

Curriculum Supplement Series

Ocean Acidification: A Systems Approach to a Global Problem

In this 3 to 5 week curriculum module, students in high school life and marine science courses use systems thinking and act as interdisciplinary scientists and delegates to investigate how the changing carbon cycle will affect the oceans along with their integral populations.

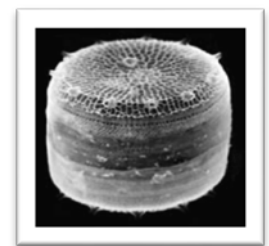
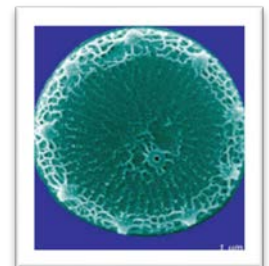
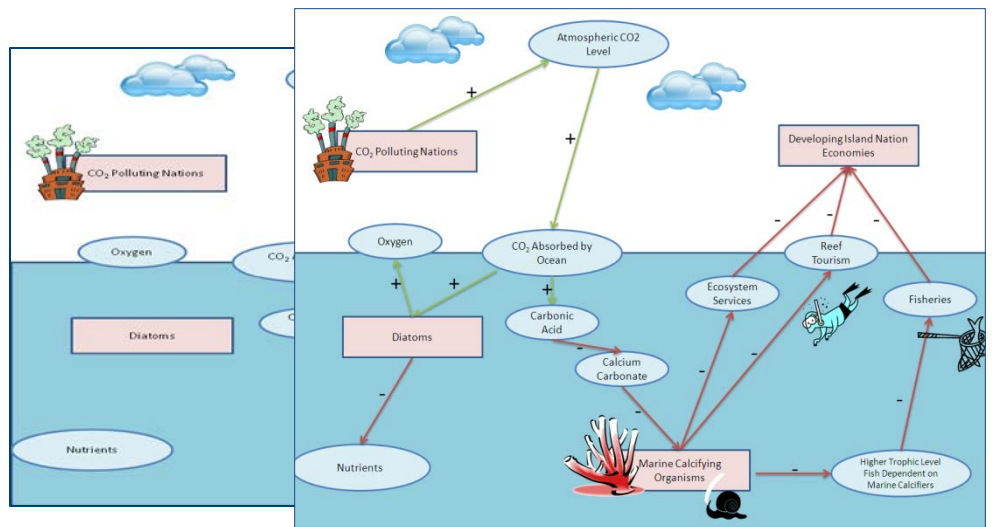
The Baliga Lab at the Institute for Systems Biology in Seattle has been translating its research into user-friendly curriculum modules since 2004. Through forming collaborative teams comprised of scientists, educators, engineers and students, today's research and methods have become hands-on, accessible student activities.

Students closely model what is occurring in laboratories worldwide and at ISB through Mónica Orellana's research, to analyze the effect CO₂ has on ocean chemistry, ecosystems and human societies. Students experiment, analyze public data, and prepare for a mock summit to address concerns. Student groups represent key "interest groups":

- Developed nations which pollute CO₂
- Marine calcifying organisms which are predicted to suffer dramatically
- Marine photosynthesizing organisms, specifically diatoms, which may play a role in CO₂ sequestering and will likely increase growth in a high CO₂ environment
- Island nations and populations which largely depend on ecosystem services that will be threatened by ocean acidification

Students design experiments to observe the effects of CO₂ on seawater pH, diatom growth, algal blooms, nutrient availability, and/or shell dissolution.

Students begin the module by critically assessing 40 different news articles. As a class they combine their findings to develop a network diagram in order to identify the key players they can learn about and experiment with in their classroom. Next they use inquiry to understand the effects and properties of CO₂. They continue by designing a second experiment based on their interest group to further explore how a change in CO₂ has impacted their subsystem. Students model collaborative research by designing and completing cohesive sets of experiments that build off others' experiments. In addition to their own data, students use real-time Puget Sound and worldwide ocean data to predict the response to further disruptions. In the culminating activity, delegates reconvene to present and discuss their findings in reference to the impact on their ocean network. Recommendations are made for scientists, politicians and people as individuals and societies. Students reflect on unanswered questions and on what their individual roles in the networks they have studied are, and how they might change their actions in order to positively impact the network.



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2010 Development Team	2011 Development Team	2012 Development Team
Mari Knutson Herbert , Lynden HS Allison Lee , ISB Aisha McKee , Intern, International School Eric Muhs , Ballard HS, Seattle Danny Thomson , Intern, Ballard HS Alexis Valauri-Orton , UG Intern	Kevin Baker , Intern, Chief Sealth HS Alexis Boleda , UG Intern Mari Knutson Herbert , Lynden HS Holly Kuestner , UG Intern Allison Lee , ISB Jocelyn Lee , Intern, Garfield HS Eric Muhs , Ballard HS, Seattle Olachi Oleru , Intern, Garfield HS Jia Hao Xu , Intern, Eastside Prep	Meredith Carlson , Intern, Nathan Hale Donald Chao , Intern, Newport HS Steven Do , UG Intern Jennifer DuncanTaylor , Port Angeles HS Mari Knutson Herbert , Lynden HS Allison Lee , ISB Raisah Vestindottir , Intern, Garfield HS Michael Walker , Olympic HS, Bremerton
2013-2015 Development Team		
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2010 - 2013 Field Test Teachers		
Jennifer DuncanTaylor , Port Angeles HS Kim Kaufman , Sammamish HS, Bellevue Bill Palmer , Sammamish HS, Bellevue Christian Reilly , Santa Catalina HS, CA David Streib , Roots Public Charter, WaDC	Mari Knutson Herbert , Lynden HS Suzanne Reeve , Sammamish HS, Bellevue Christine Lauer , Woodstock HS, Georgia Stephanie Durrant , HS3, Highline SD	Lisa George , Sammamish HS, Bellevue Michael Walker , Olympic HS, Bremerton Jean Ingersoll , Glacier Peak HS, Snoqualmie Ivy McDaniel , Chicago Public Schools, IL

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