

# Rethinking human learning with sustainability in mind: Building the scientific mind—a case in point

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## Reflections on

- Sustainability
- Learning
- The (scientific) mind



# Part 1

## Sustainability



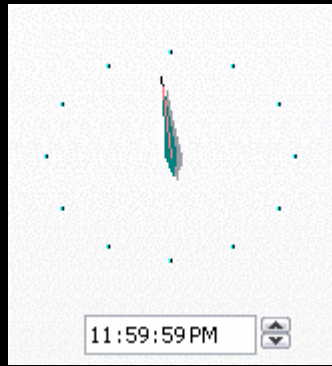
# Humanity in perspective

Event	Real time scale	1 week time scale	
Universe	13.7 billion years (WMAP, 2005)	Day 1	
Life	3.43 billion years (Allwood, Walter, Kamber, Marshall, & Burch, 2006; Awramik, 2006)	Day 6	
Hominids	From five to ten million years ago (Institute of Human Origin, 2001); i.e., ¼ to ½ million generations	Day 7	5 minutes ago
Humans	100 to 200 thousand years ago (Templeton, A.R., 2002); i.e., 5 to 10 thousand generations		6 seconds ago
Agricultural revolution	10 000 years ago; i.e. 500 generations ago		< 0.5 sec ago
Galileo	4 centuries ago; i.e. 20 generations ago		< $5 \cdot 10^{-6}$ sec ago

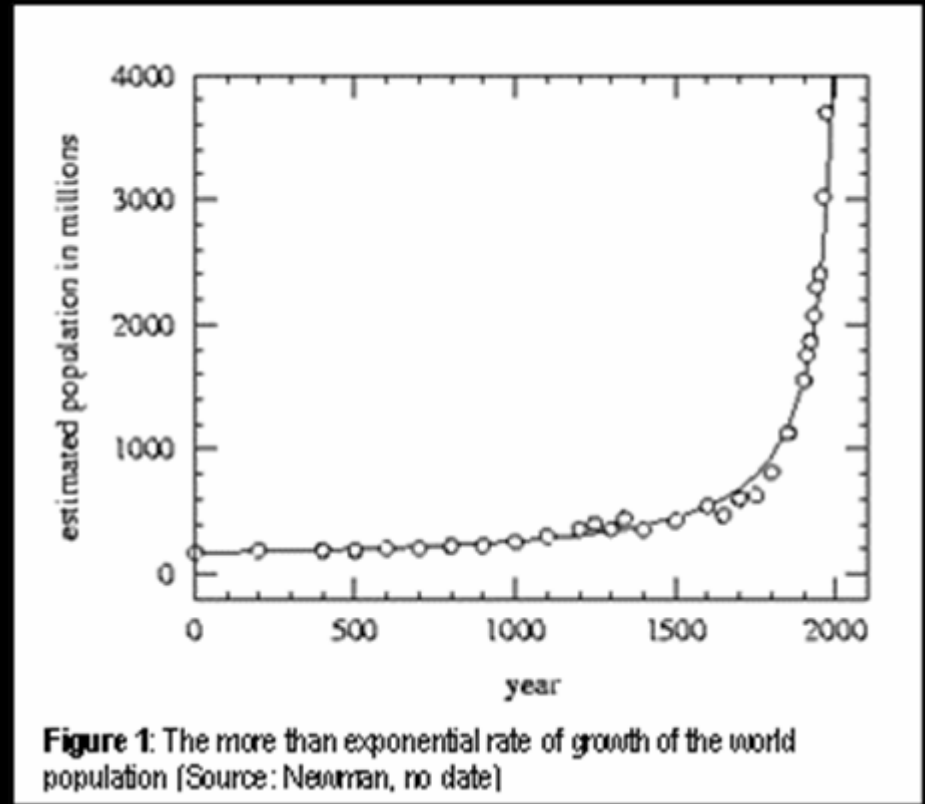


# Consequences of human intervention

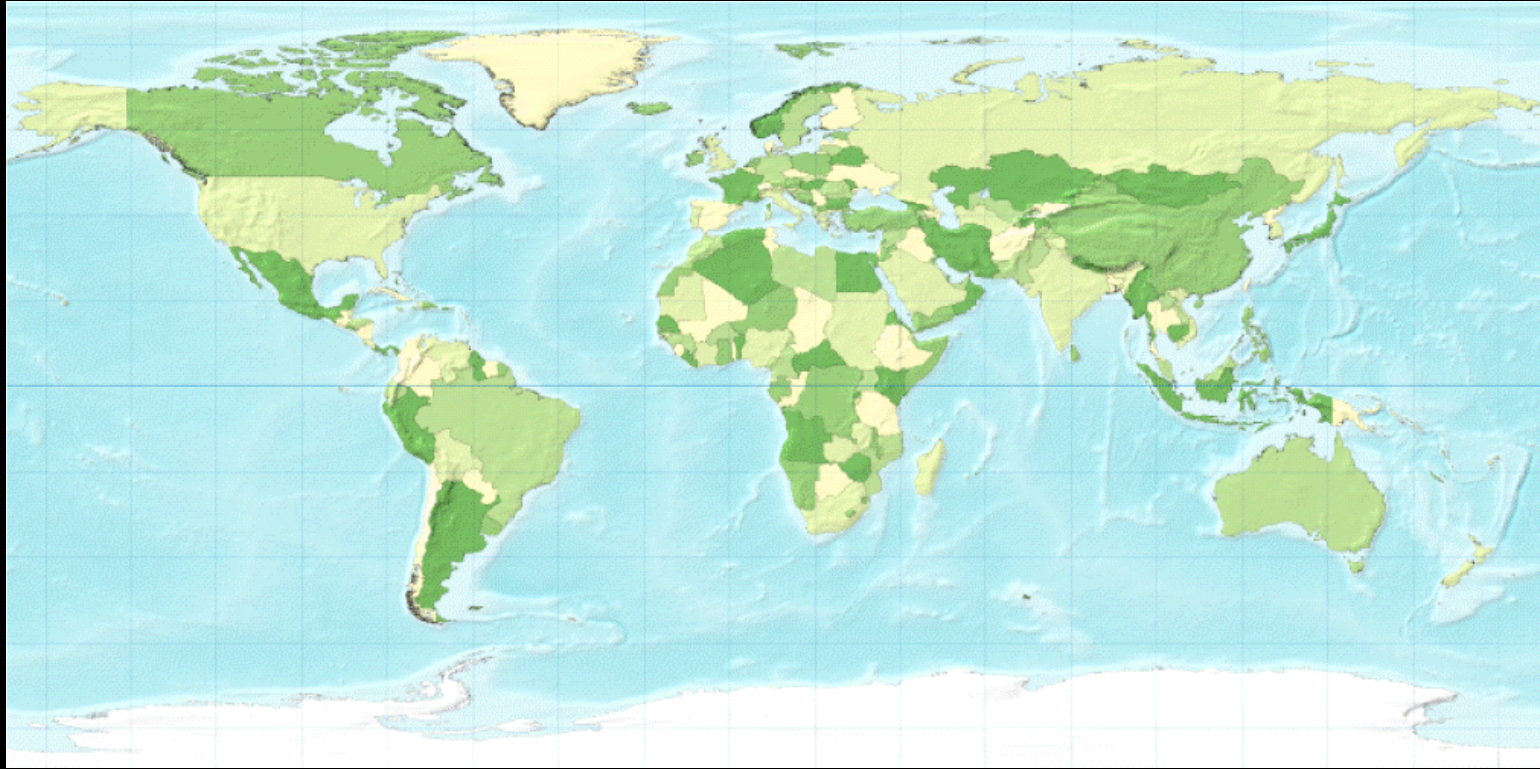
**Agricultural revolution** started half a second ago.



