mar 17, 2012

- Lectures from active researchers
- Measurements on real data from LHC experiments
- Discussions with scientists and teaching colleagues
- Presentation of the “Netzwerk Teilchenwelt” (German network for students and teachers in Particle Physics)
- Presentation of resources usable in classroom



Activities: Example 1



ATLAS Virtual Visits

Greece, Apr 04, 2012

- Lectures about ATLAS experiment at LHC at CERN
- Mini Masterclass with HYPATIA
- Preview of CERN Mini Expo in Greece
- Virtual Visit to ATLAS Control Room



Activities: Example 2



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The CERN Mini Expo Tour Greece, Nov 2011 – Jun 2012

- 7 cities; > 25k visitors (inc. >17k students)
- 12 training workshops for >800 teachers
- IPPOG Masterclasses for students and Virtual Visits



Activities: Example 3



Discover the Cosmos Summer School Crete, Jul 01-06, 2012

- 15h of lectures/demonstrations
- 10h hands-on workshops
- Facilitate teachers/trainers to integrate educational resources of science centres to the science curriculum



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Activities: Example 4



High School Teachers Programme at CERN

Geneva, Jul 01-21, 2012

- Physics teachers from member & non-member states
- Hands-On Group Work
 - Creation of inquiry-based educational scenarios in Particle Physics with eScience tools from the LHC experiments



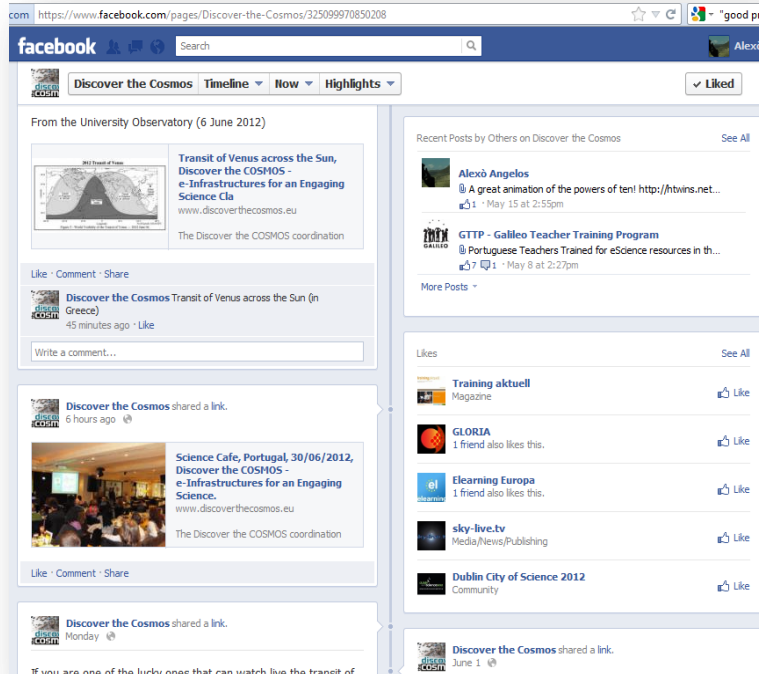
Thank You!



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