DEVELOPMENT OF THE EARTH SYSTEM SCIENCE LITERACY INITIATIVES IN THE U.S., AND THE WAY FORWARD

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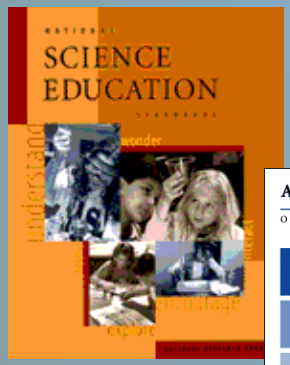
Why Literacy Frameworks?

- Significant barriers to increasing access to Earth System Science content in the K-16
- Informal education & ‘free-choice’ learning increasingly more important
- Frameworks define a learning ‘endpoint’ to focus ANY education pathway



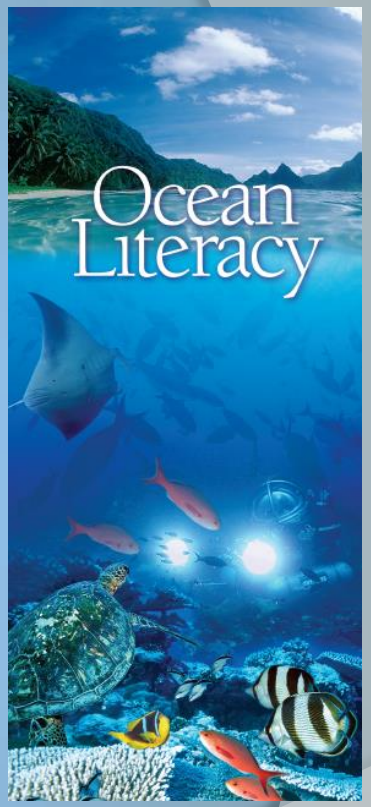
Defining Earth System Science Literacy

- Earth System Science "literate" people can:
  - Understand essential principles & fundamental concepts of ESS
  - Communicate meaningfully about ESS concepts
  - Make informed & responsible decisions regarding issues related to ESS
- Each framework has been developed through approaches that:
  - Engaged scientists & science educators alike
  - Led to wide-spread community consensus

Ocean Literacy

- The Earth has one big ocean with many features.
- The ocean & life in the ocean shape the features of the Earth.
- The ocean is a major influence on weather & climate.
- The ocean makes Earth habitable.
- The ocean supports a great diversity of life & ecosystems.
- The ocean & humans are inextricably interconnected.
- The ocean is largely unexplored.

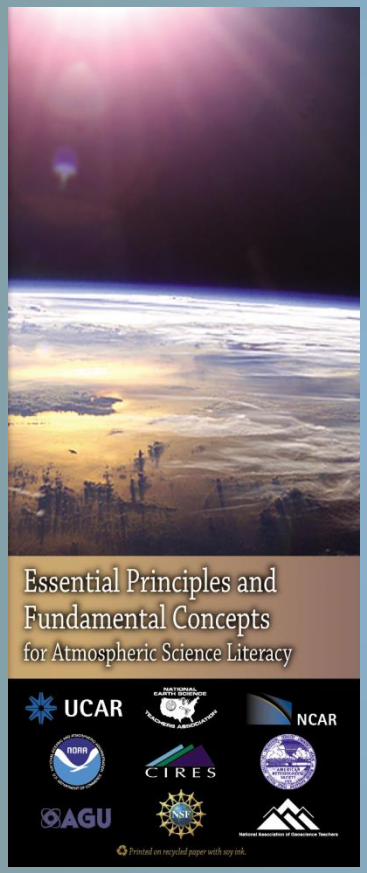
- Supporting Partners: National Geographic; NOAA; COSEE; NMSF; NMEA; College of Exploration



2005

http://www.coexploration.org/oceanliteracy/

Atmospheric Science Literacy



- Earth has a thin atmosphere that sustains life.
- Energy from the sun drives atmospheric processes.
- Atmospheric circulations transport matter & energy.
- Earth's atmosphere changes over time & space, giving rise to weather & climate.
- Earth's atmosphere continuously interacts with other components of the Earth System.
- We seek to understand the past, present & future behavior of Earth's atmosphere through scientific observation & reasoning.
- Earth's atmosphere & humans are inextricably linked.

