

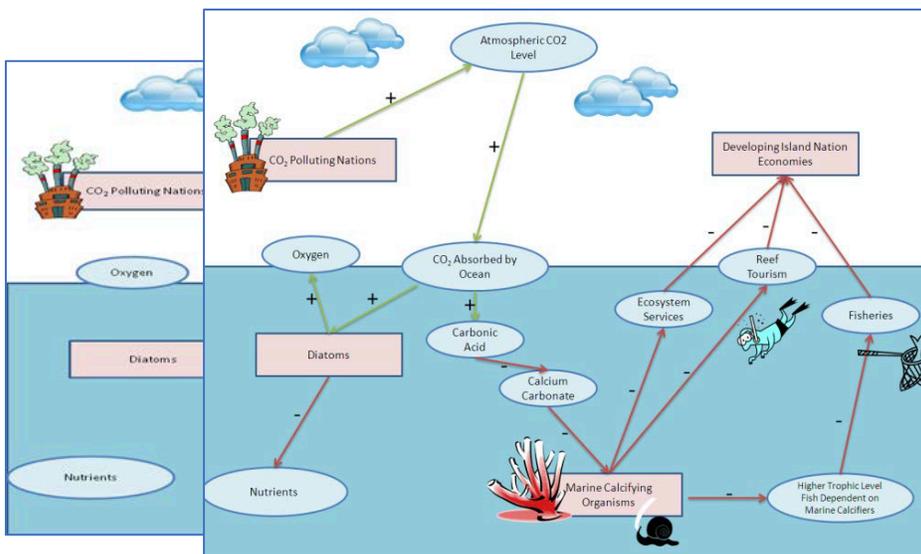
Curriculum Supplement Series

Ocean Acidification: A Systems Approach to Global Problem

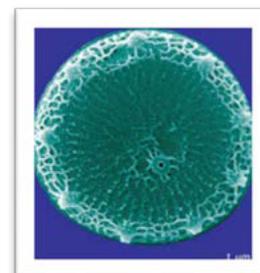
In this 3 to 5 week curriculum module, students in high school life and marine science courses use systems thinking and act as interdisciplinary scientists and delegates to investigate how the changing carbon cycle will affect the oceans along with their integral populations.

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":

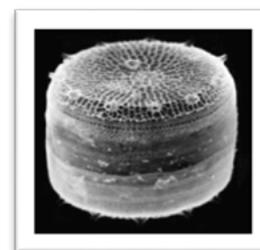


- Developed nations which pollute CO₂
- Marine calcifying organisms which are predicted to suffer dramatically
- Marine photosynthesizing organisms, specifically diatoms, which may play a role in CO₂ sequestering and will likely increase growth in a high CO₂ environment
- Island nations and populations 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.



Ocean Acidification: A Systems Approach to a Global Problem

Principal Investigator	Education Director	Co-Principal Investigator
Dr. Monica V. Orellana, ISB	Claudia M. Ludwig, ISB	Dr. Nitin S. Baliga, ISB
2010 Development Team	2011 Development Team	2012 Development Team
Mari Knutson Herbert , Lynden HS	Kevin Baker , Intern, Chief Sealth HS	Meredith Carlson , Intern, Nathan Hale
Allison Lee , ISB	Alexis Boleda , UG Intern	Donald Chao , Intern, Newport HS
Aisha McKee , Intern, International School	Mari Knutson Herbert , Lynden HS	Steven Do , UG Intern
Eric Muhs , Ballard HS, Seattle	Holly Kuestner , UG Intern	Jennifer DuncanTaylor , Port Angeles HS
Danny Thomson , Intern, Ballard HS	Allison Lee , ISB	Mari Knutson Herbert , Lynden HS
Alexis Valauri-Orton , UG Intern	Jocelyn Lee , Intern, Garfield HS	Allison Lee , ISB
	Eric Muhs , Ballard HS, Seattle	Raisah Vestindottir , Intern, Garfield HS
	Olachi Oleru , Intern, Garfield HS	Michael Walker , Olympic HS, Bremerton
	Jia Hao Xu , Intern, Eastside Prep	
2013-2015 Development Team		
Dexter Chapin , Seattle Academy	JoAnn Chrisman , ISB	Gabriel Cronin , Seattle Academy
Megan DeVault , Central Kitsap HS	Jennifer DuncanTaylor , Port Angeles HS	Anna Farrell-Sherman , Intern, Ingraham
Kedus Getaneh , Intern, Bishop Blanchet	Eric Grewal , Intern, Monroe HS	Helen Ippolito , Intern, Garfield HS
William Harvey , ISB	Mari Knutson Herbert , Lynden HS	Dina Kovarik , ISB
Jeannine Sieler , Bellevue High School	Zac Simon , ISB	Barb Steffens , Shorecrest HS
2010 - 2013 Field Test Teachers		
Jennifer DuncanTaylor , Port Angeles HS	Mari Knutson Herbert , Lynden HS	Lisa George , Sammamish HS, Bellevue
Kim Kaufman , Sammamish HS, Bellevue	Suzanne Reeve , Sammamish HS, Bellevue	Michael Walker , Olympic HS, Bremerton
Bill Palmer , Sammamish HS, Bellevue	Christine Lauer , Woodstock HS, Georgia	Jean Ingersoll , Glacier Peak HS, Snoqualmie
Christian Reilly , Santa Catalina HS, CA	Stephanie Durrant , HS3, Highline SD	Ivy McDaniel , Chicago Public Schools, IL
David Streib , Roots Public Charter, WaDC		