WHO NEEDS SCIENCE LITERACY AND WHY
learning, knowing and using science

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Outline

Why is widespread public understanding and use of science critical and especially now?

Focus on two threads connecting science and public:

A. communication and use of science between and within communities of practice

B. interplay between knowledge, learning, and societal change

Two examples of public learning, understanding, and use of science:

- governance of the Baltic Sea fisheries
- science literacy, learning, and creativity in China

Some thoughts on computational modeling, games, and science

Why learn science?

- sustain future research and educate future researchers - the “pipeline”
- make informed, rational personal and public policy decisions
- participate more fully in democratic processes
- develop critical thinking & adaptive capacity
- diminish sense of alienation and fear
- develop facility and desire for lifelong learning
- open eyes wider to the beauty of nature

WHAT ABOUT SCIENCE SHOULD EVERYONE UNDERSTAND?

Science is an evolving process of understanding our world

Science is explanatory and predictive, thus can guide personal and policy decisions

Uncertainty is fundamental to the nature of science

Emergent phenomena

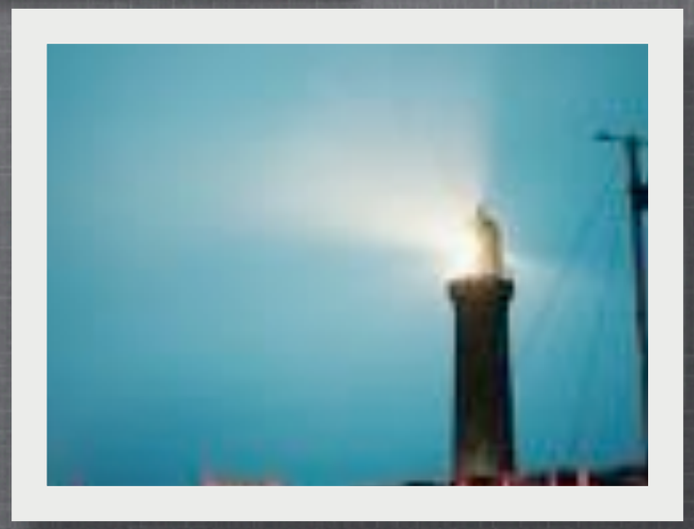
Unintended consequences

Precautionary principle

SCIENCE, TECHNOLOGY, AND HUMANITY

Natural science:
BELLWETHERS

Technology and
innovation:
BEACONS



Responses of
humans:
BEHAVIORS

Living in the Anthropocene age

We live in an age human impact has and does profoundly affect the entire Earth system

- Anthropocene coined by Paul Crutzen
- recognizes inherent socio-ecological coupling

Magnitude, scope, and urgency of global change

- instability, emergent events, unpredictability
- rapid and profound impacts on society
- gives rise to contested science and interest-driven representation

Changing humanity's trajectory requires that very many people know, understand, and act responsibly

Turn about is more than fair play

Researchers need dialogues with the public to:

- understand societal and cultural context of science, engineering, and innovation
- make informed, rational, societally-appropriate choices for their work & home
- develop communication skills for their own democratic participation in society
- attract and educate future researchers
- find and maintain own motivation for research

Agency and Responsibility

Engage stakeholders in governance of Earth system

- bring a wide range of stakeholders to the table
- engage science experts and holders of local or traditional knowledge together to **co-produce** policy- and practice-relevant **knowledge**
- **enable** an effective sense of personal **agency**
- build a network of strongly **shared** commitment and **responsibility**

Knowing, Learning, and Acting

By learning, information becomes knowledge and understanding

- good information is necessary, but not sufficient for informed, effective participation in democracy
- information must be made relevant to wider public, including the science-apathetic or science-phobic
- knowledge co-production by stakeholders is a critical factor in effective governance
- changing, unpredictable conditions require both mitigation and adaptation