8000 BC	8 million
0	250 million
1600	500 million
1800	1000 million
1960	3041 million
2000	6082 million
2008	6677 million



# The world as we know it



Source: Images of the social and economic world – Mark Newman

<http://www-personal.umich.edu/~mejn/cartograms/>



# The world in population perspective

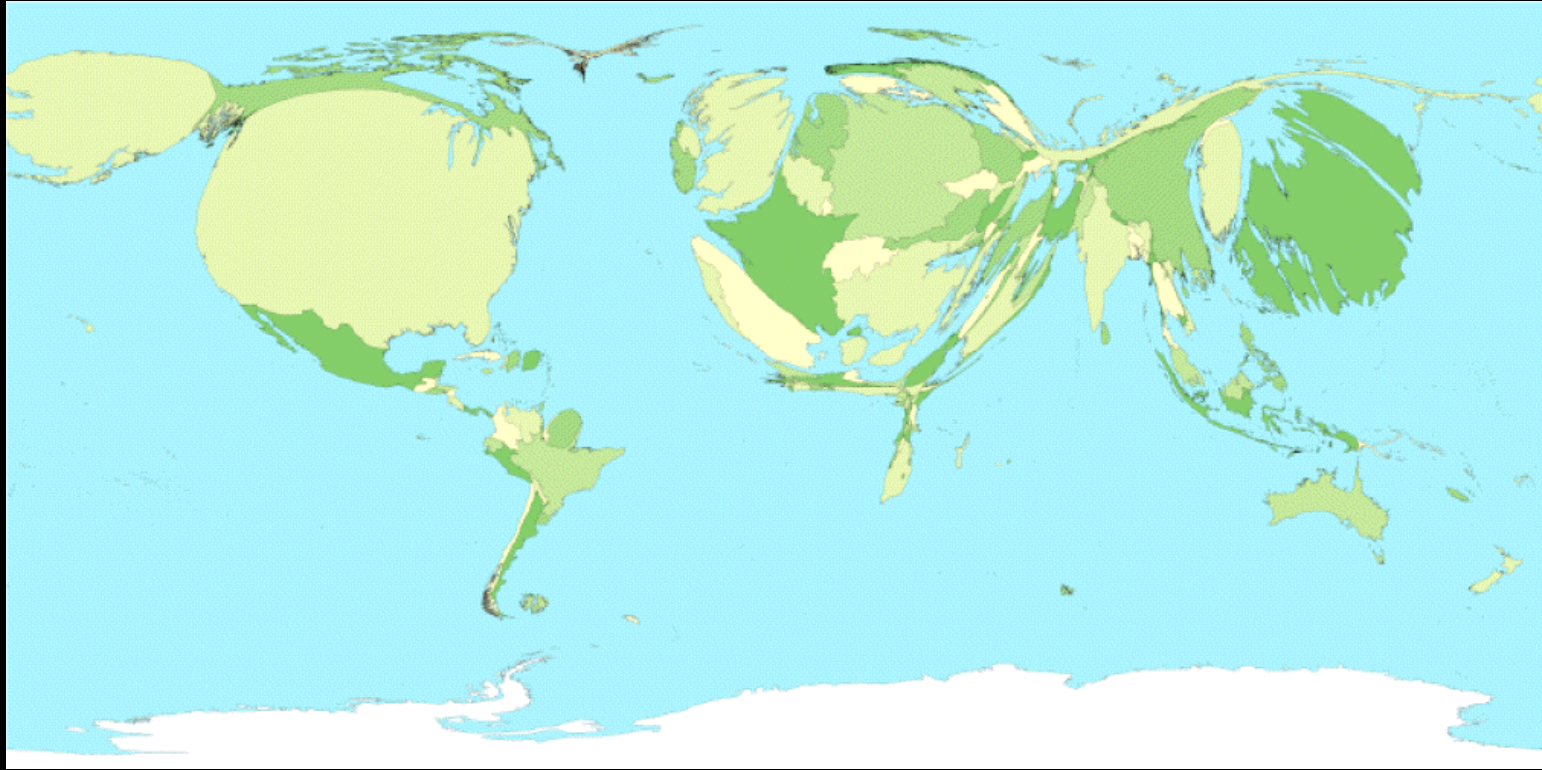


Source: Images of the social and economic world – Mark Newman

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# The world by gross domestic product



