Connecting NGSS to Other Literacy Initiatives: An Update of the Rainbow Chart of Earth Science Bigger Ideas

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Overarching Questions:

How do we know what we know? How do we know what we know after making a decision-making?

The Next Generation Science Standards
http://nextgenscience.org

Ocean Literacy Principles

Climate Literacy Principles
http://climateliteracynow.org

Atmospheric Science Literacy Principles
http://www.noaa.gov/ali/index.html

Earth Science Literacy Big Ideas
http://www.epa.gov/education/earth-literacy.html

Energy Literacy Principles
http://www1.ere.energy.gov/education/energy-literacy.html

Physical processes on Earth are the result of energy flow through the Earth system.

Biological processes depend on energy flow through the Earth system.

Various sources of energy can be used to power human activities, and this energy must be transferred from source to destination.

The quality of life of individuals and societies is affected by energy choices.

Energy decisions are influenced by economic, political, environmental, and social factors.

The amount of energy used by human society depends on many factors.

A coherent conceptual framework

The Essential Principles and Big Ideas from the Literacy Principles document represent important concepts about some of the most important ideas within each discipline, but also represent a challenge to educators. Collectively, they include 36 ideas and 247 concepts. All at the commencement level, there are no examples of creating sets of ideas everyone should understand about any topic that has led to broad understanding of the target content, in spite of countless attempts to do just that throughout history. Without a coherent framework to connect them one to another, it’s likely that learners will understand or remember them. This “Rainbow Chart” is intended to show these connections.

What do the colors mean?

Each big idea has a unique color, and the overarching questions to this rainbow of colors together appear white when ideas or principles from the other ideas were the nature of science that is inherent in those questions. Each set of literacy principles addresses all big ideas and the overarching questions.

What makes ideas bigger?

A bigger idea has the following characteristics:

- The idea cuts across the Earth science curriculum.
- Understanding of the idea is attainable by students and the understanding builds upon the idea.
- The idea is essential to understanding a variety of topics.
- The idea requires conversations; is a bottleneck question.

Furthermore, the entire Earth science curriculum is represented by this (small) set of ideas.

Earth System Science Core Ideas

Earth is a system of systems.
The flow of energy drives the cycling of matter.
Life, including human life, is influenced by the environment.
Physical and chemical principles are unchanging and drive both gradual and rapid changes in the Earth system.
To understand (deep) space and time, models and maps are necessary.

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Systems
The Earth is a System of Systems.
The Flow of Energy Drives the Cycling of Matter.
Life, including human life, is influenced by the environment.
Physical and chemical principles are unchanging and drive both gradual and rapid changes in the Earth system.
Energy
Climate changes in the Earth system are improved through observation, theoretical studies, and modeling.
Bigger Ideas and the Next Generation Science Standards

There are a number of sets of ideas that frame NGSS, and the highest level of these are the three dimensions from A Framework for K-12 Science Education. Each dimension is defined by a set of concepts, topics, or practices and the defining set of concepts. The different names of the framing ideas for the dimensions is revealed in their coloration on the Rainbow Chart. The Crosscutting Concepts are more similar in coloration than are either the Science and Engineering Practices or the Disciplinary Core Ideas (DCIs). The Science and Engineering Practices reflect the nature of scientific inquiries that undergird the Overarching Questions and the Models Bigger Ideas. Each of the DCIs is individually connected to all of the Bigger Ideas. This suggests that the DCIs are not based upon a definition similar to the definitions used in crafting the literacy Principles or as our set of Bigger Ideas. The DCIs are more akin to the topic used to structure a textbook rather than the ideas used to define the different literacies. Four sets of DCIs are included in NOSS: Physical Sciences, Life Science, Earth & Space Sciences, and Engineering & Technology.

Explore Bigger Ideas further at:
http://virtualrainbowchart.org/big-ideas.html

3 Thinking, Fast and Slow (Ch. 10). Macmillan. Kindle Edition

Bottomline ideas stated at multiple depths:

Here the Bigger Ideas are stated at different depths - a "kickstart" of a single word, at the sentence level, and in a short paragraph. We have described each idea in more detail in our series of regionally focused The Teacher Friendly Guide to the Next Generation Science Standards (K-12). Of course, many books have been written about each idea, and entire scientific careers may be based upon one or more of them and the interplay amongst them. Stating them as a single word in the form of an idea’s nickname is intended to reduce the demands on working memory. This matters, as Daniel Kahneman notes, "because anything that occupies your working memory reduces your ability to think." 1

How might I use Bigger Ideas in Instruction?

A simple idea is to have learners describe how a particular activity demonstrates (or is otherwise connected to) one or more of the Bigger Ideas, and to draw connections between ideas and the topic or field under study.