The dilemma of micromotives and macrobehaviors

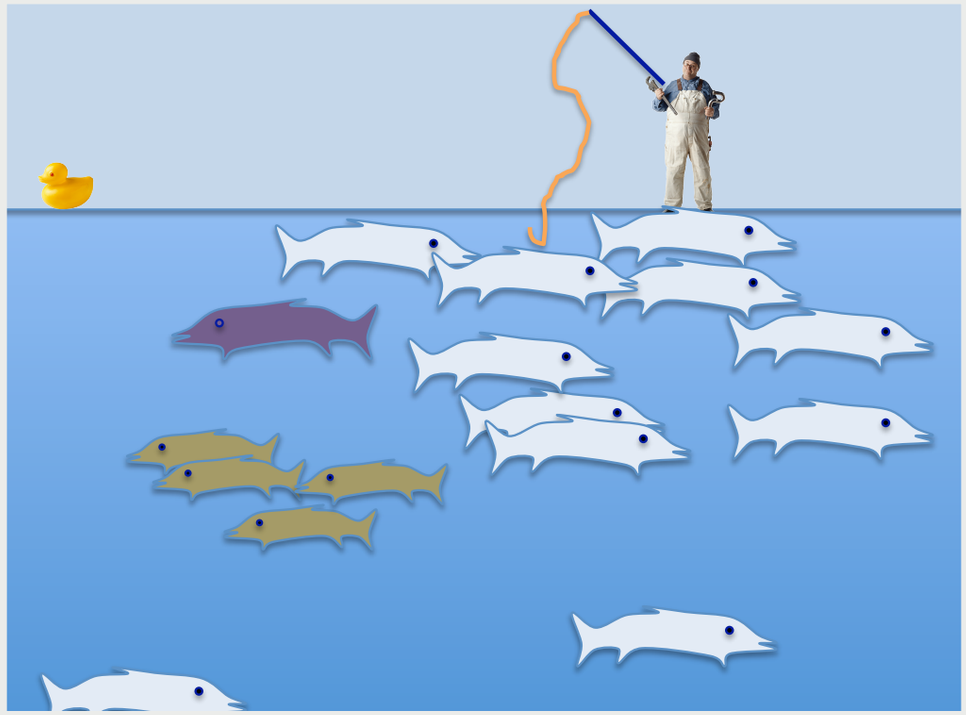
Interplay of knowledge, learning, and societal change

Knowledge, Learning, and Societal Change in the Transition to a Sustainable Future