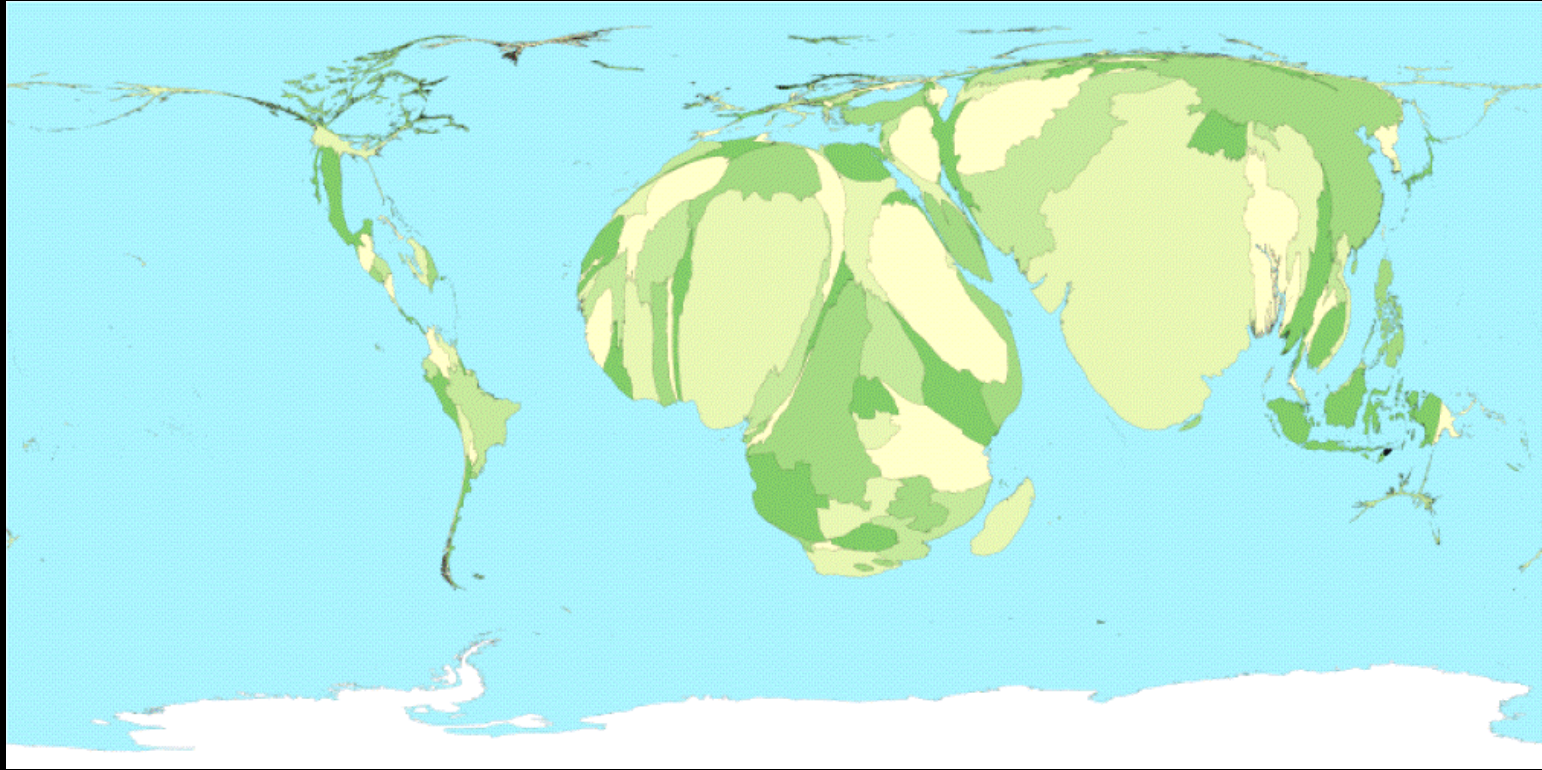
Source: Images of the social and economic world – Mark Newman

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# The world in child mortality perspective

