FONDATION
La main à la pâte
POUR L'ÉDUCATION À LA SCIENCE

Teaching sustainable development : a scientific or an ethical question?

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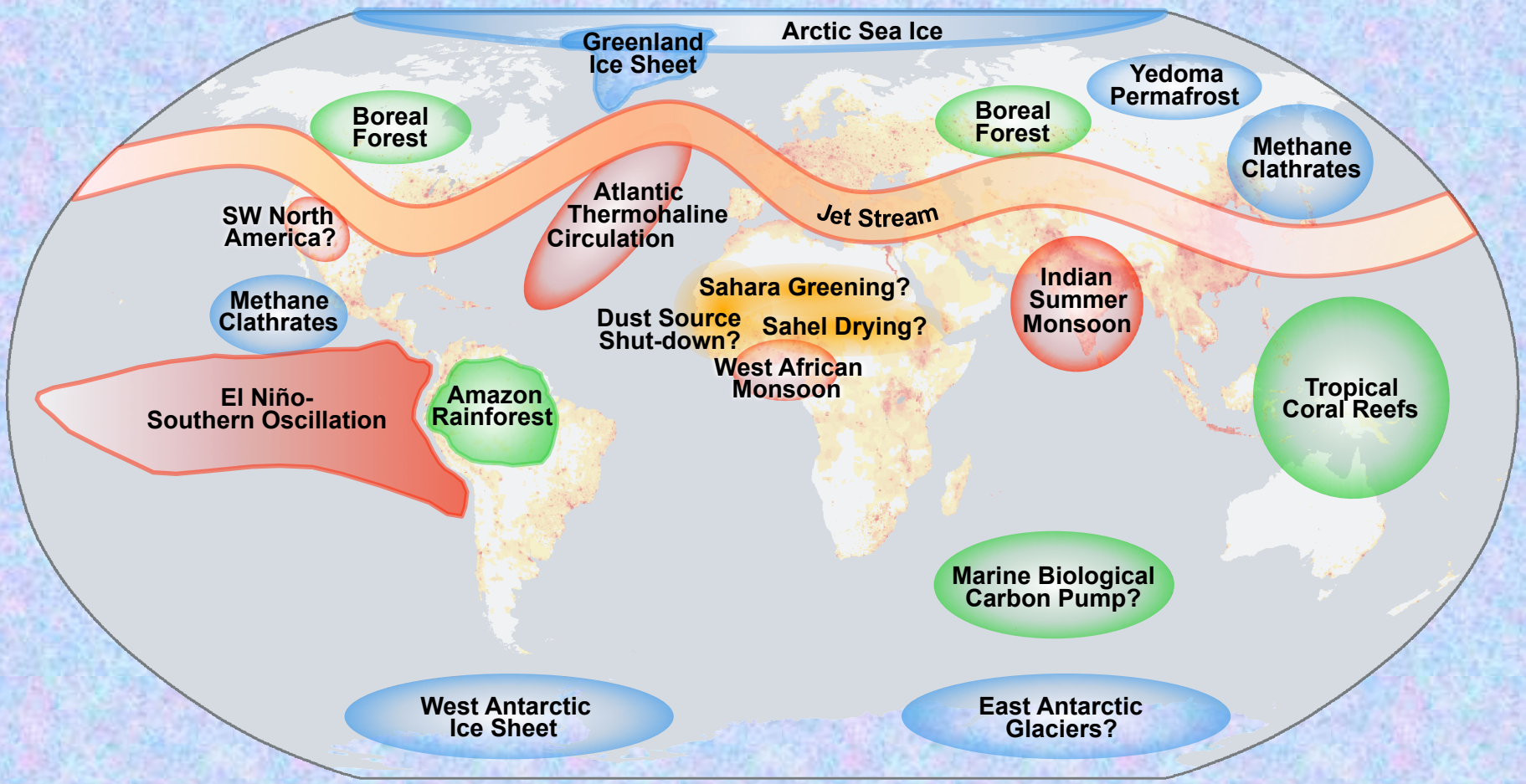
Académie des sciences, France

SUSTAIN Kick-off Conference, Bled, Slovenia, Sept 22-24, 2014

Potential instabilities in the climatic system



Cryosphere Entities

Circulation Patterns

Biosphere Components

Population Density [persons per km²]

no data | 0 | 5 | 10 | 20 | 100 | 200 | 300 400 | 1000

From Schnellhuber- PAS 2014 RK, after Lenton et al. 2008

Growth of inequity, unemployement, social instabilities

Tunis, January 2011

Cairo, January 2011

Athens July 2011

Tel Aviv, August 2011

Chile, August 2011

New York City, November 2011

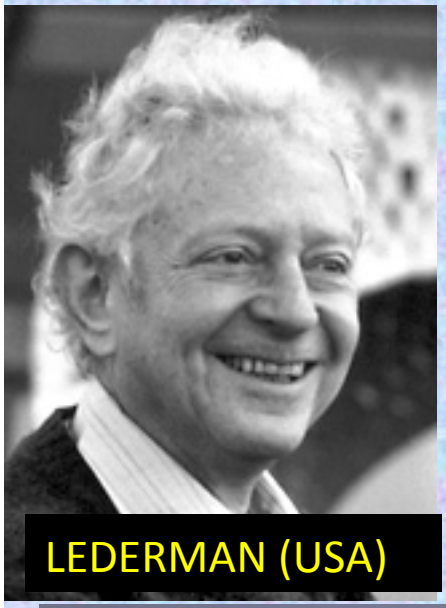
Madrid, September 2012

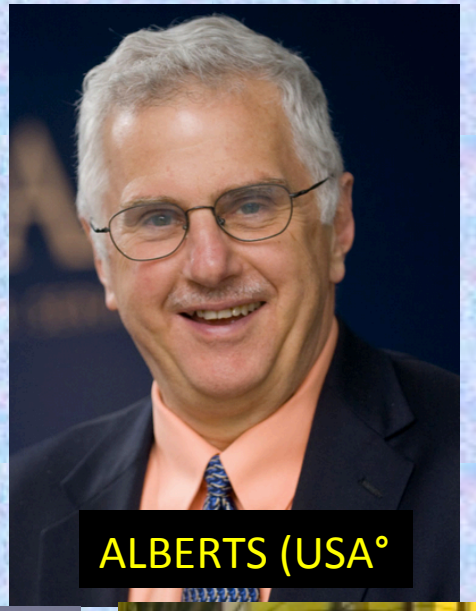
Istanbul, June 2013

Rio de Janeiro, June 2013

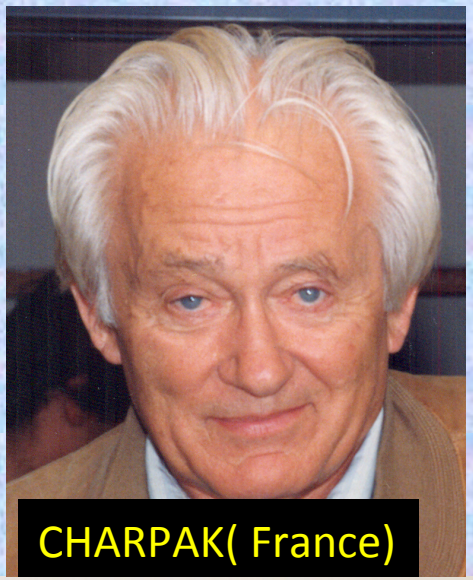
D'après Jeffrey SACHS, PASS 2014

Prominent scientists take stand for hope and trust to be fostered through science in education


LEDERMAN (USA)