ILAN CHABAY, MIRANDA SCHREURS, FALK SCHMIDT,
BERND SIEBENHÜNER, JOSEE VAN EIJNDHOVEN

International Human Dimensions Programme
In Global Environmental Change: IHDP

TWO VIEWS OF BALTIC SEA FISHERIES



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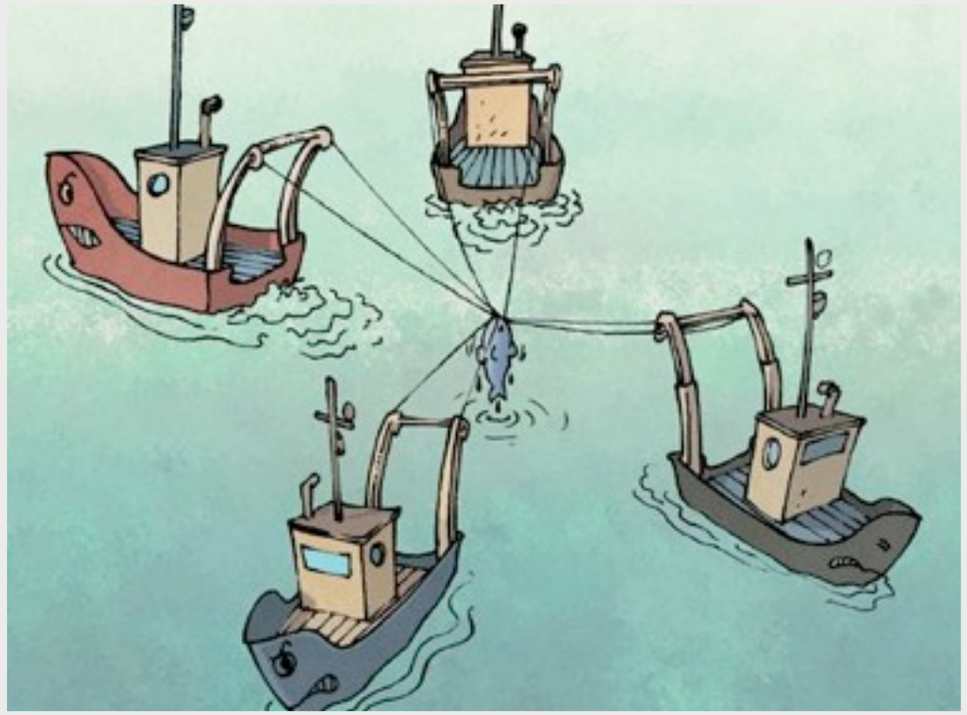
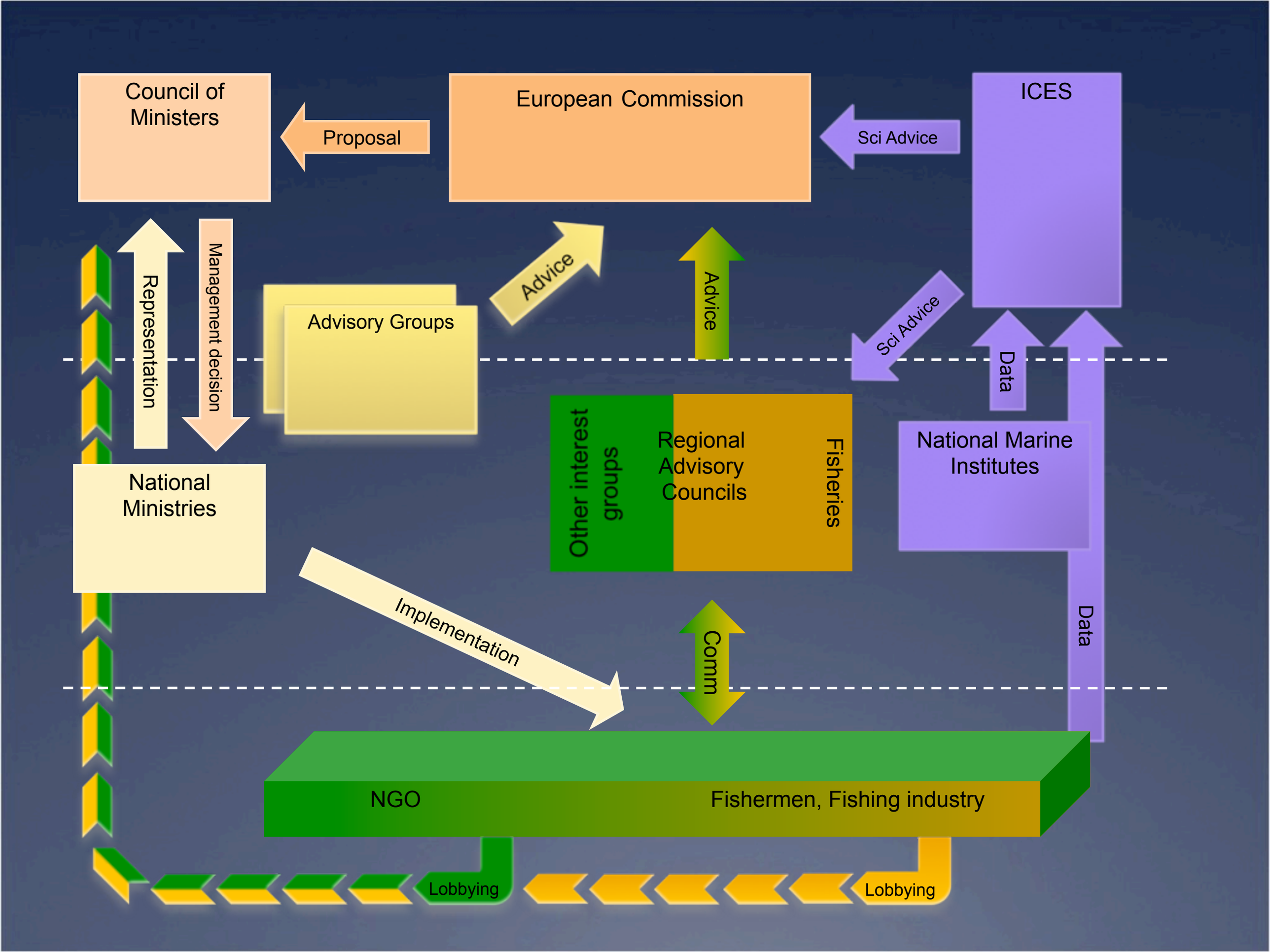


- What views of fisheries and fish stocks are held by whom and on what are they based?
- How are the views expressed and discussed?
- How is fisheries' science understood and used by individuals and agencies?
- What helps or hinders consensus formation?


