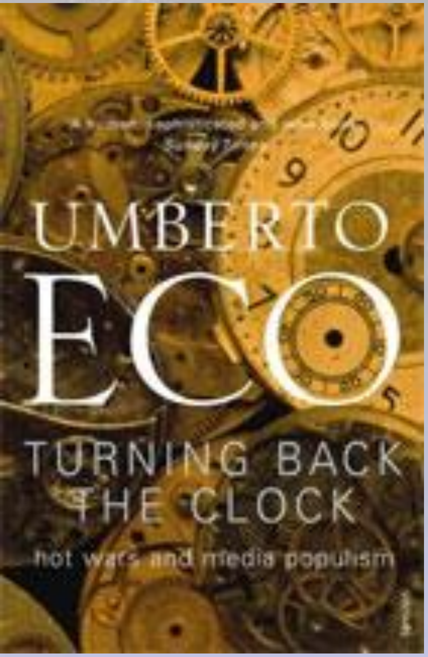
High School Teachers Programme 2012
July 16th, 2012, CERN

Frontier Physics Research in the school Classroom

Sofoklis A. Sotiriou and Angelos Lazoudis
Ellinogermaniki Agogi, Greece



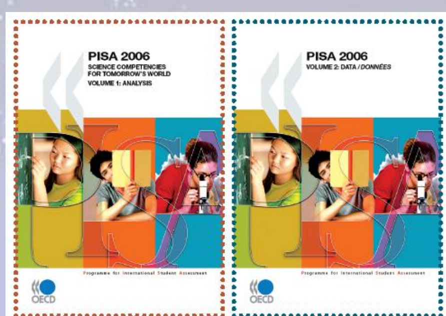
I think the classroom can help. It is up to schools, and to all initiatives that can educate, including reliable Internet sites, to ensure that young people gradually acquire the Correct understanding of scientific procedure. A most difficult task, Because even knowledge transmitted by schools is often Deposited in the memory like a sequence of miraculous episodes: Madame Curie who come home one evening and discovers Radioactivity thanks to a mark on a sheet of paper, ...Galileo who sees a lamp swaying and suddenly discovers everything, even that the world rotates…

It is the duty of a man of learning not only to do scrupulous research but also to present his Knowledge effectively. Scientists sometimes still feel it's not dignified to take an interest in popularization, although masters in the field include Einstein and Heisenberg.

But if we are to teach a nonmagical view of science, we cannot expect it to come from the mass media. The Scientific community itself must construct it bit by bit in the collective awareness, starting with the young.

- In recent times fewer young people seem to be interested in science and technical subjects. Why is this?
- Does the problem lie in wider socio-cultural changes, and the ways in which young people in developed countries now live and wish to shape their lives? Or is it due to failings within science education itself?