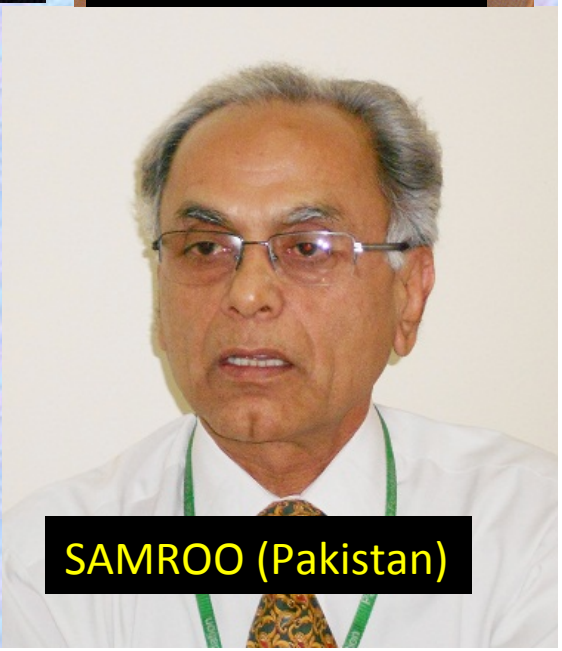

ALBERTS (USA°


MOLINA (Mexico)


CHARPAK(France)


WEI YU (China)


HAHNE (South Africa)


SAMROO (Pakistan)

Science reveals the problems, could bring the solution

Biomass is fuel source for cooking/Heating for about 2.7 Billion
Second largest source of Black Carbon; also CO & Methane
4.2 Million die each year from air pollution (indoor/outdoor)

Veerharadran Ramanathan, Scripps, California, 2009 *in* PAS 2014

Sustainable development in education

- Scientific understanding of issues = **truth** ;
- Ethical/moral judgment = **human values** ;
- Economic/political goals = **choices of actions**.

A new challenge in a rapidly evolving context of :

- Globalisation
- Poverty and Inequalities
- Digital revolution

1. Inquiry : the present status ;
2. Challenging science education ;
3. Questioning sustainable development ;
4. A global education for the future.

Encouraging Student Interest in Science and Technology Studies

EU Commission 2007

Global Science Forum

OCDE 2009

全民科学素质行动计划纲要

（2006—2010—2020 年）

China 2006

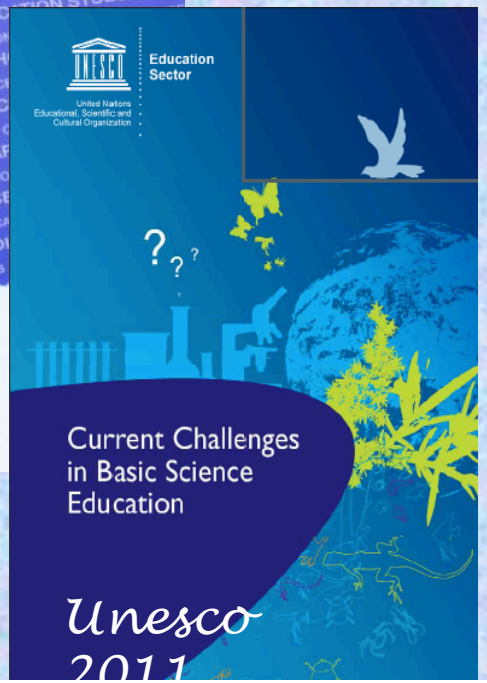
Program to convey scientific culture

to the whole people

Groupe Interacadémies sur des questions internationales (IAP)

InterAcademy Panel 2008

Rapport du Groupe de travail sur la Collaboration Internationale pour L'Évaluation des Programmes D'Enseignement Scientifique Fondés sur L'Investigation (ESFI)



Unesco 2011

Science Education in Europe: Critical Reflections

Nuffield 2008

A Report to the Nuffield Foundation

Jonathan Osborne

Justin Dillon

King's College London

January 2008

Inquiry based science education (IBSE)

***Inquiry** is a term used both within education and in daily life to refer to seeking knowledge or information by **asking questions**. It is sometimes equated with research, investigation, or 'search for truth'. ….What distinguishes **scientific inquiry** is that it leads to **knowledge** and **understanding** of the natural and made world around, through **methods** which depend on the **collection and use of evidence** .*

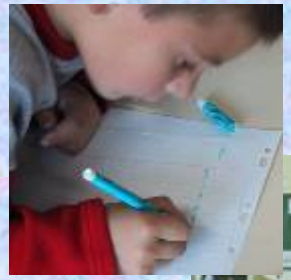
- Universality of curiosity and science ;
- Diversity of cultures, languages, educations

The Inquiry process in the classroom

1. Questionning

2. Hypothetizing

3. Experimenting & Observing



4. Communicating and concluding

1995-2014 across the world

- *A wealth of pilot projects*
  - ***Mao na massa***, Brazil (ABC et al)
  - 做中学 , China (Wei Yu et al)
  - ***Pequenos Cientificos***, Colombia (Duque et al)
  - ***Ensensenza Ciencia ECBI***, Chile (Allende et al)
  - ***Haus der kleinen Forscher***, Germany (Skiebe et al)
  - ***Primary connections***, Australia (Peers et al)
  - ***Innovec***, Mexico (Fernandez et al)
  - ***Engineering is elementary***, Boston USA (Miaoullis et al)
  - ….
- Scientists, Academies, Scientific institutions are essential partners of the pilot projects.

IBSE 2013 worldwide : millions of children..

teacher training, resources, websites..

USA

CANADA

EUROPE

TURKEY
EGYPT
IRAN
AFGHANISTAN
PAKISTAN

MEXICO

MOROCCO
TUNISIA
UGANDA
CAMEROUN
SENEGAL
BENIN
ZIMBABWE
SOUTH_AFRICA
MADAGASCAR

INDIA
CHINA
MALAYSIA
BRUNEI
VIETNAM
CAMBODIA

PANAMA VENEZUELA
COSTA-RICA HAITI
COLOMBIA PERU
BRAZIL
CHILE ARGENTINA

AUSTRALIA

..and in Europe

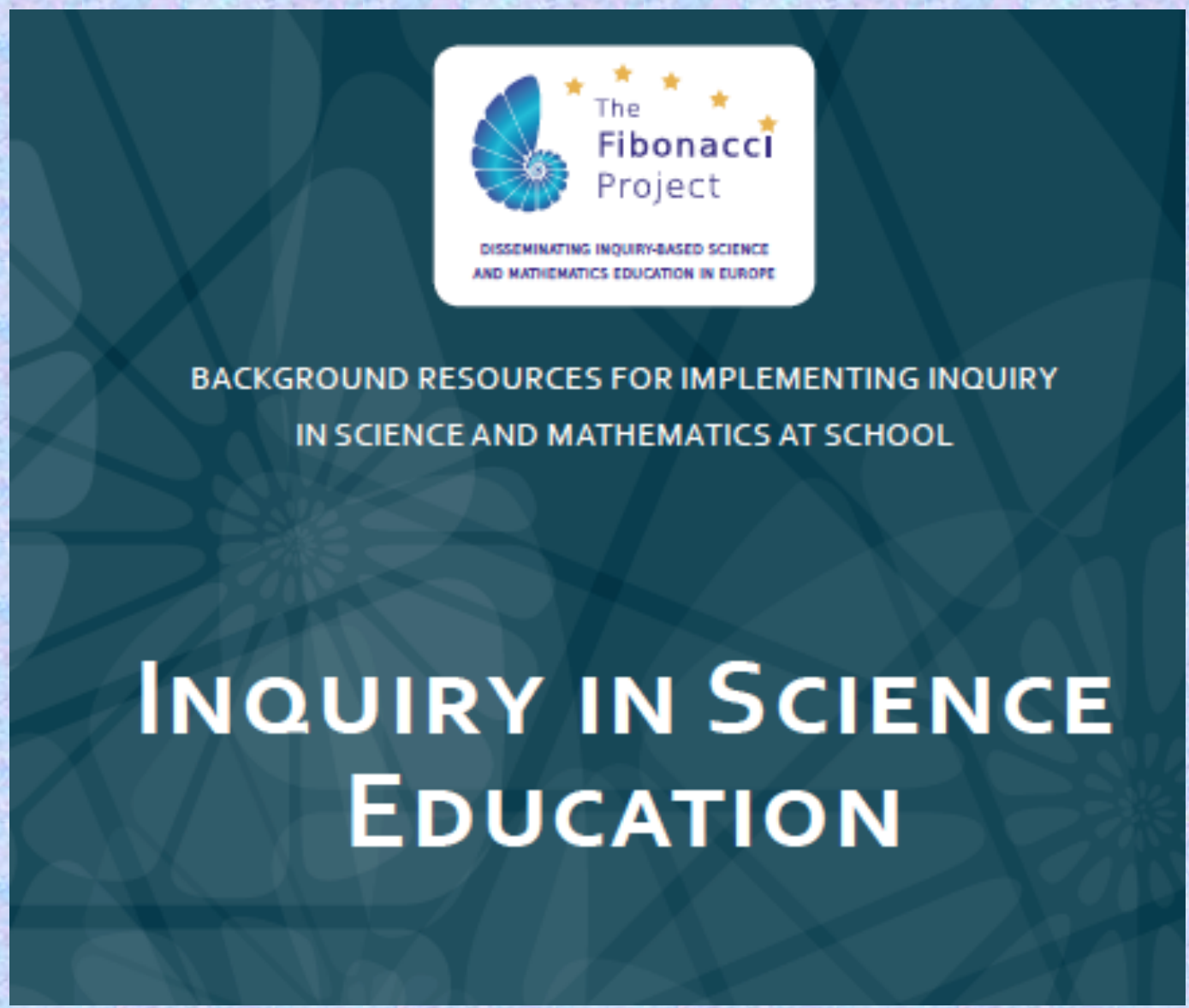
A renewal of science education in Europe

