

Resource

COSEE-Ocean Systems: *Interactive Software Developed Through Iterative Feedback Processes*

The Center for Ocean Sciences Education Excellence (COSEE) – Ocean Systems (OS) has developed a suite of multimedia tools designed to enhance the teaching of ocean and climate science. In two linked applications – the Ocean Climate Interactive (OCI) and Concept Map Builder (CMB) (described in Section I below)- concept mapping is used as a foundation for learners to make connections between fundamental concepts in ocean and climate science. Section II of this document describes how these cost-free online tools have been incrementally developed, tested, and refined over the course of a series of teacher/scientist professional development workshops to maximize their efficacy. These tools are meant to supplement their education and outreach efforts to help them more effectively reach their target audiences, and the results of post-workshop evaluations are shared in Section III. Use of both the OCI and CMB further ocean science literacy by emphasizing the connections between the ocean and climate systems, and surpass traditional concept mapping software by connecting users directly to scientific content.

I) Online Interactive Tools

The OCI (Section A) began as a concept map developed by research scientists and was later translated into an on-line flash application, and its dynamic graphical user interface encourages exploration of linked science concepts. Users have access to a vetted database of news resources, lesson plans, videos and images. The CMB (Section B) allows users to create personalized concept maps that can be used as teaching resources in the classroom. Users can attach assets from the OCI database to transform their concept maps into interactive multimedia teaching or presentation tools. Scientists and educators are trained to use the tools during COSEE "Scientist-Educator Collaborative" (SEC) workshops.

A) Ocean Climate Interactive (<http://cosee.umaine.edu/tools>)

The Ocean Climate Interactive is a flash-based interactive database of resources for climate and ocean science education, displayed through a graphical user interface that emphasizes connections between related concepts. The OCI interface features fundamental concepts in ocean/climate science, and related sub-concepts. Hovering over the concepts reveals arrows linking the concepts together, and inviting the user to explore multiple areas, and promoting systems thinking. It was created to help users to “map” ocean topics to educational standards, and bring the relevance of the oceans to classrooms, helping learners better understand the context of the oceans in both the earth and solar systems.



Figure 1: The Ocean Climate Interactive

The OCI interface (Figure 1) consists of three distinct "views." Each view describes relationships between the earth's climate and ocean systems at different scales: The *Earth-Sun System View*, *Earth View*, or the *Close-Up View* feature concepts linked to other concepts, sub-concepts, and a multitude of assets. Clicking on one of the concepts in the interactive brings the user to an overview of the topic, along with a collection of resources that they can explore to learn more. Vetted by ocean science researchers, a collection of news articles, videos, images and teacher resources have been assembled that are available for educational use (Table1). These “assets” can be viewed by clicking on concepts, or through a more comprehensive search. The videos feature visualizations of fundamental science concepts (such as the water cycle, upwelling, seasons) that can contribute to student comprehension of complex science topics (Table 2). Images include photographs, scientific data and explanatory graphics.

Assets	Images	Animations	Resources	News	All
Total	699	340	496	577	2112

Table 1. Total number of individual assets in OCI database.

Concept Name	Images	Animations	Resources	News
Biological Pump	90	55	79	85
Climate Change	98	70	106	130
CO2 & Methane	61	32	42	71
Ecosystem Change	81	49	68	105
Fossil Fuels	91	51	55	93
Fossil Record	42	28	38	45
Greenhouse Effect	101	114	97	201
Life	100	72	152	144
Major Storms	93	91	60	86
Sea Level	67	112	65	101
Sun	109	101	98	64
Transport Processes	126	107	79	101
Water Cycle	163	107	145	100
Water Density	87	49	128	103
Water Phase & Properties	87	78	127	91
Grand Total	1396	1116	1339	1520

Table 2. Total number of assets* for each concept plus its sub-concepts.

*Typically, assets are attached to several concepts. Therefore the total number of assets for each concept and subconcept are larger than the actual number of assets in the OCI database.

B) Concept Map

Builder (<http://cosee.umaine.edu/tools>)

The Concept Map Builder (CMB) allows registered users to create their own interactive concept maps (Figure 2). The maps created can be printed, downloaded, shared via email, and displayed in the OCI presentation window. What makes the CMB different than traditional concept map building software is its integration with the OCI database. This allows users to supplement each concept with multimedia assets that are displayed in the OCI interface. It is through this relationship that learners can create concept maps that illustrate ocean climate connections, as well as give educators tools to create lesson plans, presentations or multimedia collections to supplement their curriculum.