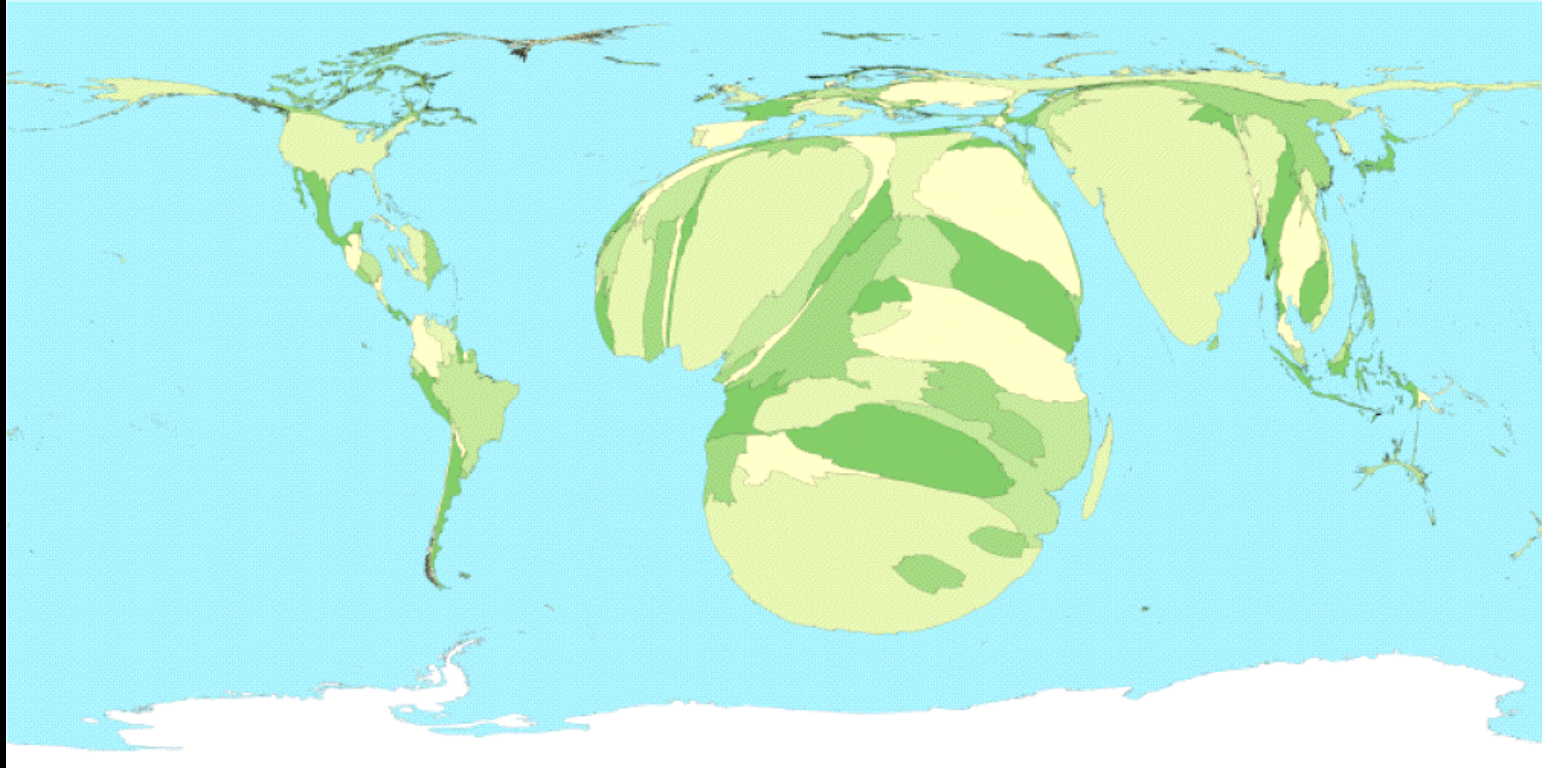


Source: Images of the social and economic world – Mark Newman

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# The world in HIV/AIDS perspective

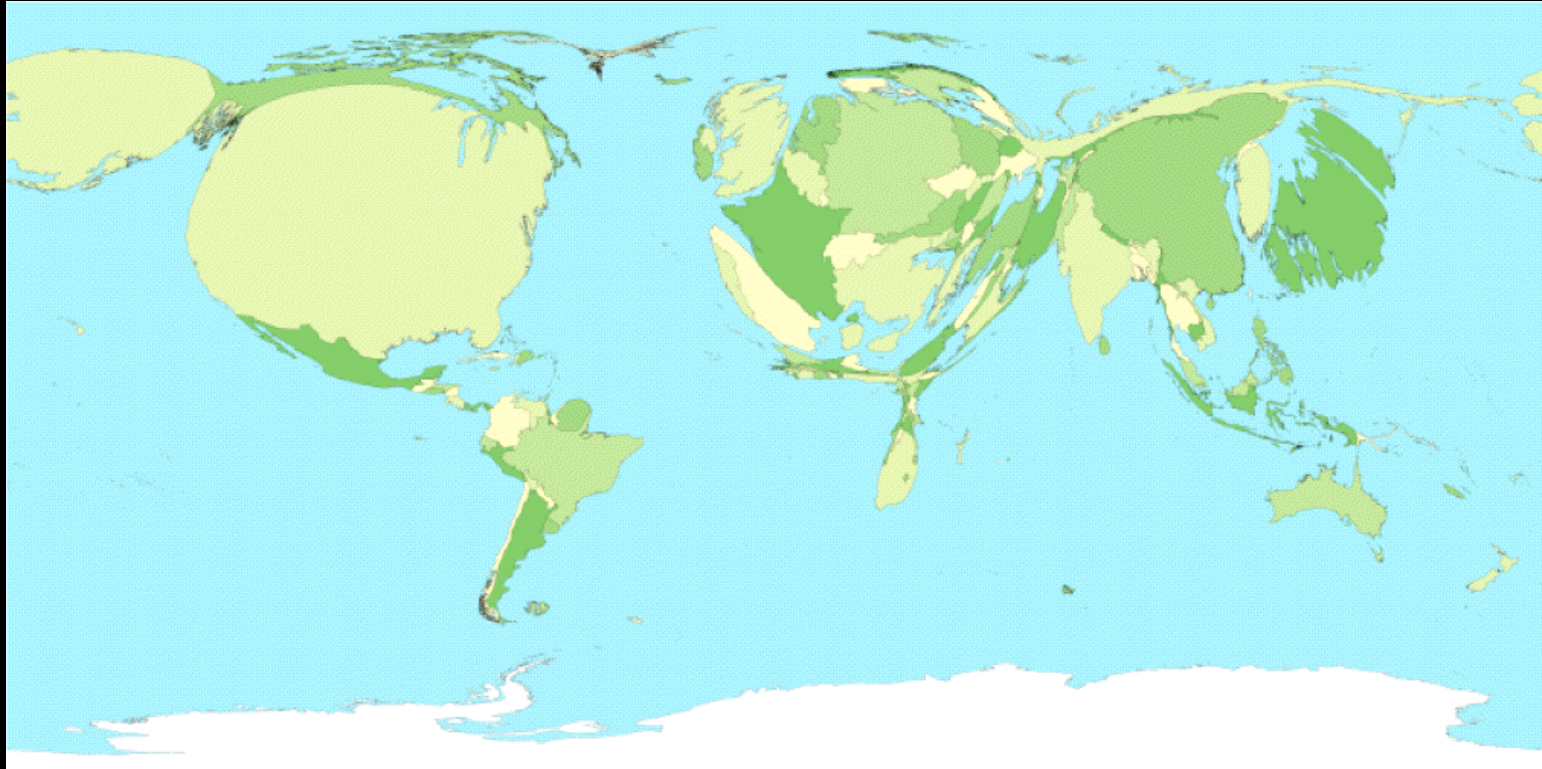


Source: Images of the social and economic world – Mark Newman

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# The world by spending on healthcare