Views and Actions of National Academies

Analysis of surveys conducted in 2010 and 2011

A report of the ALLEA Working Group Science Education

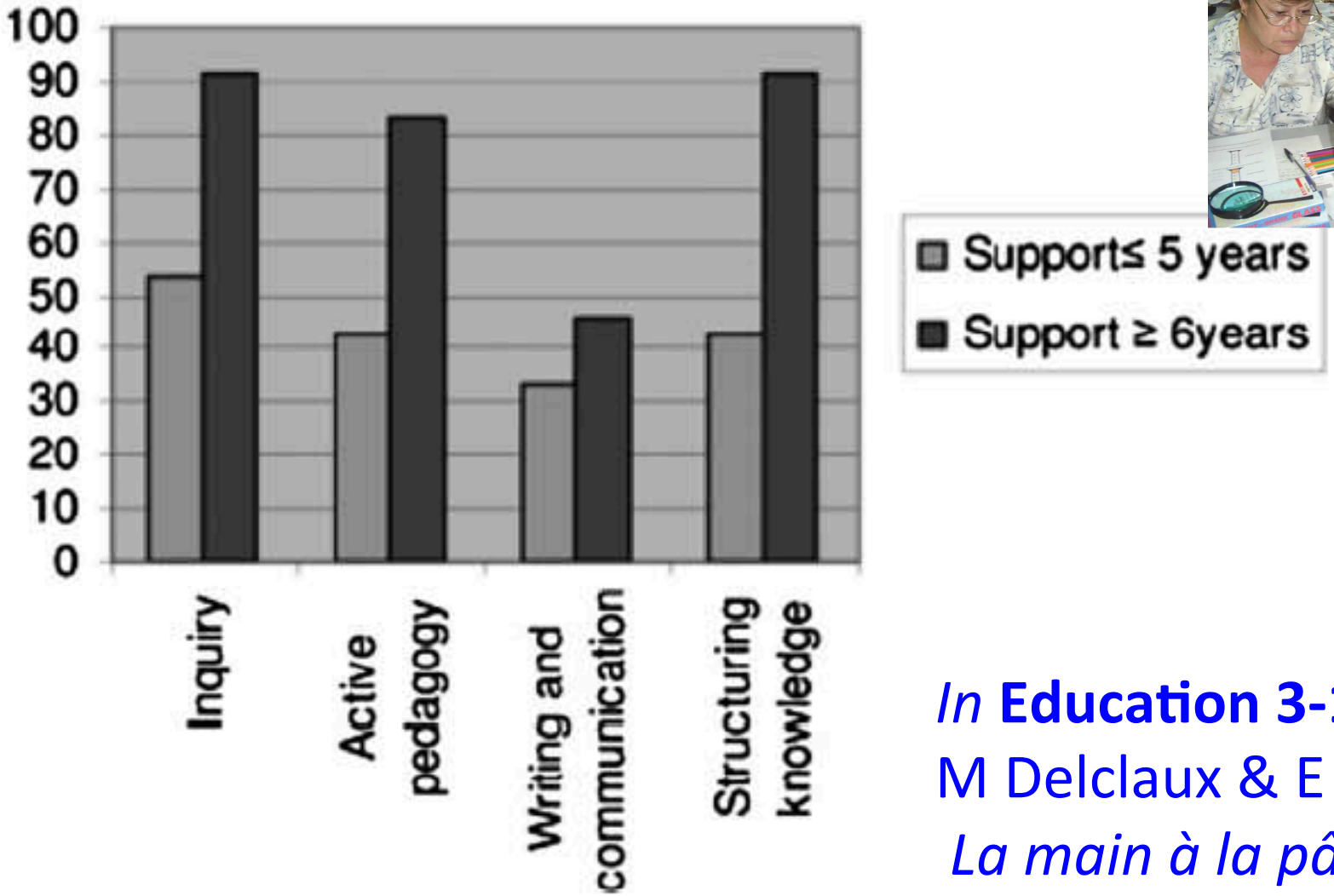
(IAP Science Education Programme Regional European Council)



Harlen W, in The **European Fibonacci project** *(2009-2013), www.fibonacci-project.eu/*

Changing teachers to IBSE takes time…

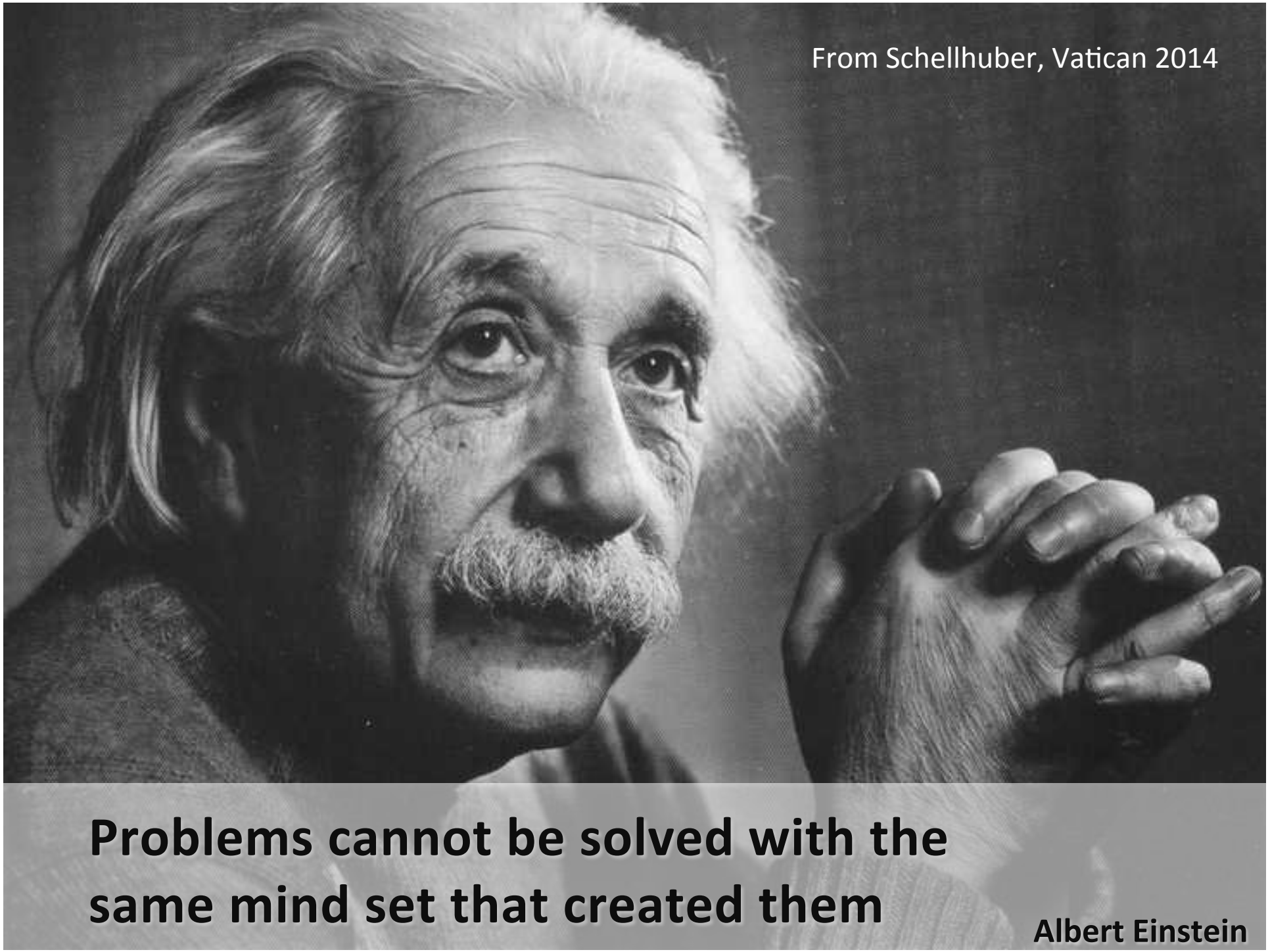
Exposing teachers to science and inquiry