Council of Ministers
Proposal
European Commission
Sci Advice
ICES
Representation
Management decision
Advice
Advisory Groups
Advice
Sci Advice
Data
Other interest groups
Regional Advisory Councils
Fisheries
National Marine Institutes
National Ministries
Implementation
Comm
Data
NGO
Fishermen, Fishing industry
Lobbying
Lobbying

Polish Fisheries Roundtable

Goal of PFRT is to support more effective discourse and consensus formation within Poland for governance of Baltic Sea fisheries

Forum established with people from fisheries, fish product companies, environmental NGOs, and marine scientists

EU Common Fisheries Policy reform in 2012 was used as external pressure to drive initial formation of forum

Created an agreement on use of mediated dialogue including joint fact finding, question framing, and polling as format of discourse

Involvement of government as observer - a venue for dialogue and social learning, not a forum for negotiation

This project is funded by the Baltic Sea 2020 Foundation, Sweden

Research is being conducted with Christian Stöhr, Ph.D. candidate in Dept. of Applied IT, Chalmers University

Useful Science Literacy Projects

Developing meaningful and relevant science literacy

- increase capacity for creativity, innovation, and adaptation for a sustainable future
- build lifelong learning starting from early childhood
- engage all members of communities
- focus on inquiry-based learning from experiences

Projects: Children and Youth Science Centers of CAST

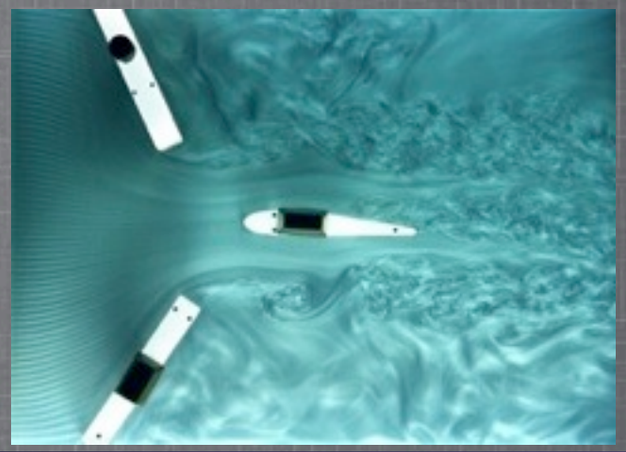
- produce, distribute exhibits on >250 trucks
- training for staff in inquiry & experiential learning
- research on science literacy of children and adults
- assess the creativity of children ages 7-18