PISA 2006


PISA 2006
PISA 2006
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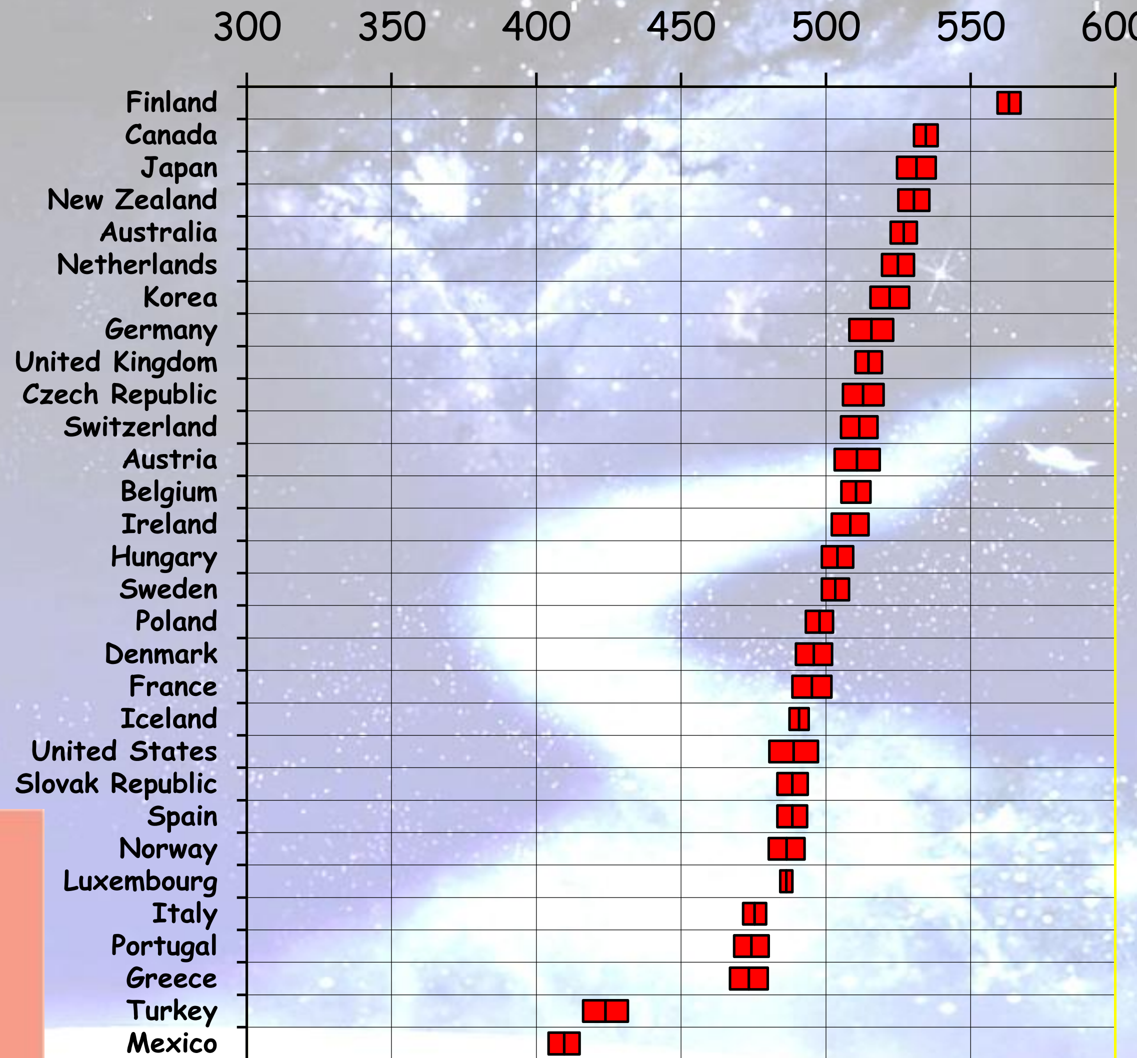
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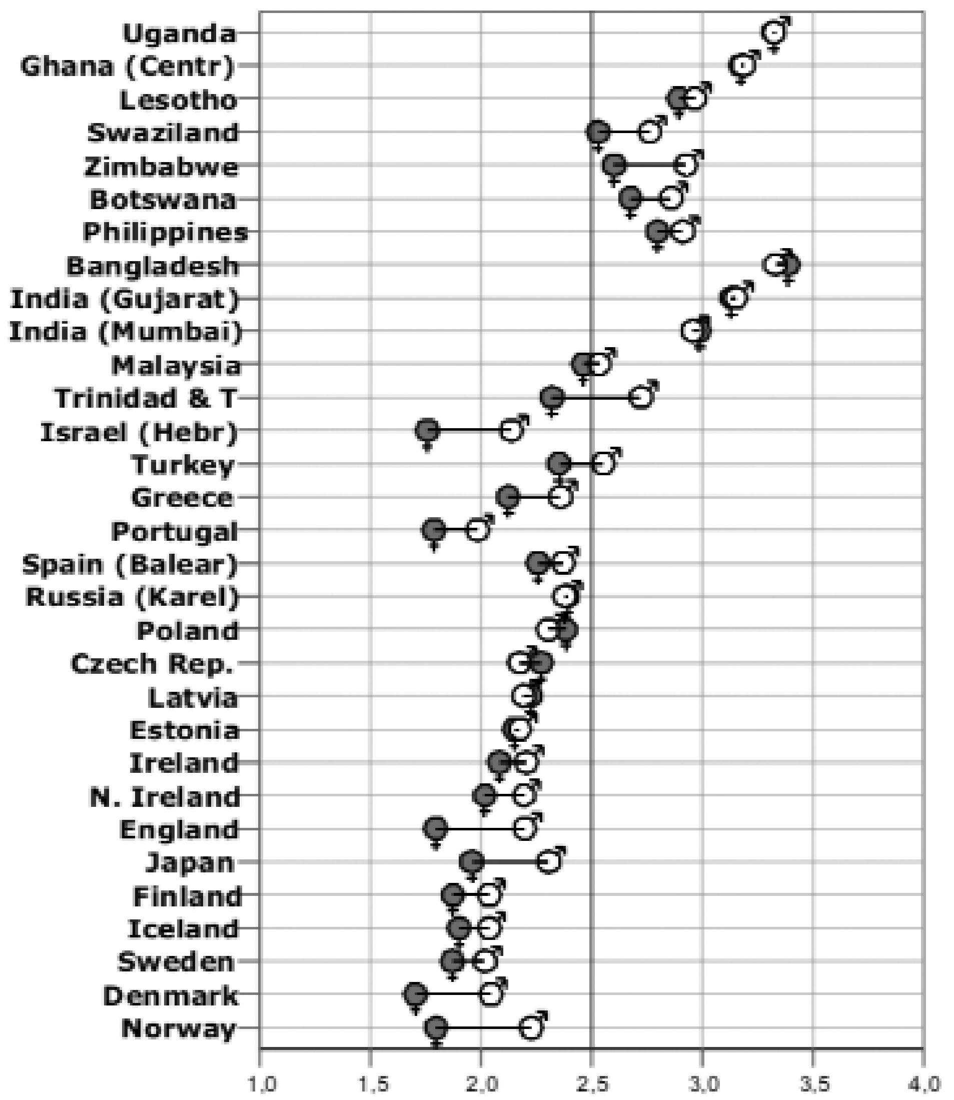
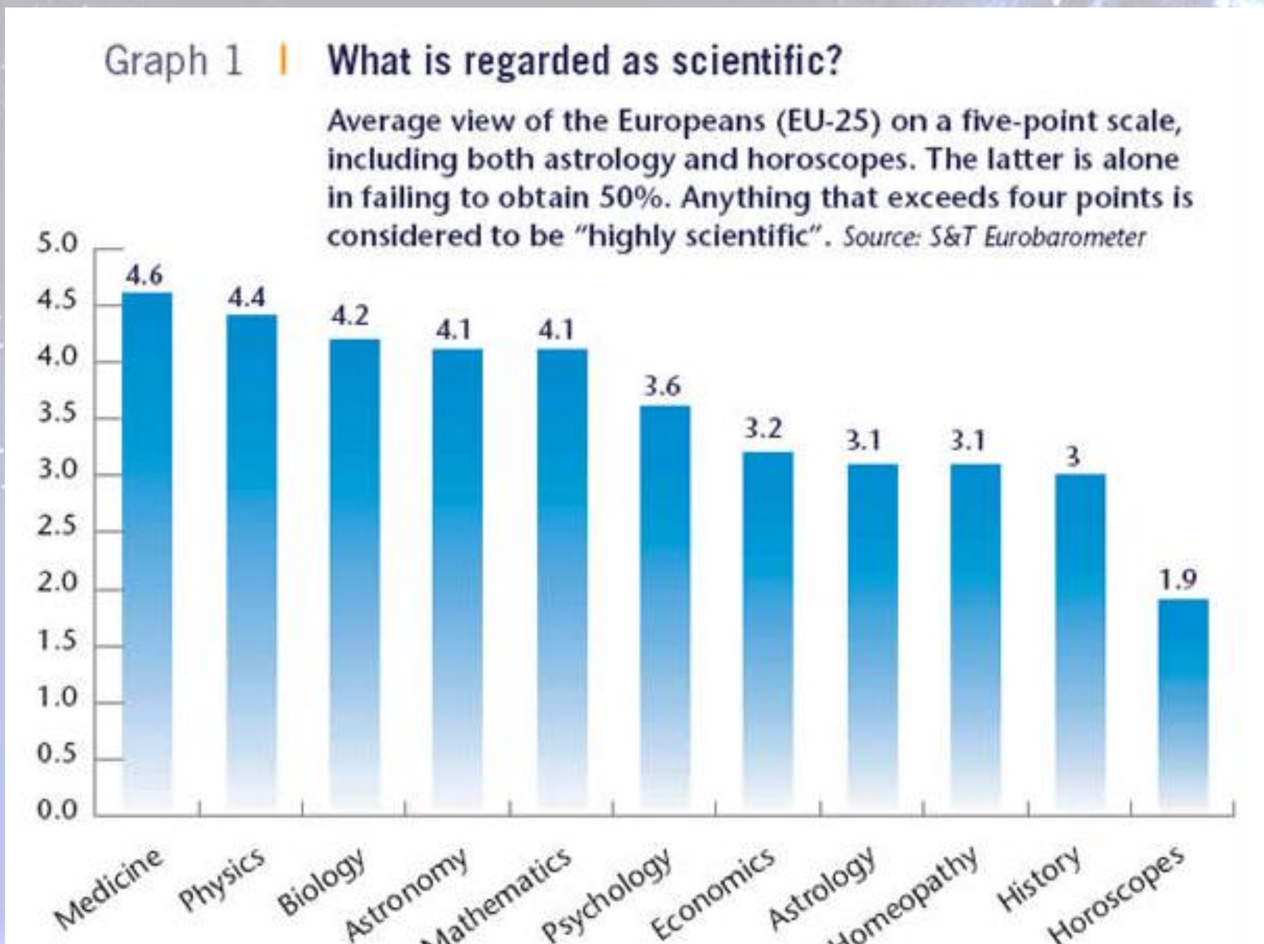
Greece
Turkey
Mexico