In **Education 3-13** (2011)
M Delclaux & E Saltiel
La main à la pâte, France

http://dx.doi.org/10.1080/03004279.2011.564198

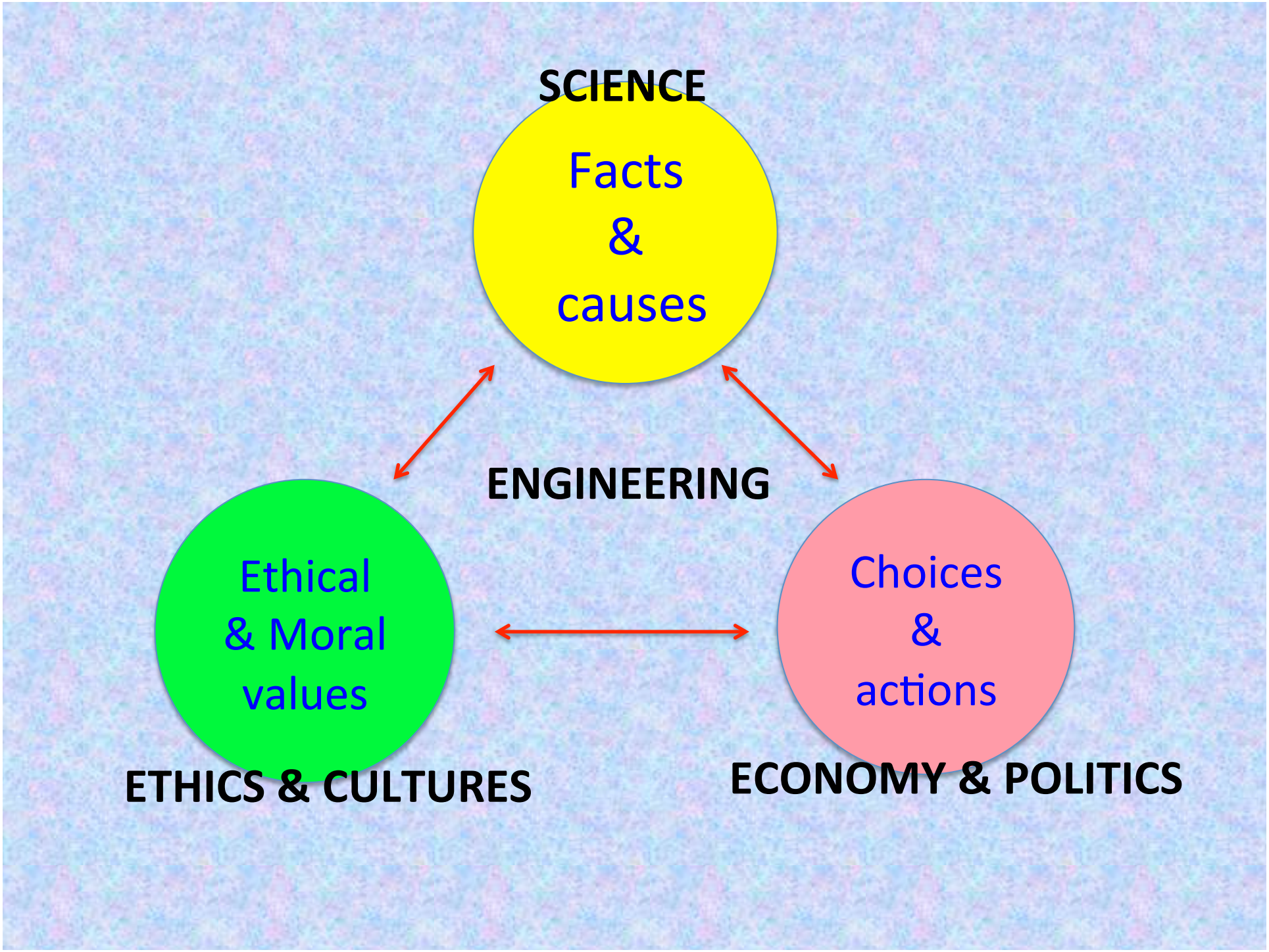
2. ESD is challenging science education


From Schellhuber, Vatican 2014
Problems cannot be solved with the same mind set that created them
Albert Einstein

Objectivity in science & ESD issues

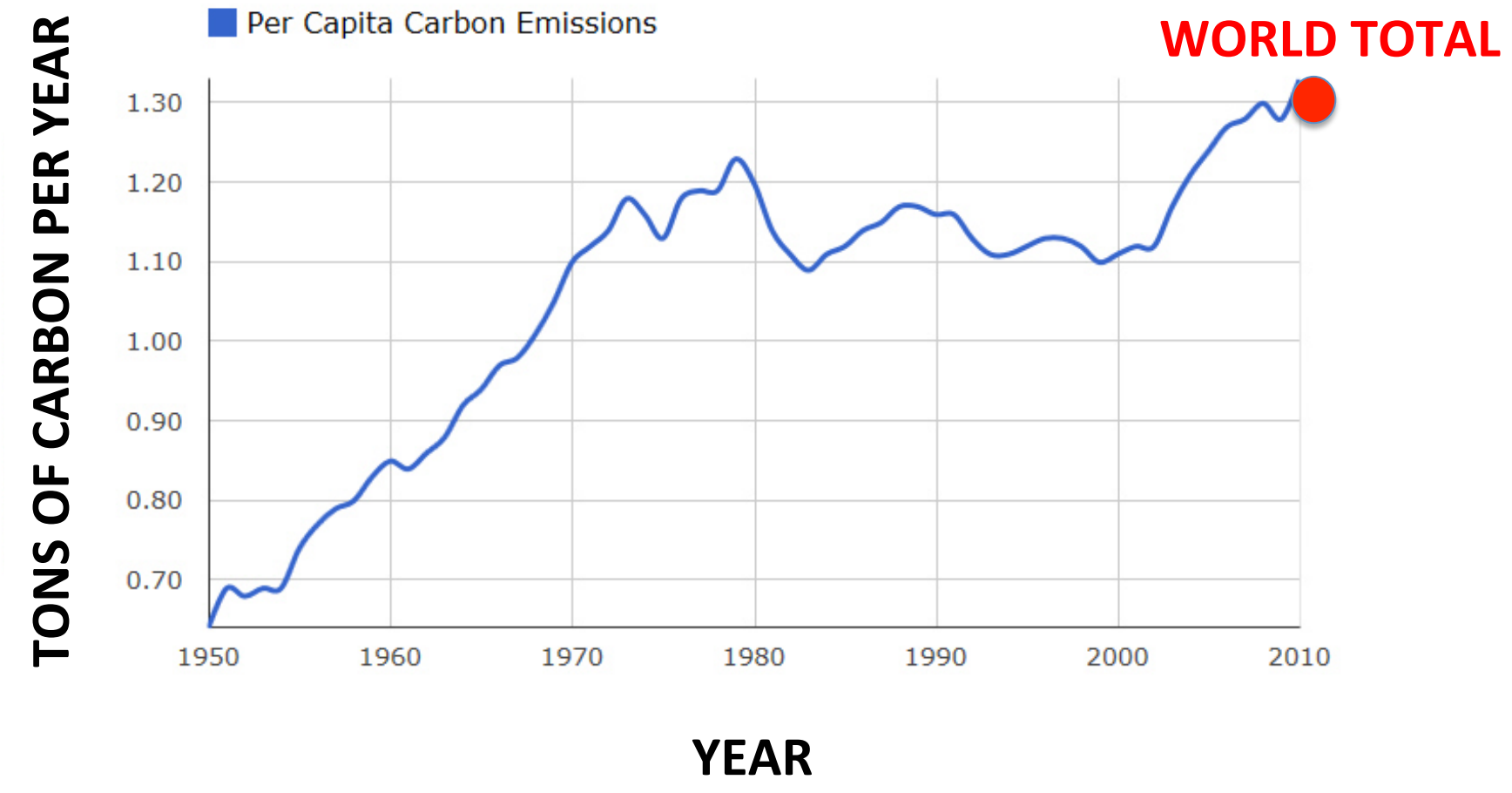
- Science often requires changing *habits of mind* ;
- From simplifying to dealing with *complexity* ;
- Science is building up *truth about* nature ;
- Science knowlege is (today) built upon *trust* ;
- Scientists must obey some *internal* ethical rules.