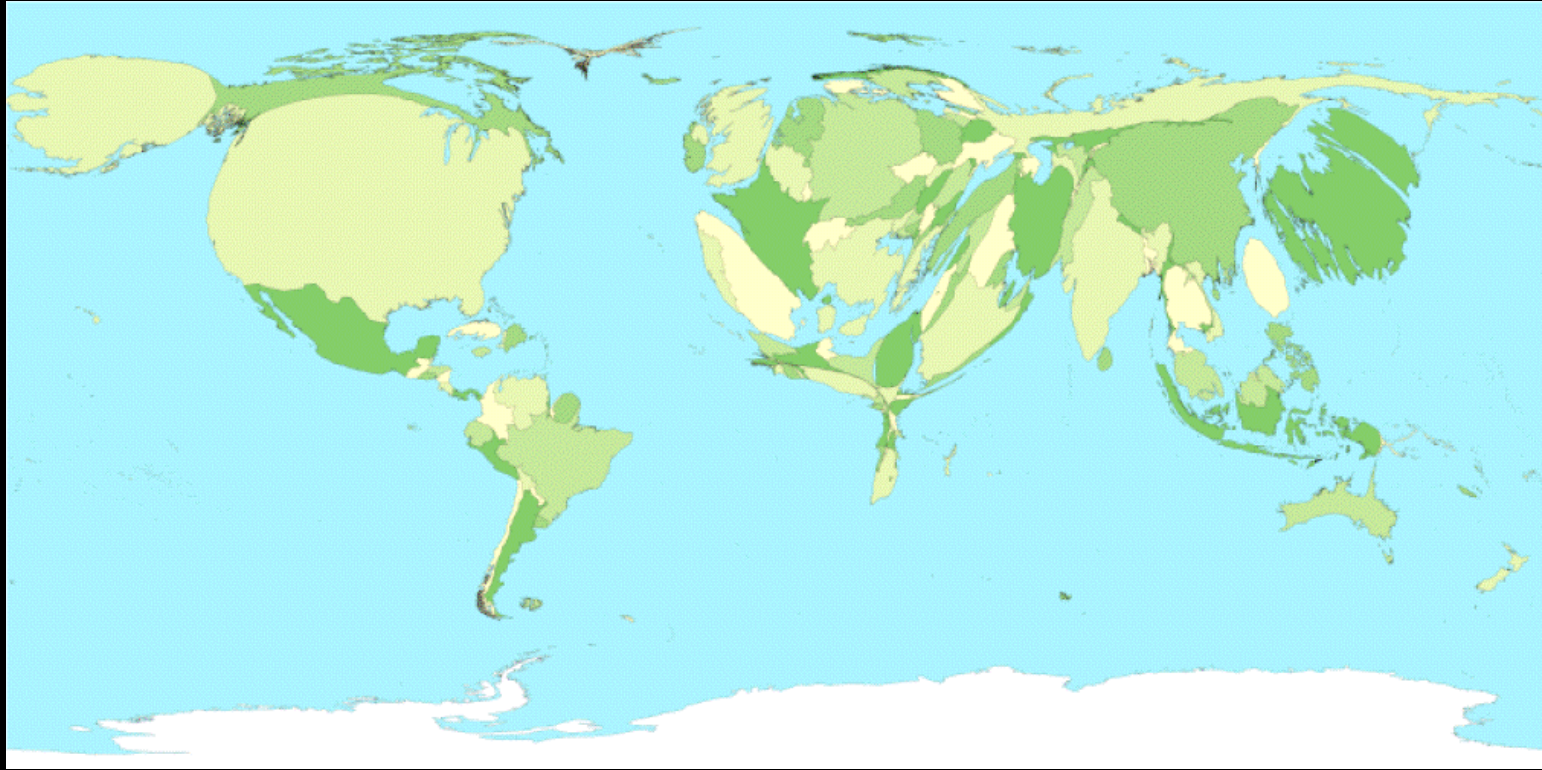


Source: Images of the social and economic world – Mark Newman

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# The world by energy consumption

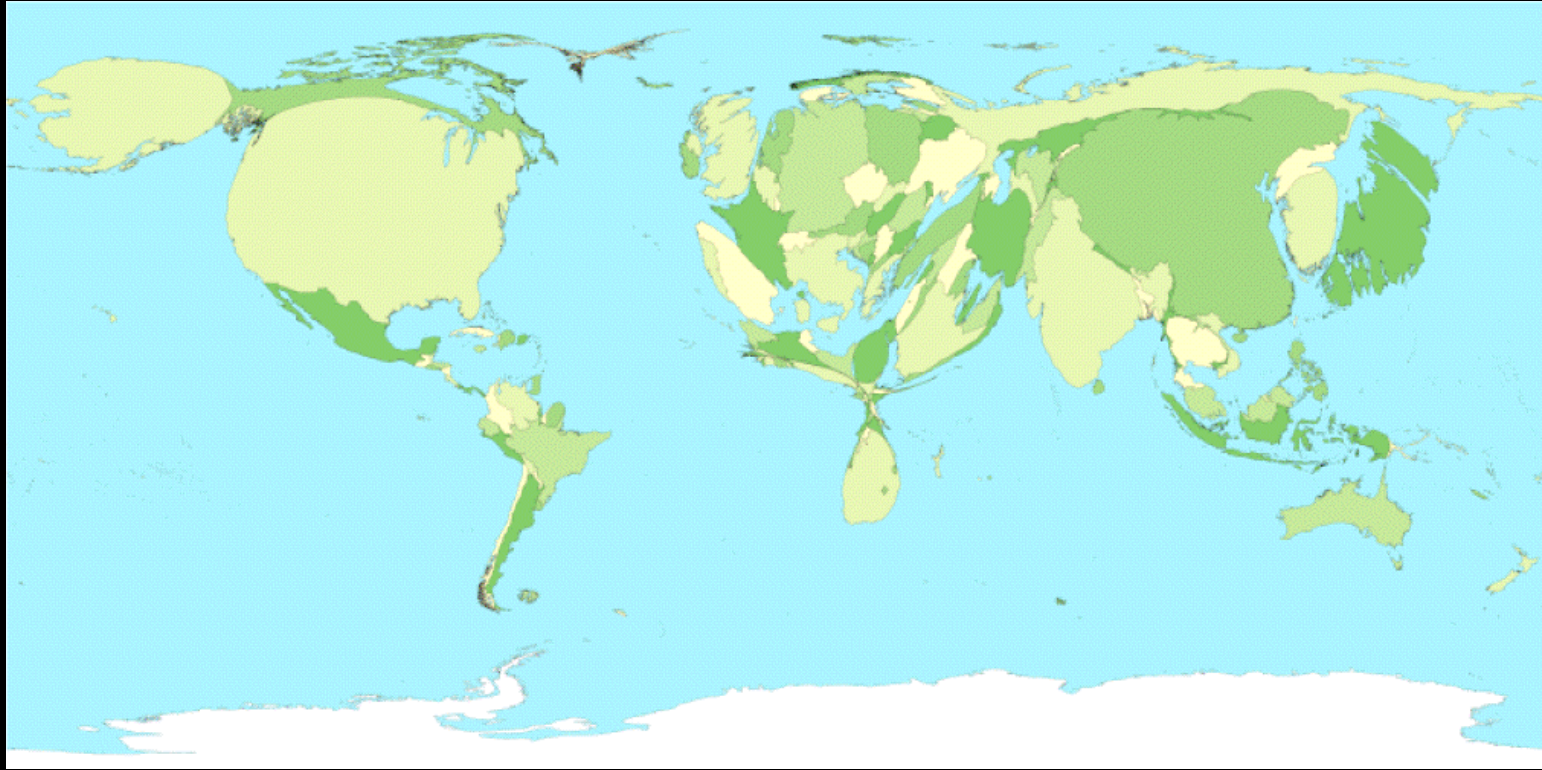


Source: Images of the social and economic world – Mark Newman

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# The world by greenhouse gas emission