The ROSE study of students' attitudes to science in more than 20 countries has found that students' response to the statement 'I like school science better than other subjects' is increasingly negative the more developed the country. In short, the more advanced a country is, the less its young people are interested in the study of science.

Double Eurobarometer survey



The Rocard Report on Science Education (2007)
Science Education in Europe:Critical Reflections (J. Osborne, J. Dilon, 2008)

Redefining Science Education

There is a major mismatch between opportunity and action in most education systems today. It revolves around what is meant by "science education," a term that is incorrectly defined in current usage. Rather than learning how to think scientifically, students are generally being told about science and asked to remember facts. This disturbing situation must be corrected if science education is to have any hope of taking its proper place as an essential part of the education of students everywhere.

Bruce Alberts, Science, January 2009

As students become absorbed with technology-based games, educators grapple with how best to use technology. Immersive simulations represent one way in which new media can enhance traditional learning experiences.

http://www.sciencemag.org/cgi/content/full/323/5913/43

Current Trends Science Education

A reversal of school science-teaching pedagogy from mainly deductive to inquiry-based methods provides the means to increase interest in science.

Inquiry-based science education (IBSE) has proved its efficacy at both primary and secondary levels in increasing children's and students' interest and Attainments levels while at the same time stimulating teacher motivation. IBSE is effective with all kinds of students from the weakest to the most able and is fully compatible with the ambition of excellence. Moreover IBSE is beneficial to promoting girls' interest and participation in science activities. Finally, IBSE and traditional deductive approaches are not mutually exclusive and they should be combined in any science classroom to accommodate different mindsets and age group preferences.

Current Trends Science Education

Renewed school’s science-teaching pedagogy based on IBSE provides increased opportunities for cooperation between actors in the formal and informal arenas.

Due to the nature of its practices, IBSE pedagogy is more likely to encourage relationships between the stakeholders of both formal and informal education. And it creates opportunities for involving firms, scientists, researchers, engineers, universities, local actors such as cities, associations, parents and other kinds of local resources.

Current Trends Science Education

Scientific disciplines in school have to be enlarged.

The introduction of problem oriented fields of studies instead Of more traditional disciplines would attract the interest of more young people.

Modeling „Problem solving competence“ in PISA

Structure model

- Problem solving process

  1. understand the problem
  2. characterize the problem
  3. representation of the problem
  4. solving the problem
  5. reflection of the solution
  6. communication of the solution

Level model

- Levels

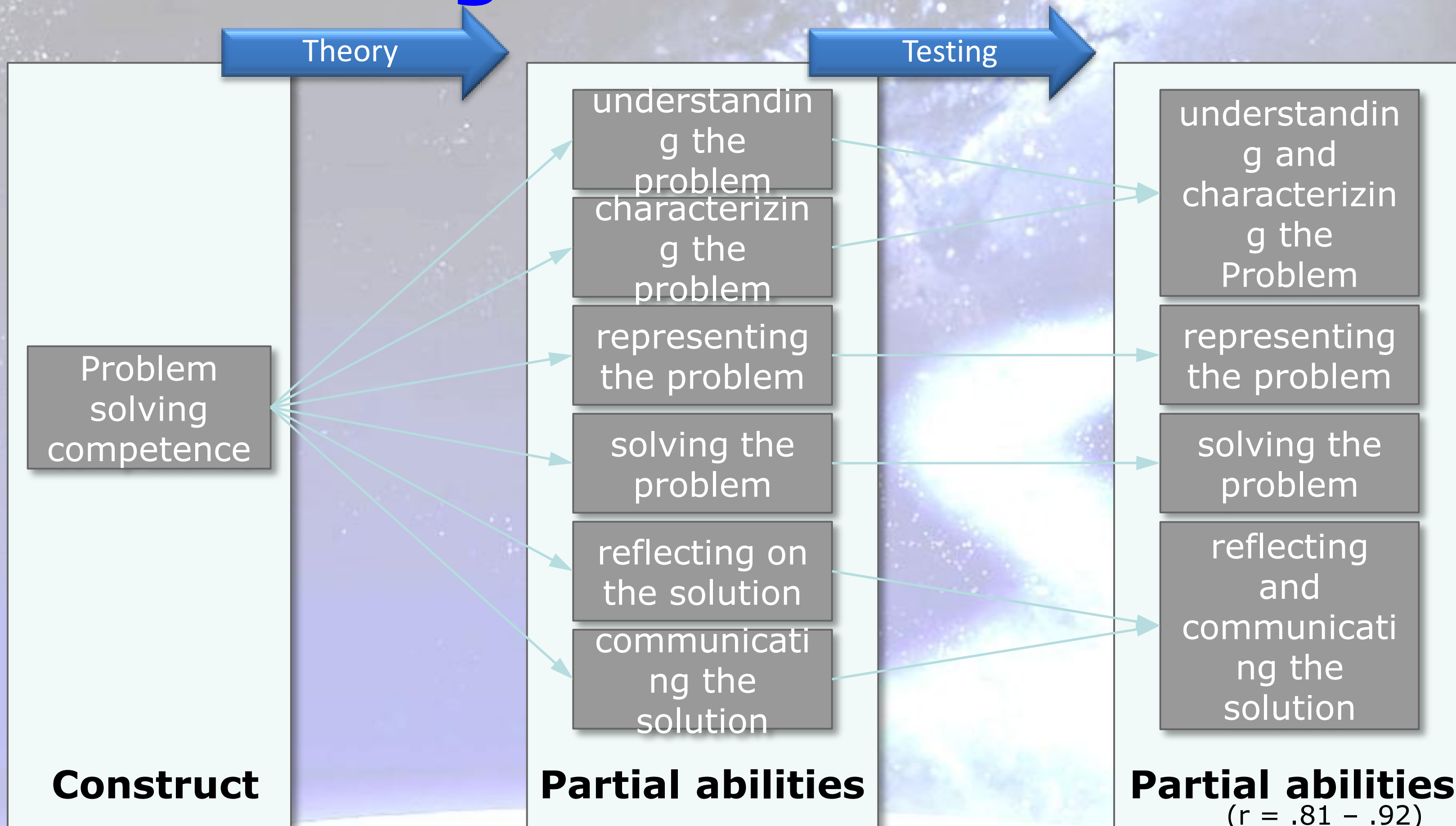
  III „reflective and communicative problem solver “