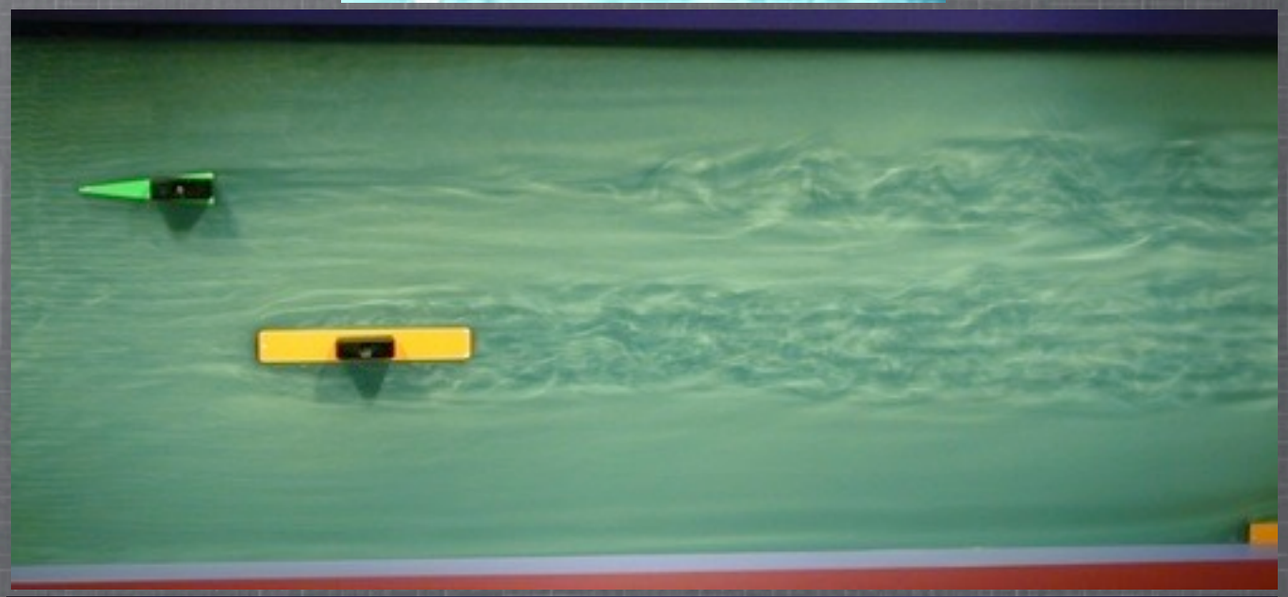
Curiosity and Questions

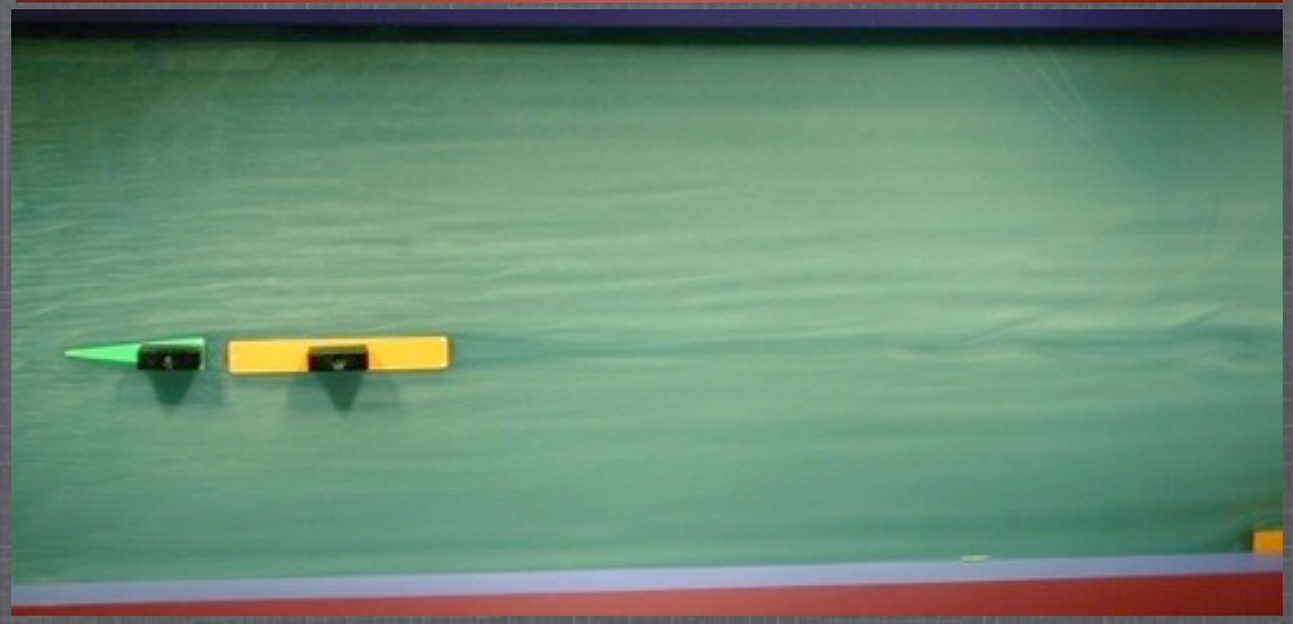
Stimulate questions first, then together look for answers that lead to further questions

National Science Popularization Day, Beijing 2008

ACTIVE LEARNING, MEMORABLE EXPERIENCES







TEACHERS SHOULD ALSO BE LEARNERS

Science Museum and Science Wagon staff using Ping Pong Pinball exhibit in Nanning, China Nov.