Source: Images of the social and economic world – Mark Newman

<http://www-personal.umich.edu/~mejn/cartograms/>



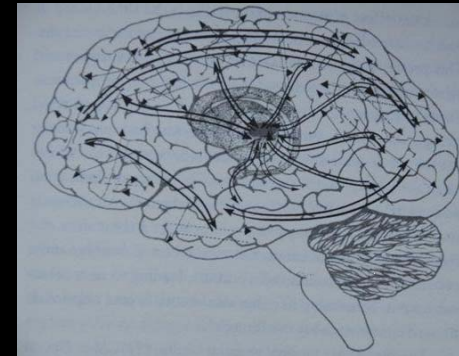
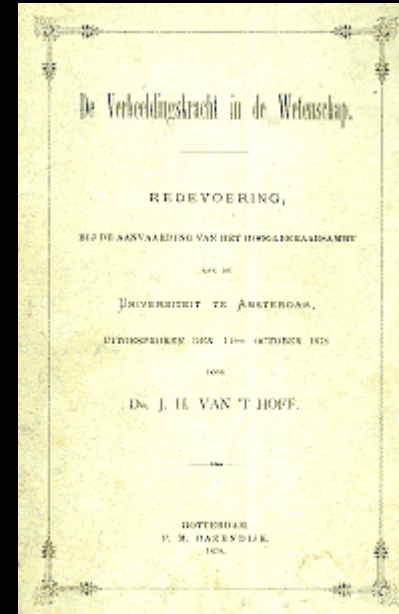
## So, where do we stand?

- ❑ No apparent pre-ordained purpose.
- ❑ No certainty regarding our uniqueness.
- ❑ A potentially harmful species that could easily squander its heritage. Would it matter? Does it matter if we care?
- ❑ No answers from science about why we are here.
- ❑ Yet we evolved, and so did our nervous system, to feel concerned (ethically and aesthetically).
- ❑ It is only natural to be led by those concerns and interact with the world accordingly.



# Consciousness

- ❑ We give conscious expression to these concerns through science and art.
- ❑ Both art and science are fed by the power of imagination
  - (Van 't Hoff, 1878 [De Verbeeldingskracht in de Wetenschap];
  - Edelman, 2006 ["Science is imagination in the service of verifiable truth"]).
- ❑ And what about religion?



# Religion

Religions provide frameworks of metaphors of origin, purpose and destiny, within and through which generic patterns of human behavior evolved and became consolidated.

Awe may be at the roots of both science and religion; less so of art. Consolation may be found in both art (particularly music) and religion; less so in science.

Edgar Morin: Science gets us a long way, but it “opens onto undecidables where philosophical options and religious beliefs come into play through cultures and civilizations” (Seven complex lessons in education for the future [UNESCO] - <http://unesdoc.unesco.org/images/0011/001177/117740eo.pdf>)

Paul Tillich: God is undefinable and thus not confined by the mind or by words. Religion is direction or movement toward the ultimate or the unconditional. Faith/religion is thus expression of 'ultimate concern.'





## Van Huyssteen (Gifford Lectures 2004, Edinburgh, Scotland - <http://www.teo.co.za/wmview.php?ArtID=160>)

Menslike uniekheid word nou vanuit drie onderskeie dog eng verbonde dissiplinêre lyne beredeneer: epistemologies vanuit die Evolusionêre Biologie, histories, uiteenlopend en gefragmenteerd vanuit die geskiedenis van die Teologie, en kompleks, multi-gelaagd vanuit kontemporêre Paleo-antropologie. In hierdie lesing kom nuwe en radikale interdissiplinêre voorstelle oor die oorsprong van die menslike bewussyn aan die orde. Hierdie voorstelle is aanvullend tot 'n teorie oor menslike kognitiewe evolusie, en steun op linguistiek, kognitiewe wetenskap, en op neuropsigologie. Simboliese voorstellings as die vernaamste aanduiding van mense, en die wyse waarop dit in ons merkwaardige mimetiese en linguistiese vermoëns gegrond is, is die primêre fokus. Om die waarheid te sê, taal is ons unieke vermoë om simbolies te kommunikeer. Om uniek mens te wees beteken om die wêreld te ervaar en te verstaan op biologies onbepaalde wyses, estetiese ervarings en spirituele nadenke ingeslote. Die spesiale aanpassings vir taal en taal as sodanig het inderdaad 'n belangrike rol gespeel in die oorsprong van menslike morele en spirituele bevoegdhede. Hieruit volg dat 'n spirituele vatbaarheid direk herleibaar is tot die vermoë om kennis en emosies simbolies te transformeer. **Die simboliese aard van *Homo sapiens* verklaar waarom die neiging tot godsdiens en godsdienstige ervarings 'n wesenlike en universeel menslike kenmerk is.** 'n Post-fundamentele benadering tot menslike uniekheid as 'n interdissiplinêre probleem waarsku egter dat godsdienstige verbeeldingskrag nie as 'n abstrakte besprekingspunt of as 'n gegewe generiese verskynsel hanteer kan word nie, maar slegs bespreek en evalueer mag word binne die konkrete konteks van spesifieke godsdienste en teologieë. (My emphasis - JV)

# Part 2

## Learning



Essential problem at this juncture of evolutionary history: We are ahead in our capacity to invent and intervene in comparison to our ability to reflect responsibly and timely on the consequences of what we do.