  II „advanced problem solver“

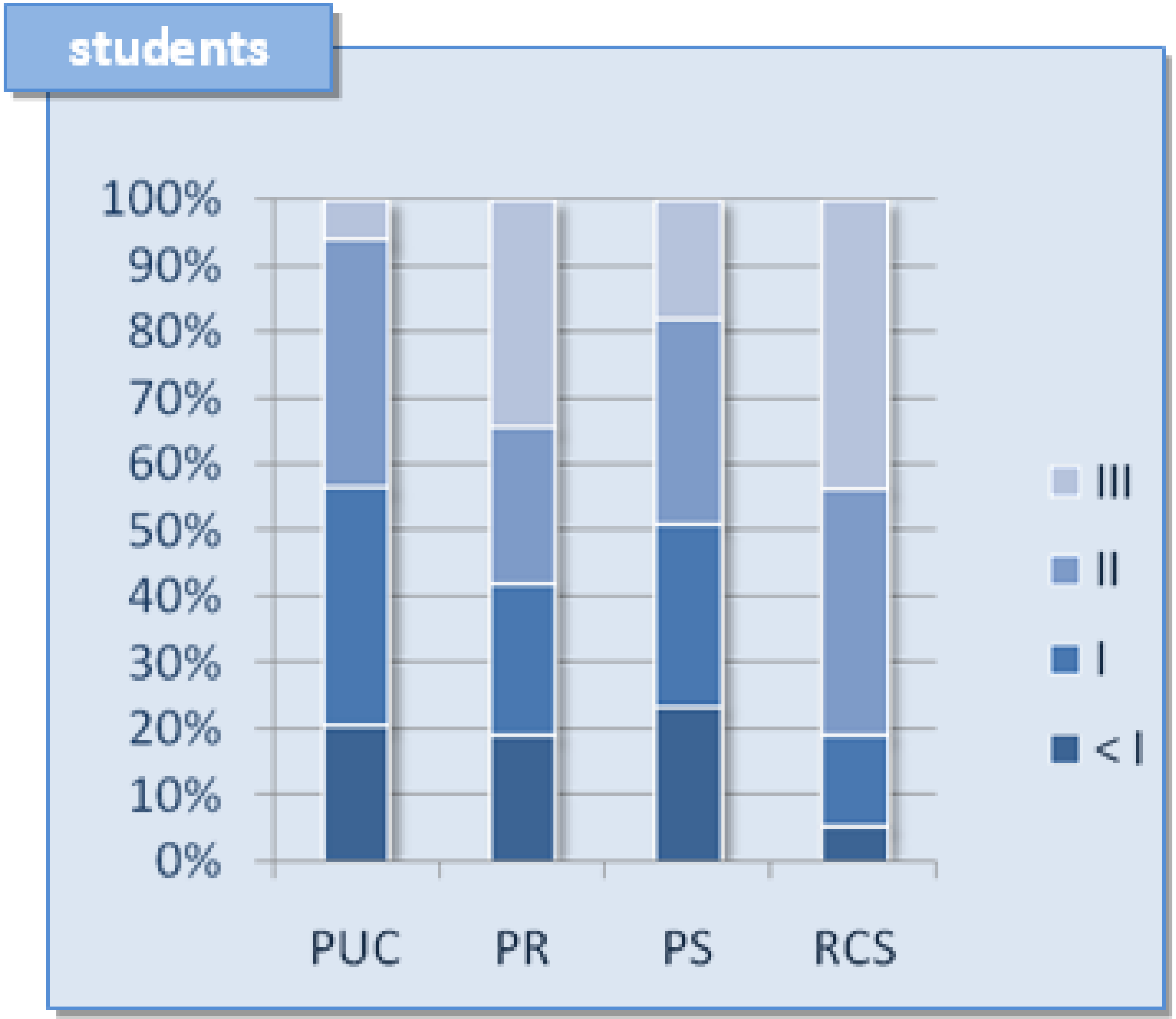
  I „beginning problem solver“

  < I “no problem solver”

Structuring Educational Activities



PISA 2003 Koppelt & Tiemann 2008, 2009


students
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
PUC
PR
PS
RCS
III
II
I
< I

Re-imagine science education

The message is clear.

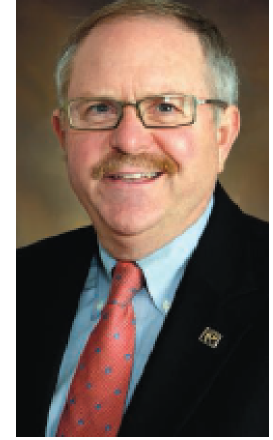
There are shortcomings in curriculum, pedagogy and assessment, but the deeper problem is one of fundamental purpose. School science education has never provided a satisfactory education for the majority. Now the evidence is that it is failing in its original purpose, to provide a route into science for future scientists.

The challenge therefore, is to re-imagine science education: to consider how it can be made fit for the modern world and how it can meet the needs of all students; those who will go on to work in scientific and technical subjects, and those who will not.