3. Questioning Sustainable development


SCIENCE
Facts
&
causes
ENGINEERING
Ethical
& Moral
values
Choices
&
actions
ETHICS & CULTURES
ECONOMY & POLITICS

Carbon (CO_2) Yearly Emission per capita

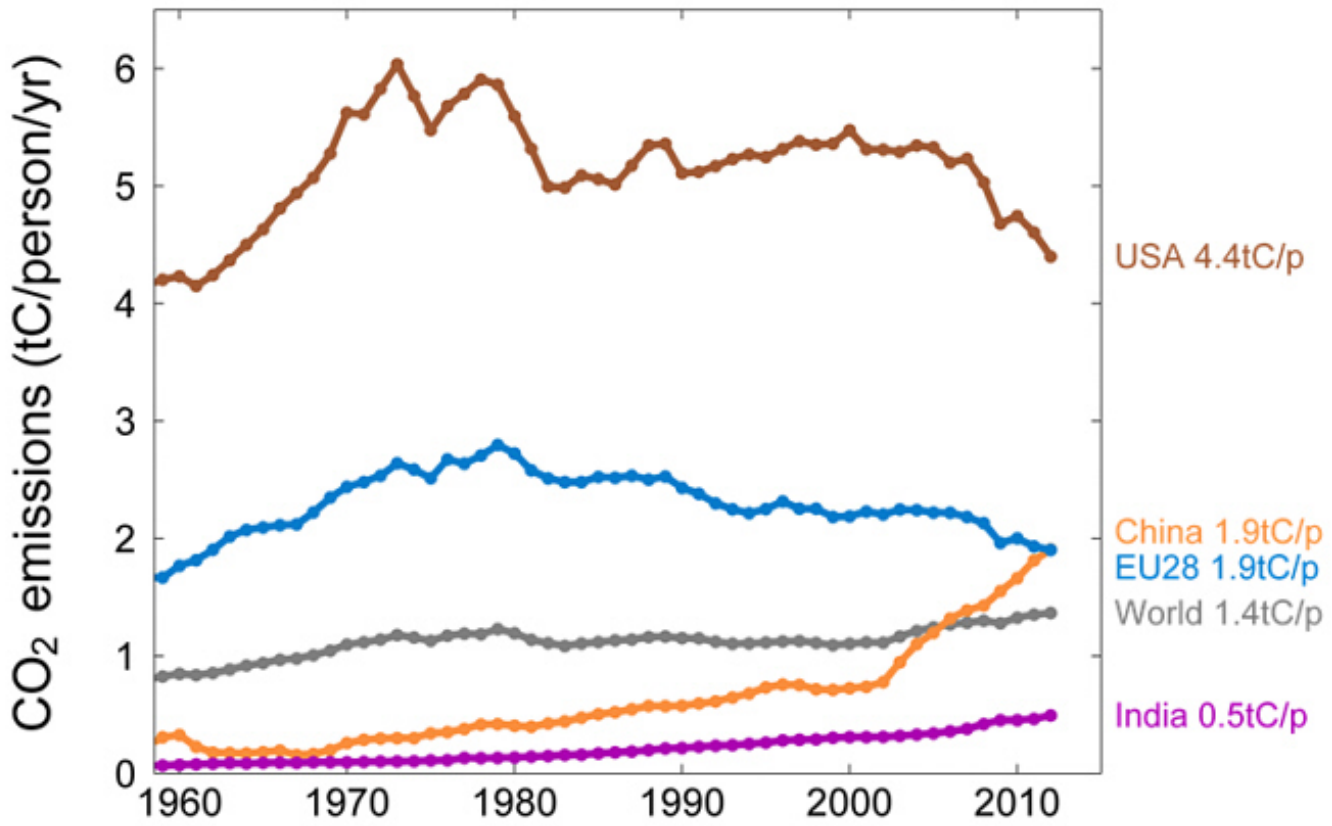
Source : Boden et al, 2013, Global Carbon Project
http://cdiac.ornl.gov/GCP/



GLOBAL CARBON PROJECT

Top Fossil Fuel Emitters (Per Capita)

Average per capita emissions in 2012
China is growing rapidly and the US is declining fast



Source: CDIAC Data; Le Quéré et al 2013; Global Carbon Project 2013

4. A global education for the future

Educating for the future

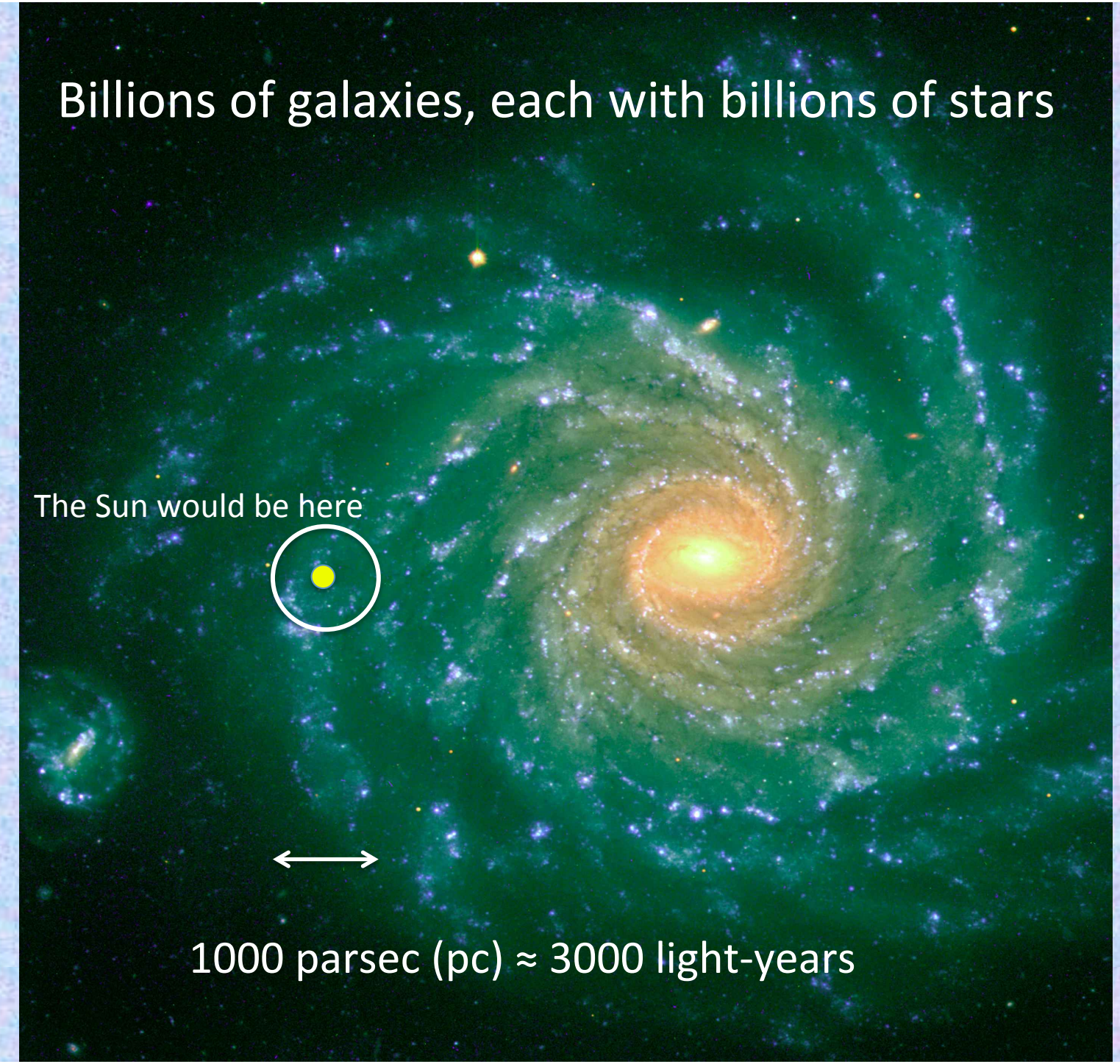
- *An understanding of science and technology in a broader frame, accounting for complexity ;*
- *A development of creativity and skills ;*
- *An ethical vision of human solidarity.*