- Supporting Partners: UCAR, NESTA, NCAR, NOAA, CIRES, AMS, AGU, NSF, NAGT

2008

http://www.eo.ucar.edu/asl/

Climate Literacy

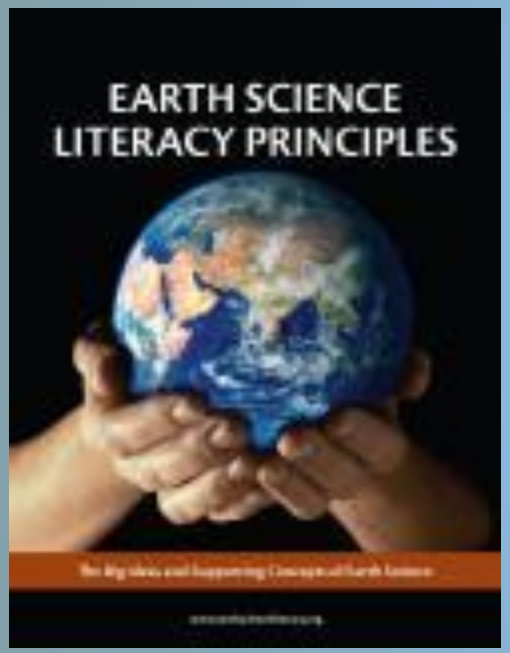
- The sun is the primary source of energy for Earth's climate system.
- Climate is regulated by complex interactions among components of the Earth system.
- Life on Earth depends on, is shaped by, & affects climate.
- Climate varies over space & time through both natural & man-made processes.
- Our understanding of the climate system is improved through observations, theoretical studies, & modeling.
- Human activities are impacting the climate system.
- Climate change will have consequences for the Earth system & human lives.

2009

- 13 USGCRP agencies & ~20 other organizations

http://www.climate.noaa.gov/index.jsp?pg=/education/edu_index.jsp&edu=literacy

Earth Science Literacy



2009

- Earth scientists use repeatable observations & testable ideas to understand & explain our planet.
- Earth is 4.6 billion years old.
- Earth is a complex system of interacting rock, water, air, and life.
- Earth is continuously changing.
- Earth is the water planet.
- Life evolves on a dynamic Earth & continuously modifies Earth.
- Humans depend on Earth for resources.
- Natural hazards pose risks to humans.
- Humans significantly alter the Earth.

- Supporting Partners: AAPG, AGI, AGU, GSA, NAGT, NESTA, Smithsonian, USGS

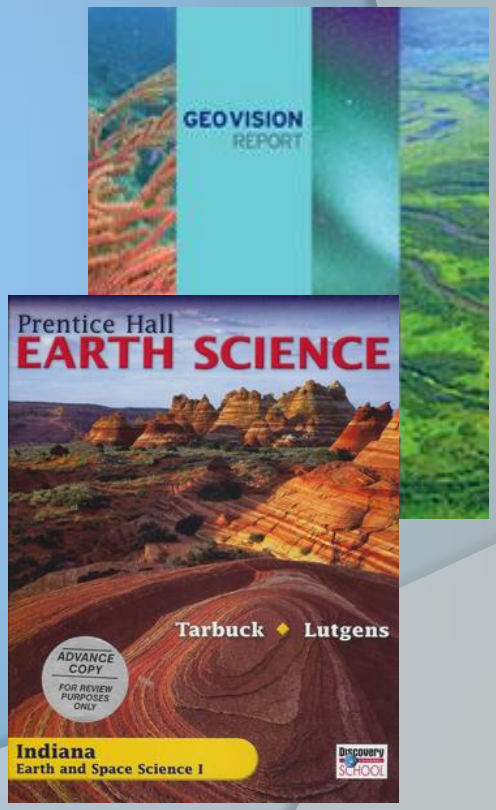
www.earthscienceliteracy.org/

Common Themes

- We understand Earth through the process of science: observation, theory, & modeling
- Earth's behavior is controlled by interactions among several systems & the transfer of matter & energy
- Earth's is dynamic; its processes vary over time & space
- Life depends on processes within Earth systems
- Humans are affected – both positively & negatively – by Earth processes
- Living things, including humans, are changing the Earth system