AN AUTHENTIC PROCESS OF DOING SCIENCE TOGETHER

Frozen Bubble Box is our laboratory with tools to test our ideas

bubbles float, change size, turn colors, and freeze in a transparent box with dry ice (frozen CO_2 at -78º)

Learning Scientific Modeling From the Start

Equip the next generations to address complex issues in multiple disciplines through progressive development of computational modeling skills

Computational models can be built a many levels of complexity and solved in a cycle of refinement and iteration

Develop strategies and progressive methods to introduce the use of computational modeling from grade 3 through university levels

Use project-based methods for collaboration, integration of social and natural sciences and humanities

Stranded On Mars™ Game

- The story occurs in a virtual theater:
  - *Players and computer-driven characters interact in many different locations*
  - *Players face intrinsic challenges based on real science*
  - *Survival and success in the game is dependent on learning, critical thinking, collaboration, and communication*
- Played by groups of 2 to 8 children ages 9 to 14 years old
- 3D graphics are based on real maps, images, and weather data from Mars
- Virtual representations are reinforced with real phenomena

The story...

You arrive on Mars as part of a group of 8 teens to live with adults in a new colony

You discover the base has been deserted -- suddenly!

Your group needs to figure out:

- How to survive
- What happened to the adults on the base?
- Could you be the next to vanish?

Three other multi-national colonies are on Mars

- Where are they?
- How do you contact them?
- Are their bases populated and intact?
- What do they know about the missing adults?

Outcomes for Players as Learners:

- Experience science within a supportive and inclusive social context
- See science as accessible and relevant to themselves
- Develop confidence in using the process of scientific inquiry
- Practice transferring skills and knowledge to new situations within the game
- Imagine fulfilling professional role in life

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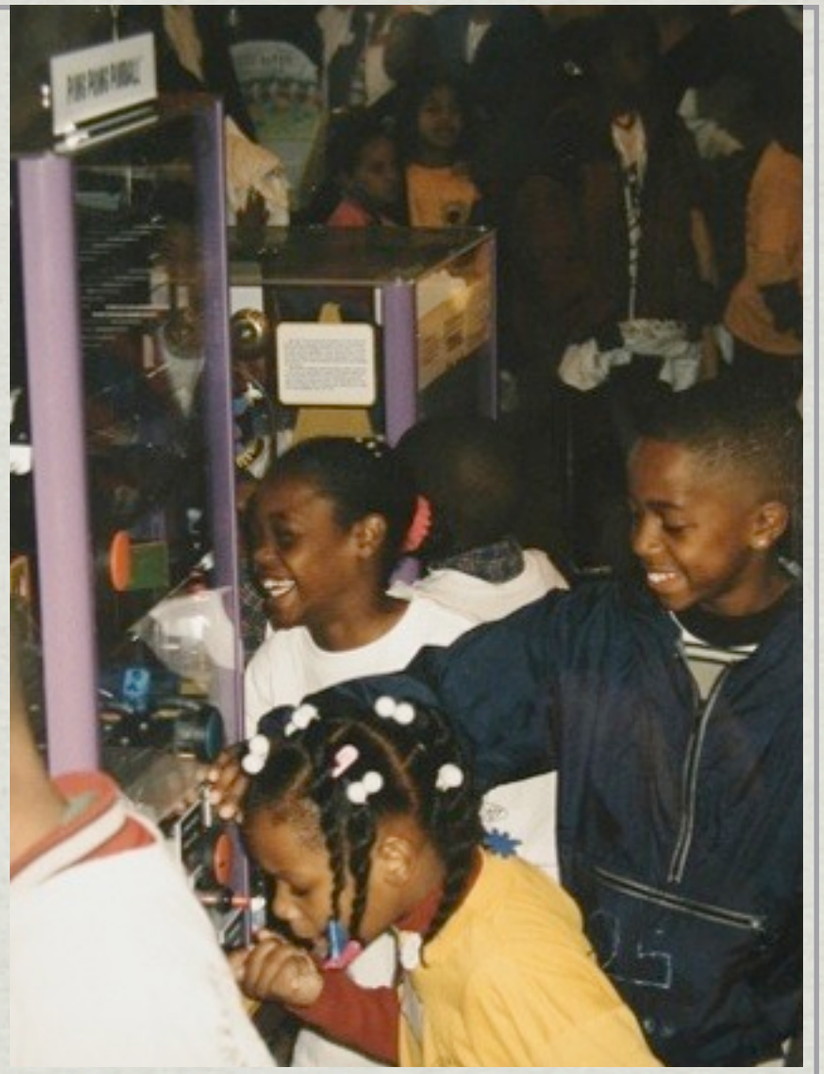

Learning to value and nurture curiosity,
learning to learn,
learning science in different ways,
learning science in different cultures,
learning science for adapting with a changing world

THANK YOU FOR THINKING WITH ME!