*...there is a need to reinstate in our thinking about learning a concern with ultimate values.*



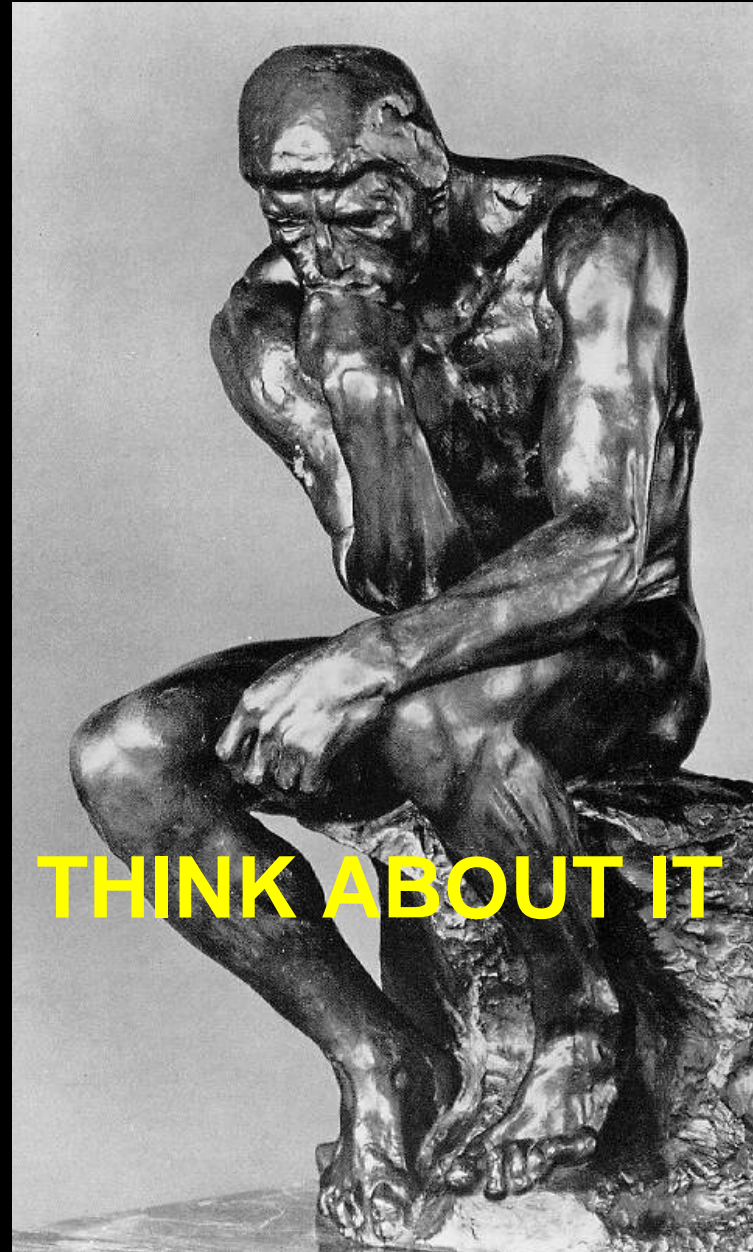
# Implications for learning

*...develop meta-learning abilities that allow us to ask pertinent questions, to set responsible goals and to use technology wisely in the pursuit of those goals.*

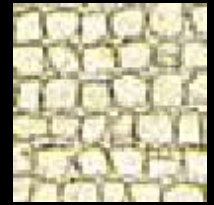
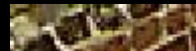


So,  
*What is learning?*

**THINK ABOUT IT**



# The little we know



# Putting the picture together





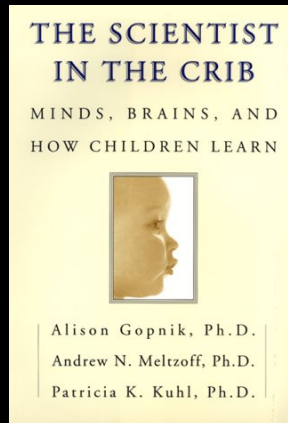
# Placing things in context





## This is how it begins:

Walk upstairs, open the door gently, and look in the crib. What do you see? Most of us see a picture of innocence and helplessness, a clean slate. But, in fact, what we see in the crib is the greatest mind that has ever existed, the most powerful learning machine in the universe. The tiny fingers and mouth are exploration devices that probe the alien world around them with more precision than any Mars rover. The crumpled ears take a buzz of incomprehensible noise and flawlessly turn it into meaningful language. The wide eyes that sometimes seem to peer into your very soul actually do just that, deciphering your deepest feelings. The downy head surrounds a brain that is forming millions of new connections every day. That, at least, is what thirty years of scientific research have told us.



Gopnik, A., Meltzoff, A. N., & Kuhl, P. K. (1999). *The Scientist in the Crib*. New York: William Morrow and Company, Inc. (p. 1)

# Four levels of adaptive behavior

- Level 1:** Interaction with threats and opportunities in the environment through genetically transmitted preprogrammed responses, e.g. fight and flight responses.
- Level 2:** Acquisition of essential environment-specific abilities, such as mastery of the mother tongue, driven by an inherited predisposition to do so.
- Level 3:** Deliberate acquisition of specific skills, knowledge, habits and propensities, motivated by individual choices or societal expectations, usually by exposing oneself to a purposely designed instructional – or self-instructional – process.
- Level 4:** The development and maintenance of a lifelong disposition to dialogue with one's environment for the purpose of constructively interacting with change in that environment.



However, there is confusion

Three problems:

1. Learning often confounded with schooling.
2. Need to move from a culture of instruction to a culture of learning.
3. Wrong preconceptions about learning.



# The Trouble with Learning

Most currently held beliefs are out of touch with today's reality.

- Linked to school or instructional settings
- Linked to particular age group
- Acquisition paradigm
- Seen as individual activity
- Takes place in the heads of people
- Empty vessel metaphor
- Preparation for life
- Reaction to change
- Disciplinarity
- Compartmentalization of knowledge
- Limited slice of the intelligence spectrum (seen as fixed)
- Limited to specific space-time frames
- Favoring only certain learning styles
- Extrinsically motivated

**(This list can be continued)**



# The Reinvention of Learning

Need to change beliefs, research, policy and practice in line with today's reality.