The role of teachers

Teachers are key players in the renewal of science education. Among other methods, being art of a network allows them to improve the quality of their teaching and supports their motivation.

Networks can be used as an effective component of teachers' professional development, are complementary to more traditional forms of in-service teacher training and stimulate morale and motivation.



It's the Teachers

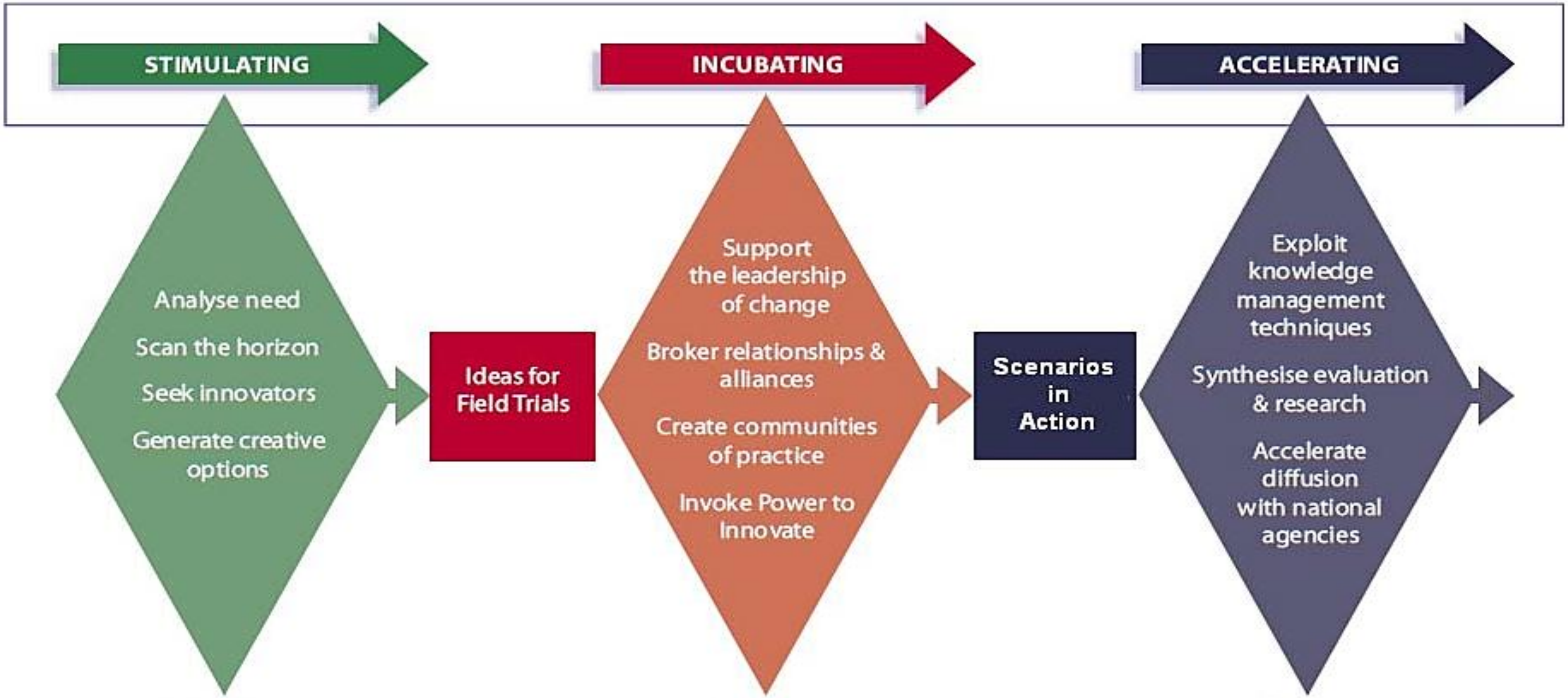
THE POOR PERFORMANCE OF U.S. STUDENTS ON INTERNATIONAL MEASURES OF SCIENCE AND MATH has been bemoaned by everyone from the president to concerned parents. The first Trends in International Mathematics and Science Study (TIMSS) results were released in 1995 and the first Program for International Student Assessment (PISA) test results in 2000. The education reforms that they helped to motivate have had little impact on U.S. performance, and the country continues to hope for a simple solution that will miraculously turn the tide. But there are no quick fixes in the world of education. Instead, the United States must commit to the laborious task of improving the teachers we train and the environment in which they teach, while providing teachers with a respect and trust commensurate with their critical societal roles.

John E. Burris is president of the Burroughs Wellcome Fund, Research Triangle Park, NC. E-mail: jburris@bwfund.org.

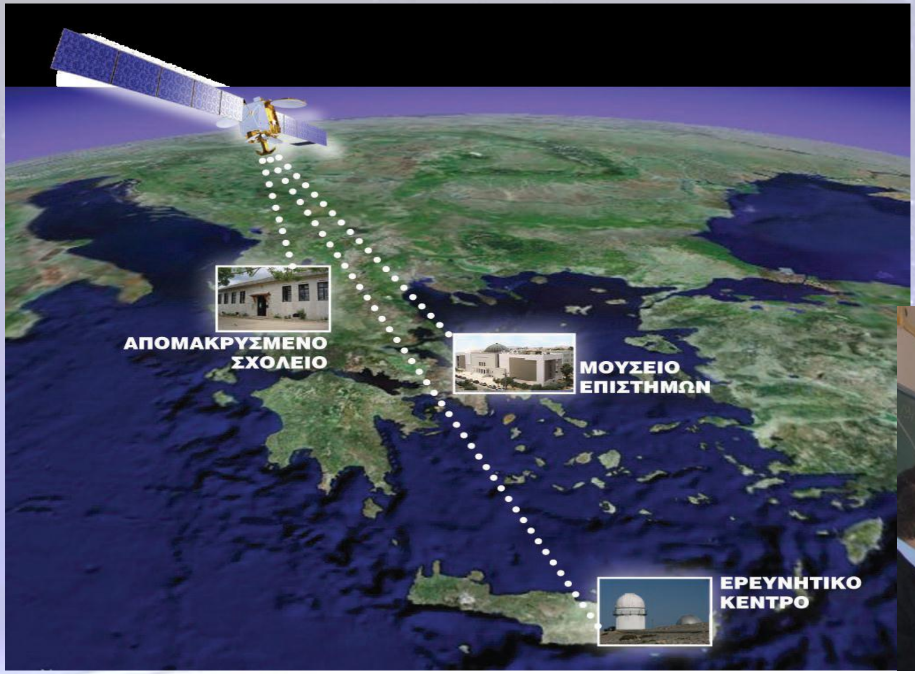
The U.S. education system has methods at its disposal to improve science and math education, such as inquiry-based learning, collaborative problem-solving, and exciting and timely curricula. But no approach can be successfully sustained without bright, well-prepared, and well-supported teachers. Finland has scored near the top of the PISA examinations for the past decade, and the lessons of its success are simple: Recruit the best and the brightest to be teachers, and train them extensively and well.* Give them the freedom to develop teaching skills, independence from centralized authority, and ample time to prepare lessons and to interact with peers and students outside the classroom. And as I discovered on a recent visit there, Finland acknowledges the central role of teachers in society, as demonstrated by the respect accorded teachers and the high demand of young people to be teachers, despite salaries at the national average.