School as usual ?

or

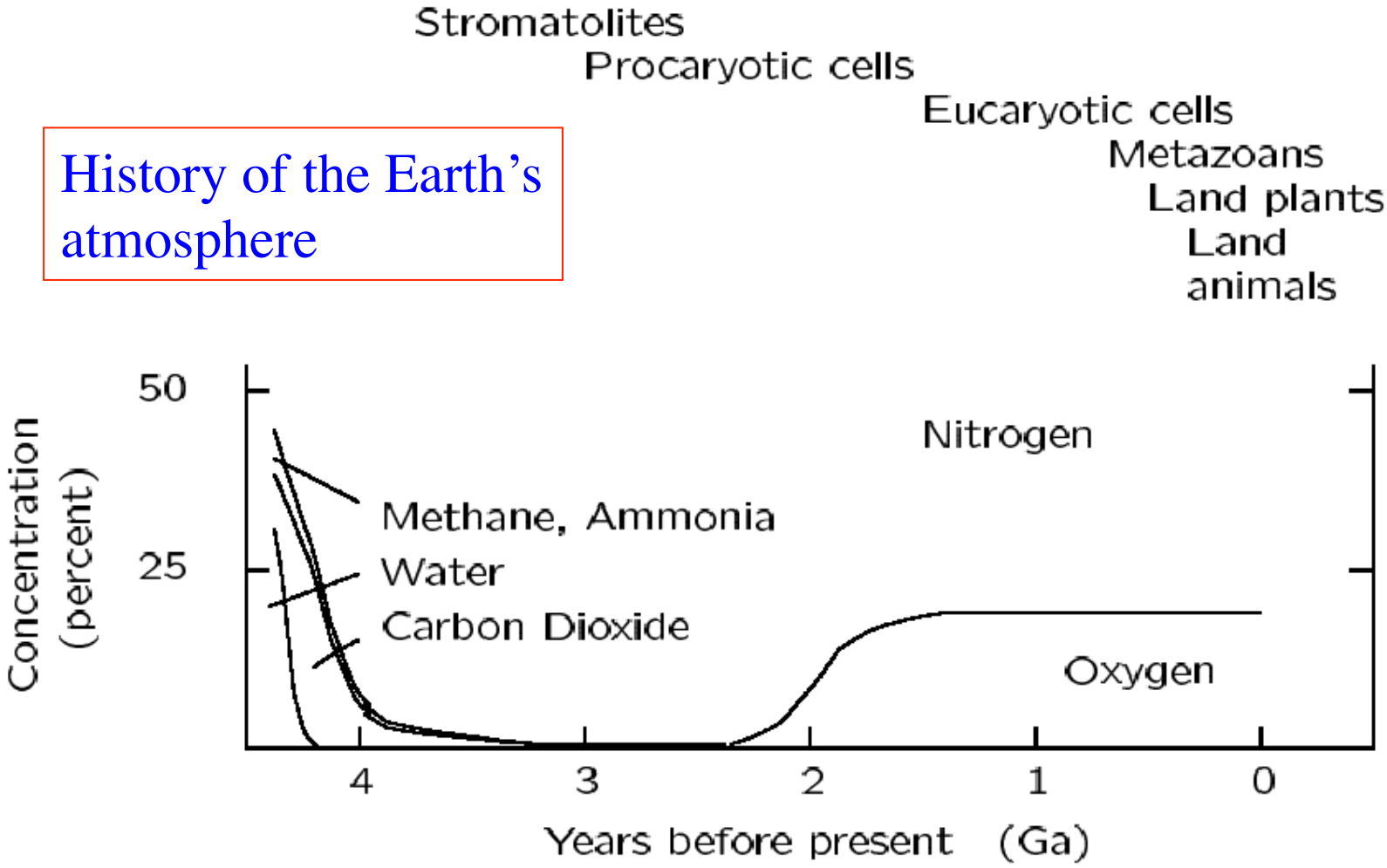
a new vision of science in modern culture

challenging teachers ?


Billions of galaxies, each with billions of stars
The Sun would be here
1000 parsec (pc) ≈ 3000 light-years

