

Ocean Science Concept Mapping: What do People need to know about Ocean Sciences

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Abstract: While attempting to infuse more ocean science research into K-16 classrooms, museums and aquaria, the New England Regional Center for Ocean Sciences Education Excellence (NER-COSEE) is focused on identifying excellent examples of ocean science education. However, without a “map” of ocean sciences, it is difficult or impossible to meet the needs of both the research and education communities. Therefore, we are using a combination of surveys, small working groups, concept mapping strategies, and collaboration across the ocean science community to produce a simplified web of age appropriate ocean science concepts along with excellent examples of how to teach these concepts.

Ocean science education (OSE) communities are struggling to embrace National Research Council guidelines and recommendations for infusing inquiry-based learning into our classrooms. At the same time, the community must embrace state and national science standards. OSE curricula vary tremendously, and furthermore are in flux, making it difficult to reach a consensus on the key concepts to be conveyed. This lack of consensus impedes efforts to define what constitutes strong OSE, erodes efforts to implement OSE in various settings (perceived as “weak”), and makes it difficult to develop science standards based on OSE. Based on community input, our goal is to define fundamental science concepts

that can be revisited by students at various educational levels (K-16 and beyond) with age and developmentally appropriate activities, examples, and detail. Students gain a deep understanding of science concepts when they approach the concepts from various perspectives, revisit the concepts at increasingly sophisticated levels, and are presented many examples of the same concepts (Donovan, Bransford, and Pellegrino (Eds), 1999. *How People Learn*, National Academy Press).

OSE is often organized around subject area (observation: most ocean science texts include 26 +/- 2 chapters) rather than a small number of central concepts. Our hypothesis is that the OSE community can agree on a limited number of “key concepts” that define good OSE curriculum and standards.

Through a series of surveys, we have identified the following 8 Key Concepts:

I.) WAYS OF KNOWING

(Scientific Method, Observations, Technology, Informatics, Habits of Mind, Faith) “Reflection on how we know what we believe will help our understanding”

II.) HUMAN INTERACTIONS

(Sustainability, Ocean Policy and Management,

Human Health) “Currently, the human species is significantly affecting earth systems, but has the ability to choose its relationship with the environment”

III.) ECOSYSTEMS

(Biological Communities, Population Ecology, Habitats) “The survival and health of individuals and groups of organisms are intimately coupled to their environment”

IV.) EARTH SYSTEM SCIENCE

(System Properties, Oceanography, Atmospheric Science, Earth Science) “The Earth as a whole acts as a complex set of interacting systems with emergent properties”

V.) EVOLUTION-BIODIVERSITY

(Species Diversity, Natural Selection, Biogeography) “Evolution explains both the unity and diversity of life”

VI.) ENERGY FLOW AND TRANSFORMATION

(Forms of Energy, Thermodynamics, Conservation of Energy, Energy Use, Motion) “Energy

transformations drive physical, chemical, and biological processes. Total energy is conserved and flows to more diffuse forms”

VII.) CONSERVATION OF MASS

(Input/Output Models, Elemental Cycles, Hydrological Cycle, Stoichiometry, Equilibrium) “Mass is conserved as it is transferred from one pool to another”

VIII.) SPATIO-TEMPORAL RELATIONSHIPS

(Geospatial Position, Mapping, Historical Trends, Coordinate Systems) “Choosing the appropriate reference frame is the key to understanding one’s environment.”

We will discuss our progress on mapping these concepts to state and national frameworks, and identifying exemplary curricula and activities for all ages.