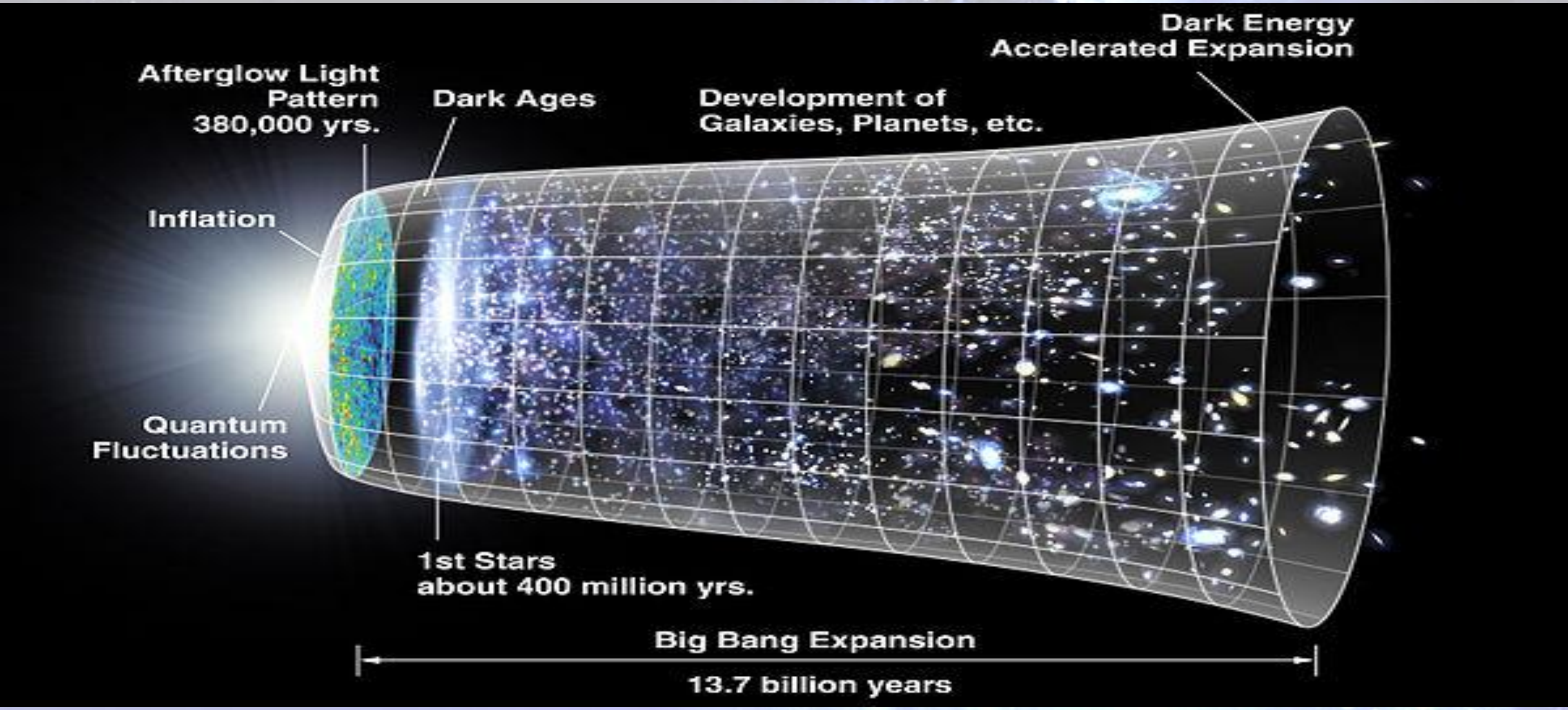
This approach is radically different from what happens in the United States, where the brightest are often not recruited into teacher education. Many U.S. colleges and universities provide substandard training, focused on methods classes to the exclusion of rigorous education in the disciplines that many will teach. Future teachers are educated only through the bachelor's degree level, in contrast to