- Conceive of school or instructional settings in wider context
- Learning as lifelong disposition
- Participation paradigm
- Seen as individual and social activity
- Mainly takes place outside the heads of people
- Is dialogic
- Inherent feature of life (humans prepare for lifelong learning)
- Constructive participation in change
- Disciplinarity, multi-, inter-, and transdisciplinarity
- Consilience
- Multiple intelligences that can develop
- Multiple space-time frames
- Accommodating different learning styles
- Intrinsically motivated (motivation awakened through dialogue)

(This list can be continued)



Consider the following:

## Human learning:

- ❑ Starts nine months before we are born and continues until we die (and it extends beyond our physical existence to the extent that we are all part of the social and historical process of the continual development of thought)
- ❑ Occurs in multiple contexts
- ❑ Has multiple dimensions
- ❑ Is engaged in by individuals and social entities (collectives of people who share a purpose).



# The kind of learning we need

- ❑ *If there is such a thing as “preparation for life,” then it must be a preparation that allows us to cope with the unpredictable.*
- ❑ *Need to learn beyond disciplines; to enhance our ability to problematize; to work on problems creatively and collaboratively.*
- ❑ *Need to perceive of learning as an ecological phenomenon: Learning is generative; no learning stands on its own.*

*At a societal level we must be aware of the need to develop “policies for the learning environment at large” that can ensure that learning becomes mutually reinforcing in the different, though interconnected, parts of the learning ecology.*



# Learning undefined

***“Human learning is the disposition of human beings, and of the social entities to which they pertain, to engage in continuous dialogue with the human, social, biological and physical environment, so as to generate intelligent behavior to interact constructively with change.”***

Visser (2001). Integrity, completeness and comprehensiveness of the learning environment: Meeting the basic learning needs of all throughout life. In D. N. Aspin, J. D. Chapman, M. J. Hatton and Y. Sawano (Eds), *International Handbook of Lifelong Learning* (pp. 447-472). Dordrecht, The Netherlands: Kluwer Academic Publishers.



# Part 3

## The (scientific) mind



# An essential resource: THE MIND

- ❑ Anglo-Saxon origin: “*gemynd*”= memory
- ❑ Two perspectives on memory:
  - memory as static concept (stored retrievable information)
  - memory as dynamic concept, i.e. giving meaning, intentionality.
- ❑ While we live, we are all “memories in the making”(Yusra Laila Visser, 1997).
- ❑ Susan Greenfield (2000): “*Mind . . . is the seething morass of cell circuitry that has been configured by personal experiences and is constantly being updated as we live out each moment*”(p. 13). In other words, it is, according to Greenfield, “*the personalization of the physical brain*”(p. 14)through our experience.

Visser, Y. L. (1997). Personal communication.

Greenfield, S (2000). Private life of the brain. Harmondsworth, UK: Penguin.



## An essential mindset: THE SCIENTIFIC MIND

The spirit of science is alive in us at birth and during our earliest childhood years. In fact, evolution has set us up from before birth to display the kinds of behavior that can be associated with having a scientific mind.

Having a scientific mind is fundamental to our becoming aware of ourselves in relation to all that surrounds us, our universe. The extent of that universe is only limited by our unfolding capacity to comprehend it, emotionally and cognitively. Such comprehension is vital to our ability to play a consciously constructive role as an integral part of that same universe.

Nurturing the spirit of science is key to expanding the boundaries of our comprehension. *It's never too early to start attending to nurturing the scientific mind.*



# The scientific mind: A multidimensional mindset

The scientific mind is a complex mindset. The following suggestions are offered as a starting point for the description of its multidimensional character:

- The spirit of inquiry
- The spirit of collaboration
- The quest for beauty (harmony, parsimony, wholeness)
- The desire to understand and do so profoundly
- The creative spirit
- The urge to be critical
- The spirit to transcend
- The spirit of building on prior knowledge
- The search for unity
- The building of the story of human knowledge and ability
- The spirit of construction

From: ***The Scientific Mind in Context*** concept paper.  
<http://www.learndev.org/dl/TSM-ConceptPaper.pdf>

# The scientific mind at seven

Listen to Yasmina Ahmed:



I am seven years old. I liked the conference because it was about science. I like science. But I also like to draw. When I draw I can transform things. I can for instance change guys into girls simply by changing a few lines. On the first day I talked with Ron about molecules and about my microscope. I like doing experiments. I often put things inside water to find out what happens. I've also made a drawing of the inside of a tomato. At the conference I was listening to what people were saying and then I decided to make a drawing of the universe wrapped around the world. I don't know if I want to be a scientist or an artist. I like drawing, but as a scientist I would like to make potions. I already have a lot of chemicals.

Yasmina Ahmed at Building the Scientific Mind colloquium,  
The Hague, The Netherlands, 2006  
<http://www.learndev.org/ColloquiumBuildingTSM2005.html>



## Why stop at seven?

The traditional schooling practice, with its emphasis on the acquisition of factual knowledge and lack of encouragement to explore and comprehend deeply, is possibly a major cause of the disappearance of curiosity. If so, it may be the single most important inhibitor of the development of the scientific mind.



# Opportunities in early childhood: Opportunities for life.

The opportunities we take in early childhood ultimately determine whether the child that was alive in us at birth will still live inside us as we fulfill our lives.



## The scientific mind throughout life

Keeping the scientific mind alive and fostering its growth throughout life requires creating multiple conditions in diverse learning spaces.

Join the Building the Scientific Mind (BtSM) colloquia to help:

- identify the above conditions
- invent relevant action
- build awareness
- influence research agendas
- contribute to propitious policy development.





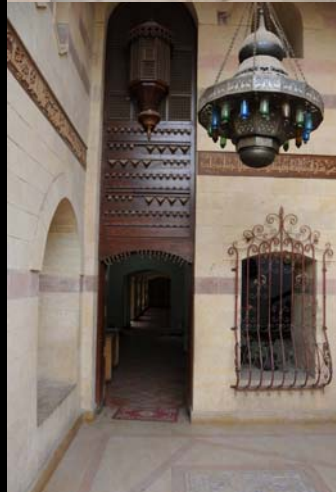
# Third Advanced International Colloquium on Building the Scientific Mind

Cairo, Egypt

May 10/11-14, 2009

With:

- Ain Shams University
- Friends of the Environment and Development Association
- Foundation for a Culture of Peace
- UNESCO
- Universe Awareness
- **AND YOU**



# THANK YOU



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SEE YOU IN CAIRO!

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