Use of the Literacy Frameworks

- Building blocks for an integrated Earth System Science Literacy framework
- Endorsed in strategic plans for GEO education
- Guiding development of formal & informal education resources, textbooks, etc.
- Required reference point for some NSF, NOAA, & NASA education solicitations



New Opportunities for ESS Literacy

- Science & Technology of high priority for Obama administration
- Focus on climate change, clean energy, ‘green jobs’ economy
- Administration proposes R&D investments to be 3% of GNP
- Projected budget increases for the science agencies
- Priority investments in STEM educators & grad students
- Dept of Education offering ‘carrots’ through *Race to the Top* and *Educate to Innovate* initiatives

Climate Change: A Wedge' For Reform

- FY 09 & 10 NSF budget includes $10M for Climate Change Education (plus NASA & NOAA CCE $)
- NSF Dear Colleague Letter 09-058 established foundations for a strategic CCE portfolio
- Core priority areas identified:
  - Scale-up & dissemination of effective educational resources
  - Assessment of student learning of complex climate issues as it translates into action
  - Addressing local and national STEM education policies for teaching about climate change
  - Professional development in climate change literacy for policy makers at all levels

NRC Roundtable on Climate Change Education (PI: M. Storksdieck)

- Membership: ~25-30 members w/diverse expertise; Federal agency representatives
- Meetings: 5 quarterly meetings; 2 workshops
- Reports: 2 workshop reports
- Emphasis areas:
  - Key challenges faced in learning about & teaching about climate change, informed by the learning sciences
  - STEM education reforms needed to remove obstacles to teaching about climate change, within the context of Earth System Science

New Common Science Education Standards Initiative

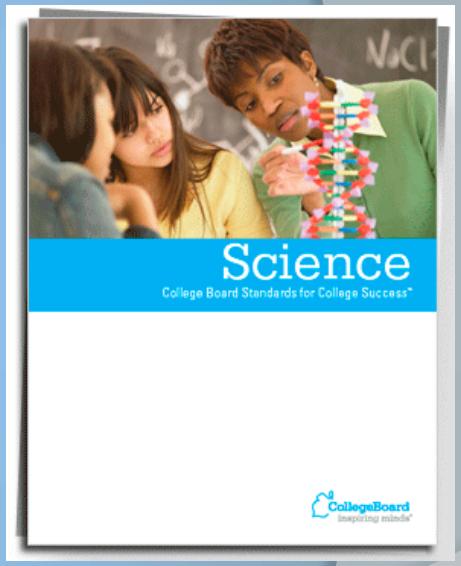
- Collaborators:
  - NRC Board on Science Education; Carnegie Corporation
  - NSTA; Achieve; AAAS
  - Chief State Science Supervisors
- Goal is to develop a conceptual framework of disciplinary & cross-disciplinary core ideas for K-12 science standards
- 2010 Meetings: Jan 28-29; Mar 4-5; Apr 22-23

www7.nationalacademies.org/bose/Standards_Framework_Homepage.html

College Board Science Standards

Science College Board Standards for College Success™ (Science CBSCS, 2009):

- Identifies minimal knowledge & scientific practices expected for all college-bound students
- Outlines a progression of critical thinking skills from 6-12th grade, leading to AP level
- Defines a specific Earth Science track
- Focuses on development of the knowledge, skills & practices required to understand the overarching principles & core ideas that have explanatory power within & across science disciplines



Next Steps on the ESS Literacy Path

- Keep Earth System Science in the conversation!
- Use the frameworks to provide consistent messages
- Help translate national policies to local practices
- Prepare educators for new interdisciplinary curricula
- Develop & implement ESS-related assessments for formal & informal venues

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