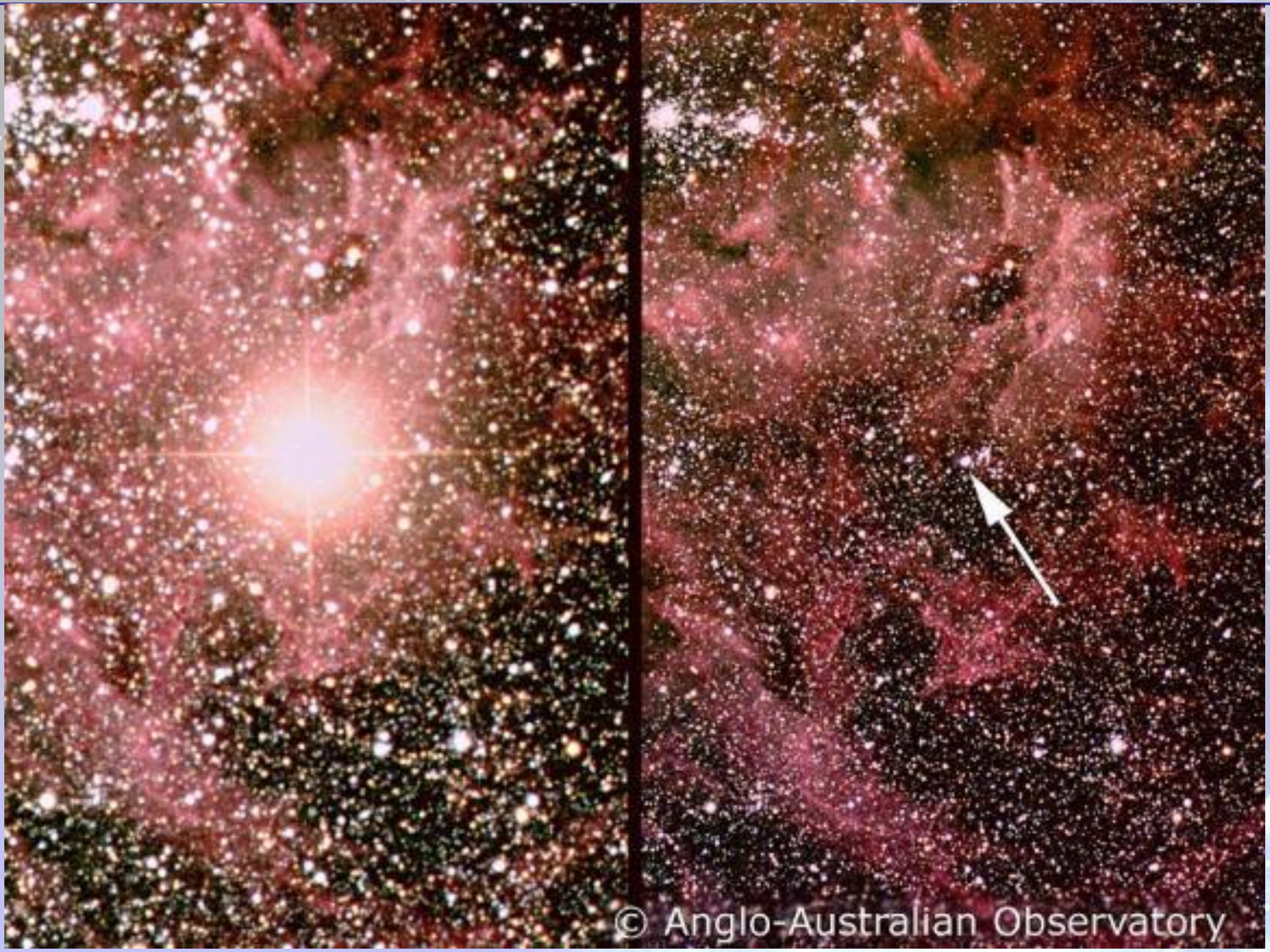
GENERAL WESTERN MODEL	THE FINNISH SYSTEM
Standardisation Strict standards for schools, teachers and students to guarantee the quality of outcomes.	**Flexibility and diversity** School-based curriculum development, steering by information and support.
Emphasis on literacy and numeracy Basic skills in reading, writing, mathematics and science as prime targets of education reform.	**Emphasis on broad knowledge** Equal value to all aspects of individual growth and learning: personality, morality, creativity, knowledge and skills.
Consequential accountability Evaluation by inspection.	**Trust through professionalism** A culture of trust on teachers' and headmasters' professionalism in judging what is best for students and in reporting of progress


STIMULATING
INCUBATING
ACCELERATING
Analyse need
Scan the horizon
Seek innovators
Generate creative options
Ideas for Field Trials
Support the leadership of change
Broker relationships & alliances
Create communities of practice
Invoke Power to Innovate
Scenarios in Action
Exploit knowledge management techniques
Synthesise evaluation & research
Accelerate diffusion with national agencies

Creating effective links between schools and the research community

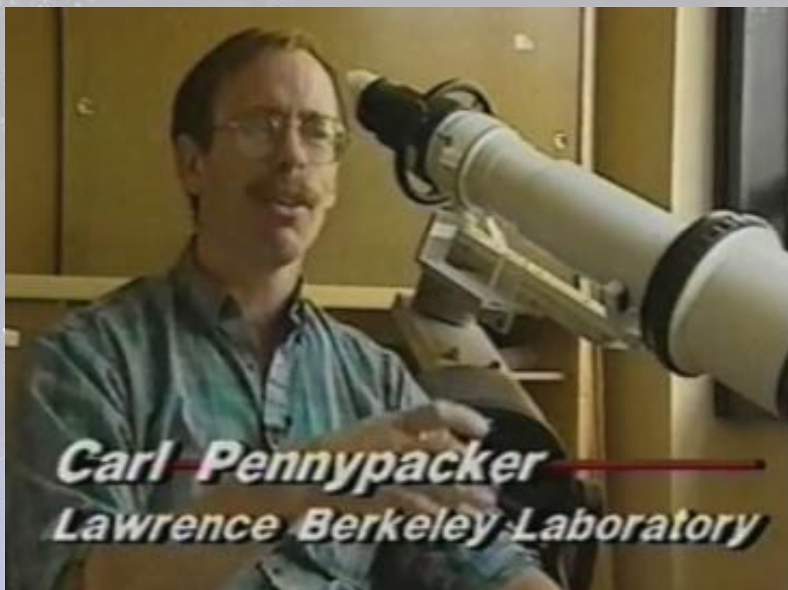



Dark Energy
Accelerated Expansion
Afterglow Light
Pattern
380,000 yrs.
Dark Ages
Development of
Galaxies, Planets, etc.
Inflation
Quantum
Fluctuations
1st Stars
about 400 million yrs.
Big Bang Expansion
13.7 billion years



http://www.nobelprize.org/nobel_prizes/physics/laureat

Ingredients for a successful path: The discovery of SN in classroom



A scientist bringing real data and the scientific method to schools

A robotic telescope and an innovative teacher

The outcome: Students producing scientific results while learning curriculum content

Students that co-authored on the scholarly publications relating to the supernova discovered in 1994 in the Whirlpool Galaxy . The teacher Tim Spuck and the students made news reports around the world.

Effective Community Building

you could define the entire task of (a school) system in this way: its role is to ensure that when a teacher enters the classroom he or she has the materials available, along with the knowledge, the capability and the ambition to take one more child up to the standard today than she did yesterday. And again tomorrow.

Exhibit 21: Japan: Learning communities

Enabling teachers to share best practice, learn from each others strengths and weaknesses, and jointly develop and disseminate excellent practice

Lesson study

Teachers work in teams to analyse and develop model lessons. The study requires each teacher to reflect in depth on their own practice, with the assistance of their peers. The final sample lessons are recorded and distributed.