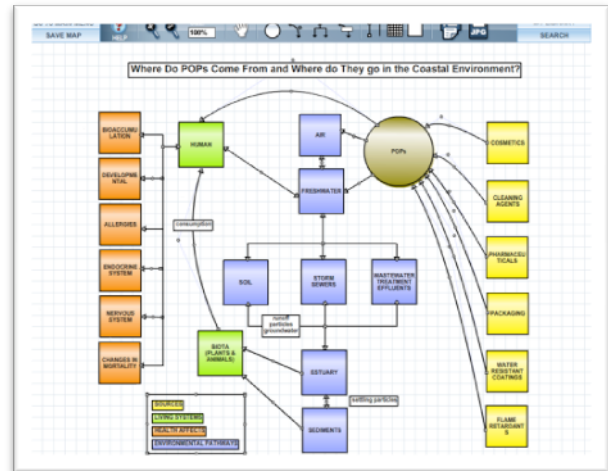


Figure 2: The Concept Map Builder

Traditionally, concept mapping has been used in formal education as an assessment tool. However, COSEE-OS has found that that collaborative concept mapping catalyzes peer-based dialogue, promotes understanding of and consensus around scientific concepts, and is very suited for application to complex and system-scale science. Concept maps can also be used for curriculum development, as presentation aids, and for project planning (e.g., proposal and thesis preparation). Educators and scientists who have participated in SEC workshops have often gone on to use concept mapping in many other unanticipated and novel ways.

Since launching in 2008, more than 1100 concept maps have been created by registered users. The number of maps created each month has increased four-fold since launch, with an average of 63 maps produced each month in 2010.

II) Tool Development

Cycles of development, testing and user feedback have allowed OS tools to keep pace with the growing needs of scientists and educators. Scientists worked with COSEE-OS to design the first OCI user interface in 2005-06 using consensus-based concept mapping as a framework for its design. Subsequently, extensive beta testing by dozens of scientists and formal and informal educators led to the development of the CMB, released in January 2008. Both the OCI and CMB have been extensively tested in COSEE-OS workshops, resulting in periodic releases of new software

versions with additional features or enhancements. On all workshop evaluations, participants are asked specific questions about tool usefulness and features, and their suggestions for further improvements are invited and then subsequently reviewed by OS to determine the direction of future software development.

As new features are developed, the reach and use of the tools has increased over time, with 1007 registered users and 1,144 concept maps created through June 2010. Version 1.2 of the software included the ability to save, share, and print custom concept maps. Today, version 1.6 allows users to search the OS data and save a “library” of assets that can be linked directly to concepts, connect maps together with hyperlinks, preview assets attached to concepts and more easily edit concept attributes. In the summer of 2010, nearly 100 OS workshop participants will be invited to a webinar highlighting how their suggestions were translated into new software features. Such on-line events will allow OS to further engage its user community in the long term.

III) Tool Evaluation

An important goal for COSEE-OS model workshops is to foster high-quality interactions between scientists and educators through the use of concept mapping and the online interactive tools. 91% of participating educators in five SEC workshops agreed that concept mapping helped them think through the science topics they learned during the workshop, and 90% said that concept mapping was a helpful way to share ideas and “build a bridge of communication” with scientists. In post-workshop interviews, an equally high percentage of participating scientists agreed that concept mapping helped them share their understanding of connections with educators.

During the model workshops, both formal and informal educators provided feedback about the usefulness of the OCI and CMB for: finding good education resources, helping create good lessons and/or presentations, and helping their students understand and make connections between ocean and climate concepts (Figure 3). In general, educators’ reactions were very positive. In the Network-wide survey of scientists who had participated in COSEE activities during 2009; of the 25 responding scientists, 72% stated that OS online tools have been “Useful” to “Very Useful” in their efforts.

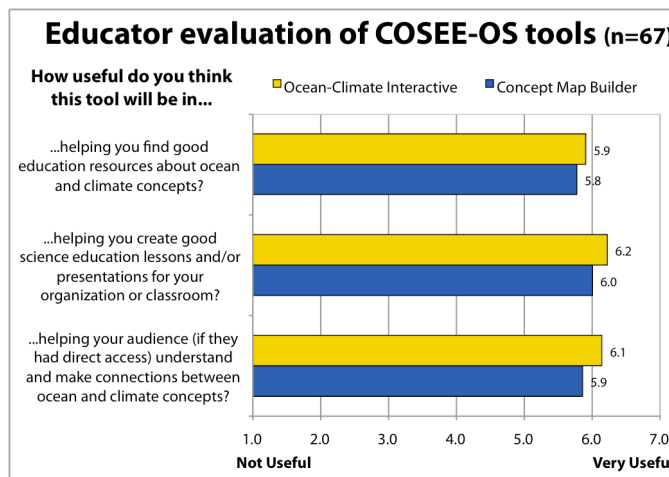


Figure 3: Educator evaluation of COSEE-OS tools. Ratings are an average Likert score on a scale of 1-7.