An holistic vision with the Great Story : Universe, Earth, Man

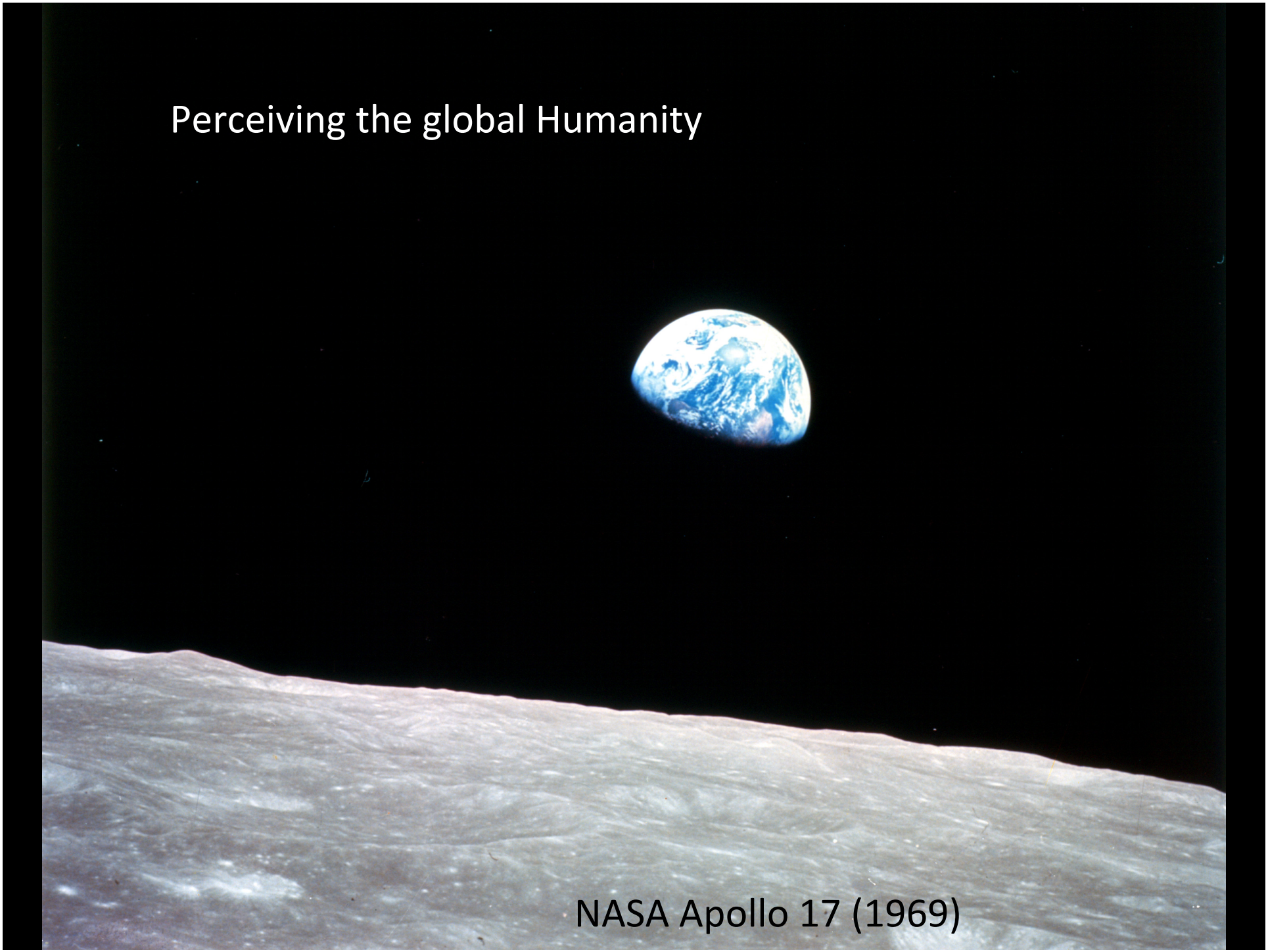
History of the Earth's atmosphere



Cyanobacteria photosynthesis -> O_2
• H_2 -> CH_4 underground/sea or escape

O_2 indicating life

Perceiving the global Humanity



NASA Apollo 17 (1969)

Pale Blue Dot
The Earth seen from the Voyager probe camera beyond Neptune's orbit, at 6 billion km (© NASA)

New challenges for science teachers

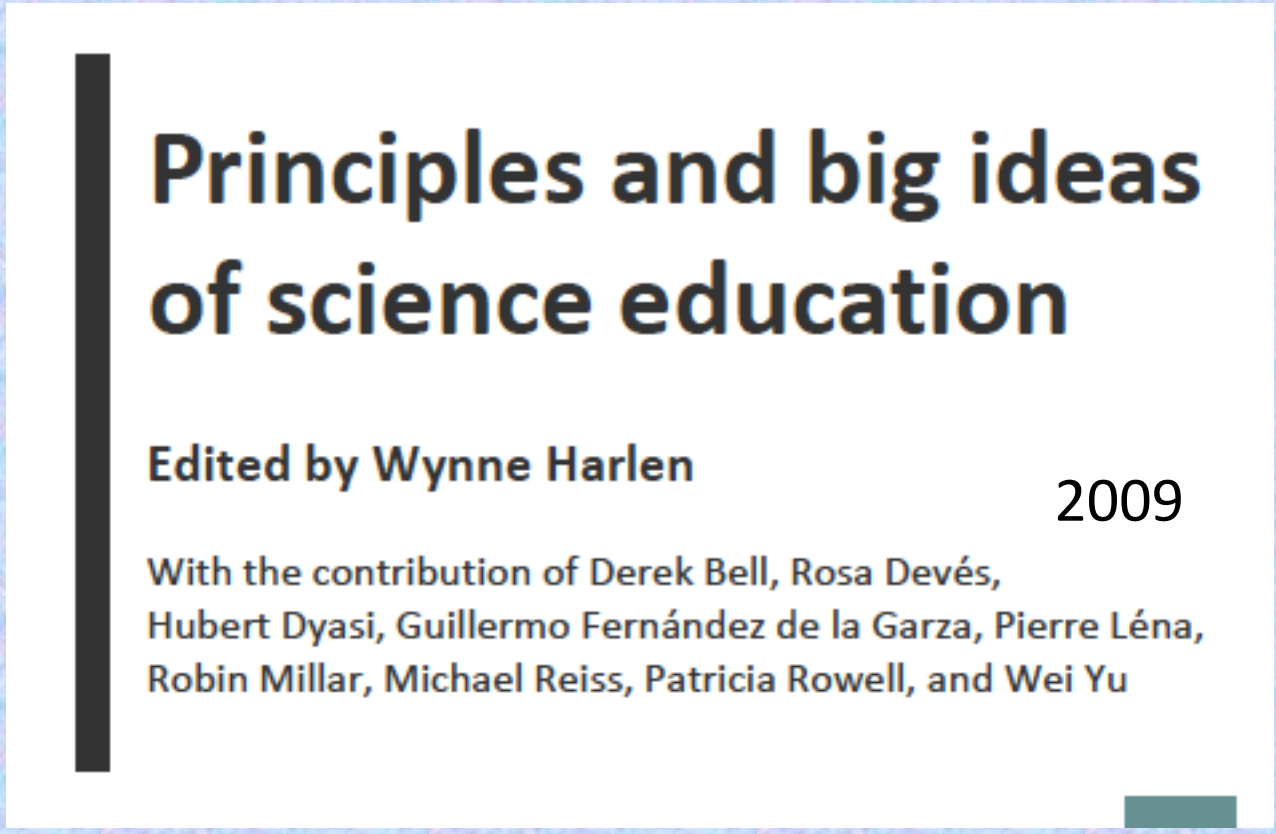
- ✓ Pluridisciplinarity :
  - S,T (e.g. EIST in France), E ?
  - Math (cf. IBSE & IBME in *Fibonacci*)
  - Science and language

- ✓ Identifying **Big Ideas :**
  - Big ideas *on* science ;
  - Big ideas *of* science ;

- ✓ The digital revolution ;

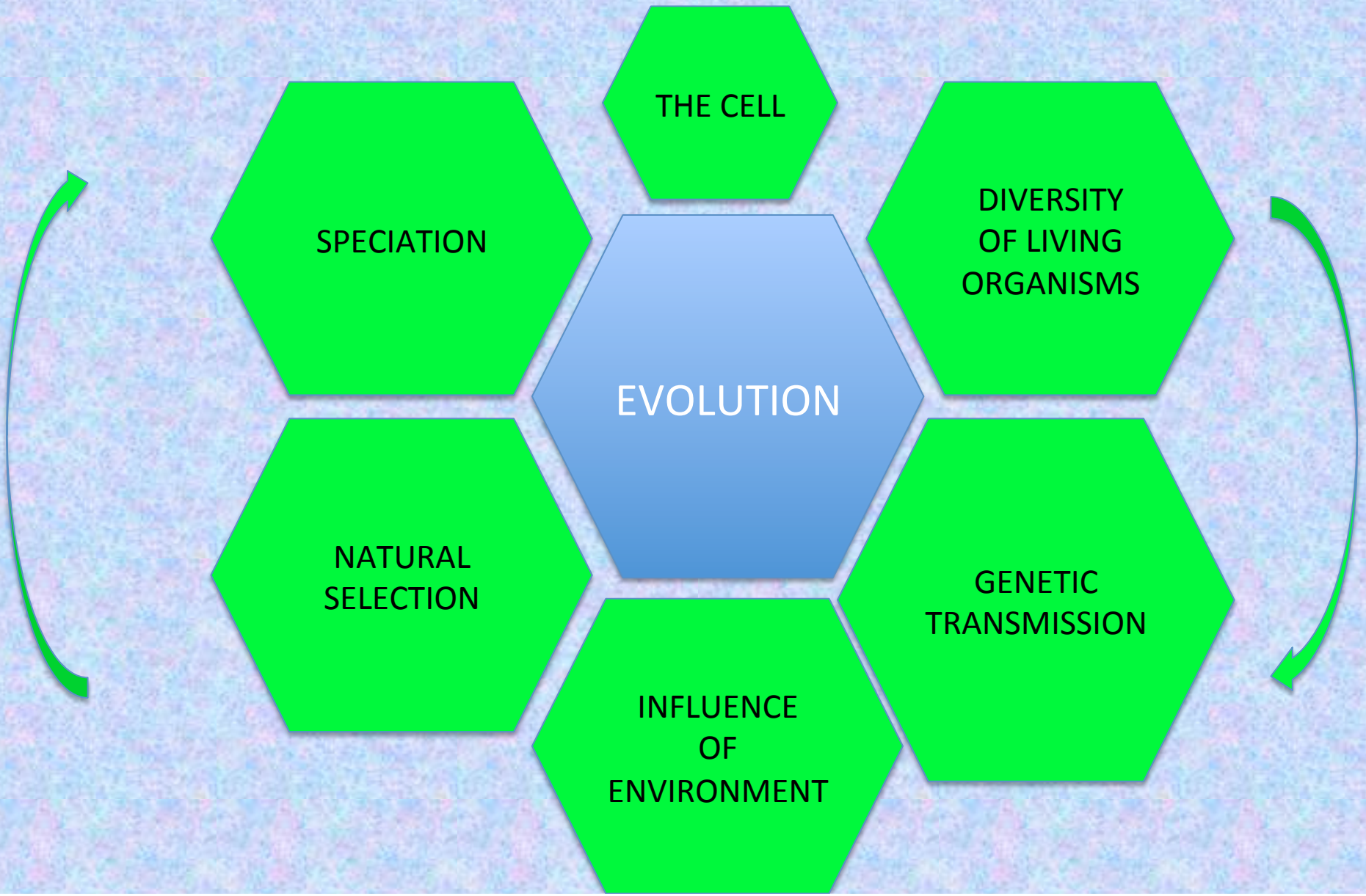
- ✓ Building ESD modules and sequences ;
- ✓ Developing formative/summative **assessment** tools.