Demonstration lessons

Teachers demonstrate excellent practice to a wider group of instructors, followed by discussion and feedback sessions. The lessons are used to give each teacher access to examples of excellent practice, to recognise development, and to hold teachers accountable for the quality of their instruction

Building a community of practice

http://www.inspirational-science.blogspot


Sharing our experiences
Is the best resource
we can have.

special emphasis on building a network of the teachers that would form a community of practice.

- **A purpose to believe in:** “I will change if I believe I should” The first, and most important, condition for change is identifying a purpose to believe in. In our case, we must persuade teachers of the importance of scientific literature in terms of social value, importance to their students and personal achievement through learning and teaching these important subjects. We must carefully craft a “change story” underlining the benefits that the project can offer to all the involved actors. Furthermore, we must cultivate a sense of community, making the teacher feel part of a cohesive multi-national team. This sense of belonging will prove very important for motivating teachers and asking them to take then next, possibly “painful” steps, of learning new skills.

special emphasis on building a network of the teachers that would form a community of practice.

- **Reinforcement systems:** "I will change if I have something to win". From a pure behaviouristic point of view, changing is only possible if formal and informal conditioning mechanisms are in place. These mechanisms can reinforce the new behaviour, penalize the old one or, preferably do both. In our case, we can use informal reinforcement patterns in order to make teachers commit more to our project. A short list of such methods could include competitions, challenges, promoting the best teacher created project or lesson plan, offering e.g. the participation to a summer school as rewards.

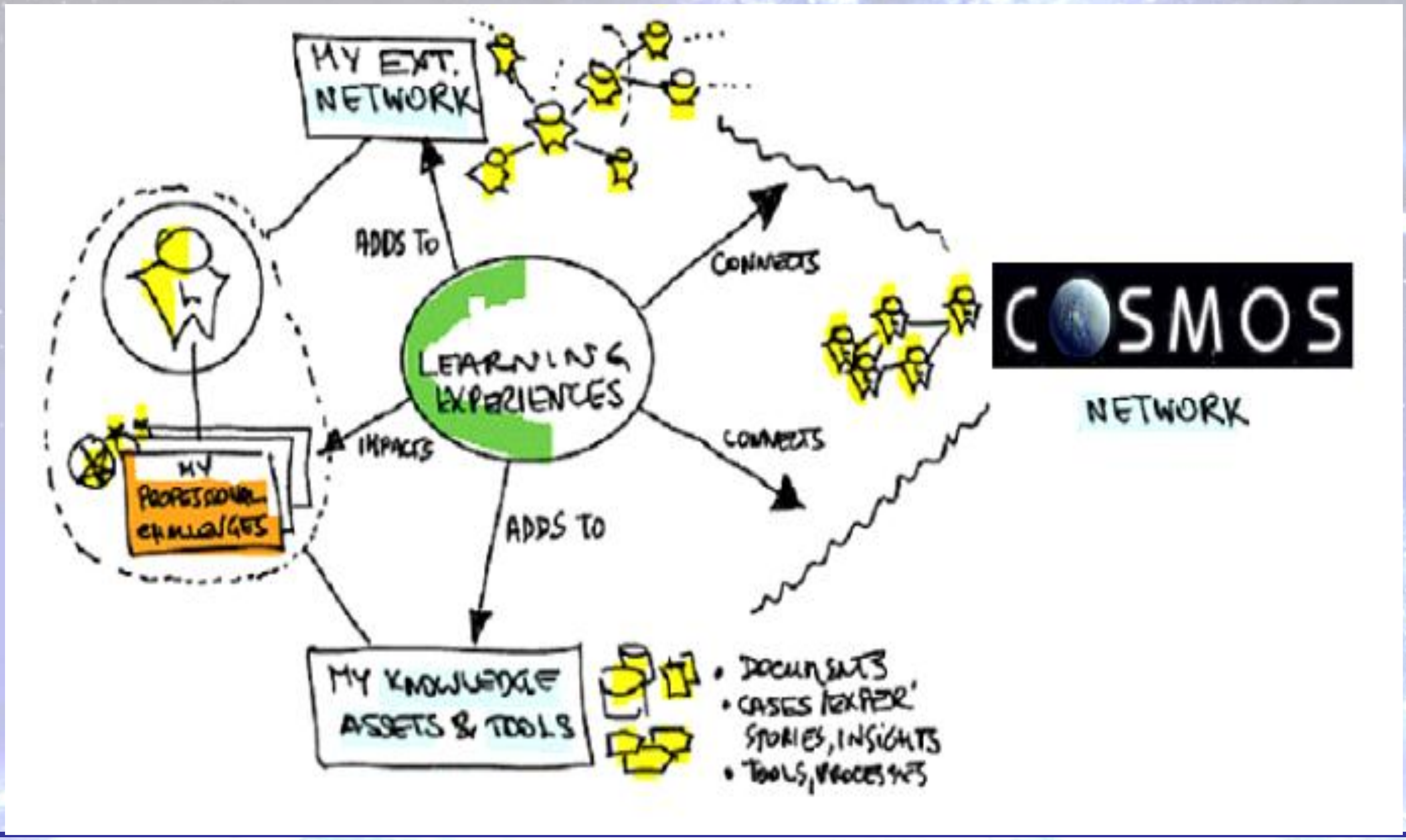
special emphasis on building a network of the teachers that would form a community of practice.

- **The skills required for change:** “I will change if I have the right skills”. A change is only possible if all the involved actors have the right set of skills. In the case of our project, we should make sure that our training program is designed in such a way that teachers acquire all the skills they will need, both technical and pedagogical.

special emphasis on building a network of the teachers that would form a community of practice.

- **Consistent role models:** "I will change if other people change". A number of "change leaders" will need to be established, acting as role models for the community of teachers. These very active and competent teachers will be a proof of concept for their colleagues that the change is indeed feasible, acceptable and beneficial for them. To achieve that we will have to identify the high flyers among the participating teachers and pay special attention into motivating them, supporting and encouraging them.

Collaborative Learning and community development



Building communities of practice

http://www.inspirational-science.blogspot

Digital Content on Discover the COSMOS Portal (May 2012)

- 105,000 Educational Materials on HEP and Astronomy
- 2,000 weblinks
- 500 videos and animations
- 500 Tests and students activities
- 400 Detailed Lesson Plans
- Educational Software and applications
- Training Materials

http://portal.discoverthecosmos.eu