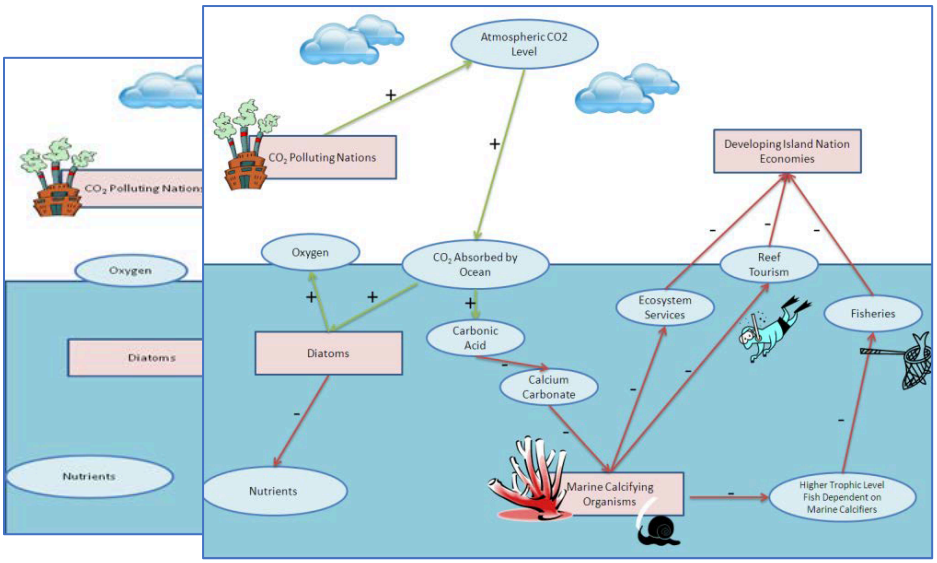
Curriculum Supplement Series

Ocean Acification: A Systems Approach to Global Problem

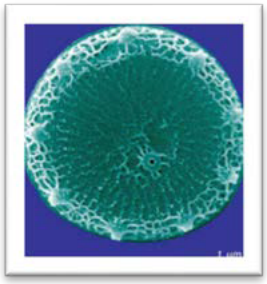
ISB Systems Education Experiences

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.

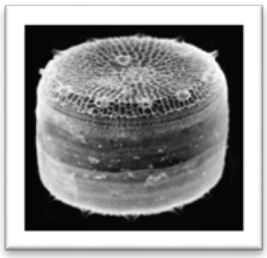
The Baliga Lab at the Institute for Systems Biology in Seattle has been translating its research into user-friendly curriculum modules since 2004. Through forming collaborative teams comprised of scientists, educators, engineers and students, today's research and methods have become hands-on, accessible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



Students closely model what is occurring in laboratories worldwide and at ISB through Mónica Orellana's research, to analyze the effect CO_2 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 CO_2
- Marine calcifying organisms which are predicted to suffer dramatically
- Marine photosynthesizing organisms, specifically diatoms, which may play a role in CO_2 sequestering and will likely increase growth in a high CO_2 environment
- sland nations and populations which largely depend on ecosystem services that will be threatened by ocean acidification



Students design experiments to observe the effects of CO_2 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 CO_2. They continue by designing a second experiment based on their interest group to further explore how a change in CO_2 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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Photos: genome.jgi-psf.org/Thaps3, www.pnas.org/content/105/5/1391/F1.expansion.html