Dealing with complexity



http://www.interacademies.net/ProjectsAndActivities/Projects/12250/18276.aspx

Evolution : a big idea, to be confronted with ESD



A module from *La main à la pâte* (Grades 3-4-5)

www.fondation-lamap.org

Faouzia Farida

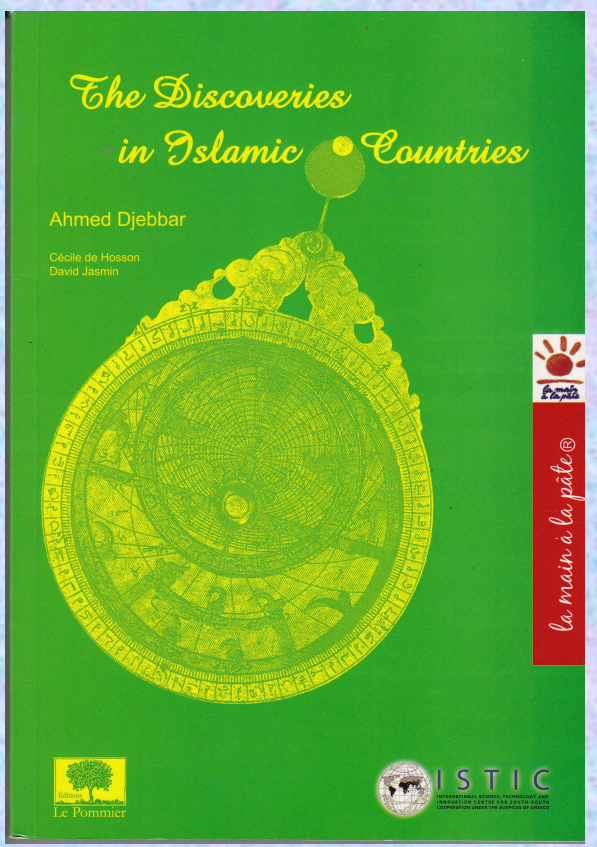
Charfi

La Science voilée

2013

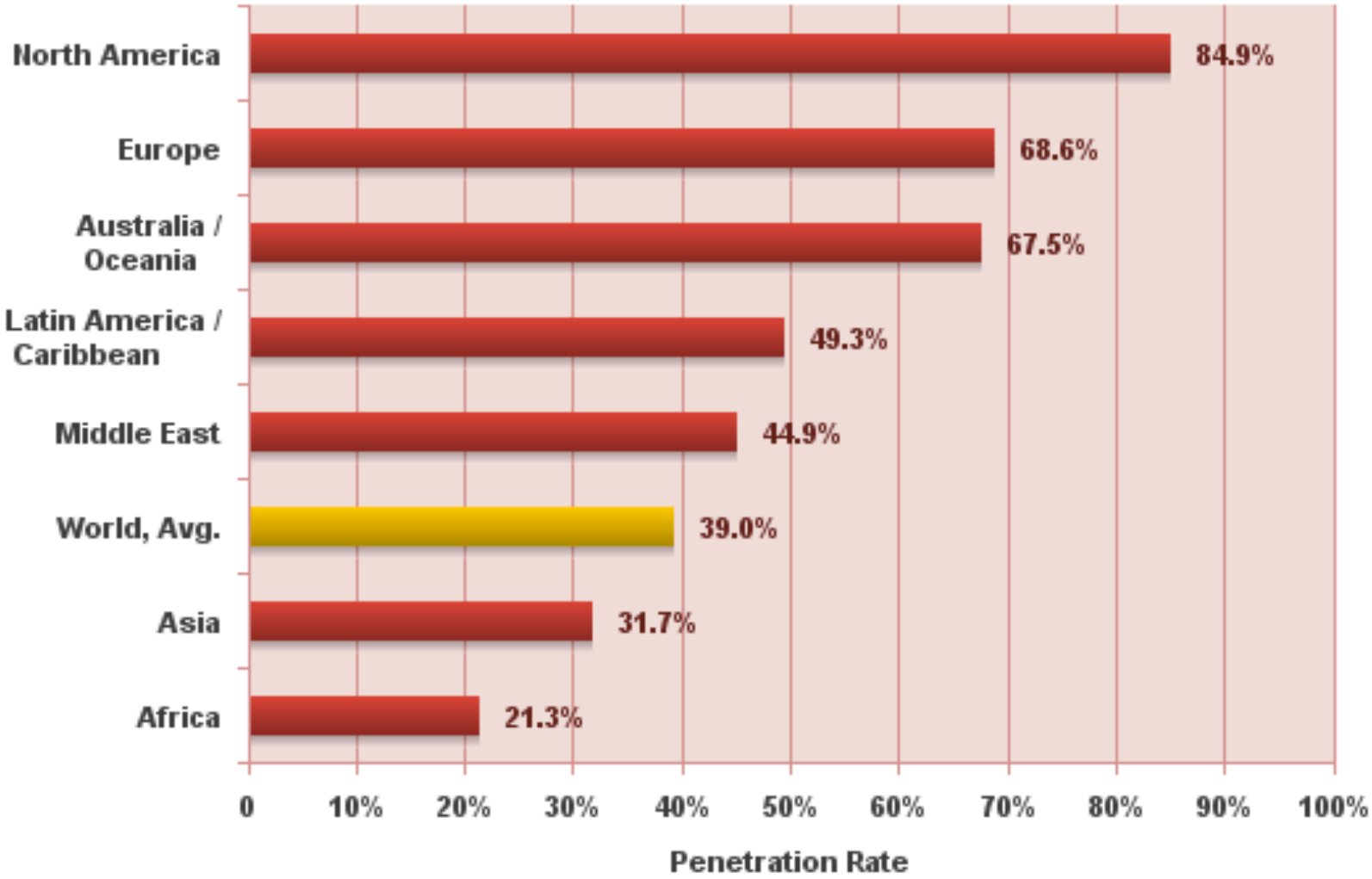
Odile Jacob

SCIENCE ET ISLAM



Science and culture

World Internet Penetration Rates by Geographic Regions - 2013 Q4



Source: Internet World Stats - www.internetworldststs.com/stats.htm
Penetration Rates are based on a world population of 7,181,858,619 and 2,802,478,934 estimated Internet users on December 31, 2013.

Children, our today' students, are the ones who in 2040-2050, will be the adults who shall live on an Earth with 9 billions inhabitants.

They will have to deal with our legacy of problems and use the skills education is giving, or not, to them now.

The poorest will be the most suffering ones.