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| **Title of Unit** | Predicting the Biological Impact of Climate ChangePredicting the Biological Impact of Climate Change |
| **Date and Approach for Unit Development** | July 2013 NANCI  |
| **Unit Developers & Contact Information** |  **Ecology Team**Nancy Auer (Michigan Technological University)Annika Moe (University of Minnesota)Beth McHenry (MBeth BastiaansShannon HowardKate Warpeha  |
| **Context** | This unit is designed for a 100 level non-majors intro biology course. We assume a 50 minute lecture period, but have included a series of extensions that teachers may use to expand the unit to a longer class period or multiple class periods. This would be the start of larger unit on global climate change near the end of the course. Students will already be familiar with graphing, the scientific method, and peer review. This activity is especially effective in a discussion section, but can be adapted to use in a lecture. |
| **Abstract** | Brief description of the unit and overall teaching approaches. |
| **Learning Goals & Outcomes/Objectives** | **Goal(s)**: what students will know, understand, and be able to do; includes content knowledge, attitudes, & skills (i.e. “understand natural selection;” “appreciate the role of biology in society;” “think like a scientist” | **Desired Outcome(s)/Objectives(s)**: specific student behaviors or performances that will indicate they have successfully accomplished the goal(s) |
| Students will understand scientific data and applyit to their understanding of climate change. | * Describe a trend based on a graph.
* Predict a biological impact of climate change and formulate a testable hypothesis and research plan.
* Draw a graph representing hypothetical data.
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| Students will apply the scientific method. | * Predict a biological impact of climate change and formulate a testable hypothesis and research plan.
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| **Incorporation of Scientific Teaching Themes** |
| **Active Learning**1) Jigsaw activity2) Peer-review/writing on boards3) Group discussions | **Assessment**How teachers will measure learning; how students will self-evaluate learningformative: *students -* 1) Read a graph and identify the trend - peer group will provide feedback through discussion2) Create a hypothesis or prediction - peer group will provide feedback through discussion3) Plan a rigorous hypothesis test (identifying variables and basic study design) - peer group will provide feedback through discussion; additional students will review the plan via written questions*teacher* - 1) Teacher will assess hypothesis test by viewing boards (some or all as practical)2) Teacher will assess peer feedback by viewing student questions written on boards (some or all as practical)Summative: 1) LRQ (learning readiness quiz) completed online2) Teachers will collect and assess assignments consisting of the individual student's revised prediction, hypothesis test, and predictive graphs | **Diversity**How the unit is designed to include all participants1) Goal framed openly, allowing for a diversity of pre-existing opinions and experiences2) Group discussions3) Diversity of activities for different learning styles |
| *Instructor preparation:*Write a LRQ (learning readiness quiz) covering carbon cycle and greenhouse effect. The quiz could also review graphing and scientific method concepts taught earlier in the semester.Establish a system for sorting students into a jigsaw.Distribute graphs for students to view (one per student; equal numbers of students view each graph).If whiteboards are not available in the classroom, provide students with whiteboard "slates," or paper and post-it notes. *Activities in class:*Listen to “A Song of Our Warming Planet” by Daniel Crawford YouTube video andexplain its relationship to real data. *Time: 5 minutes* http://www.youtube.com/watch?v=5t08CLczdK4*Activities during tidbit*:* 1 Each student receives one of four graphs. Students at the same table receive the same graph. *Graphs include:* atmospheric CO2, temperature, ice cover, atmospheric oxygen
* As a group, students identify and describe the trend they see in one sentence. Each student writes it down on her/his graph. (Discussion in groups only – students do not report out.) *Time: 5 minutes*
* *Jigsaw:* At the start of class each student received a number or color, etc. Students form new groups, and all graphs are represented in the new groups .
* Ask students to share the one-sentence trend they discovered in their first group.

*Time: 2 minutes** Ask students "How might living organisms be affected by one or more of the observed trends? Brainstorm at least two hypotheses as a group."
	+ An example you can give: maple syrup production in Canada will increase as temperature increases and the maple tree range shifts further northward.
	+ A "Challenge example" is to combine trends: An increase in CO2 in addition to temperature will further increase maple syrup production do to increased carbon uptake by plants.
	+ remind them: X-axes may not have the same time range.
	+ also remind them: hypotheses don't necessarily have to be negative.

*Time: 10 minutes* * Consider your hypotheses. As a group, choose one that could be tested. On the board, write your hypothesis and a brief description of how you would test it. remind them to include:

Which variables would you measure? What existing data (satellite images, ice *cores, .gov sites, etc.) could you use?**Time: 15 minutes** *Group feedback:* Rotate one position to the left. On the board, in a different color, provide written feedback only in the form of questions.

*Student time 8 minutes** As a group, students review the feedback they received and discuss revisions to their research plan.
* Each student takes notes on the revised research plan and keeps it for a homework assignment.

*Time: 8 minutes**post tidbit activity:*individual out of class assignment:* Using the research plan you composed in class, draw a graph of hypothetical data that:

a.Would support your hypothesis.b.Would not support your hypothesis.* In no more than 200 words, summarize your hypothesis and revised research plan.
* Submit your summary and both of your graphs.
 | *Pre-assessments:*\*LRQ (learning readiness quiz) completed online*Post-tidbit assessments:*\*Teachers will collect and assess assignments consisting of the individual student's revised prediction, hypothesis test, and predictive graphs |  |

Sample Presentation Plan (detailed schedule with approximate timing for unit)

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| **Session 1** |
| *Preclass* | •Students read sections on the carbon cycle and greenhouse effect from their textbook.•Students take an online LRQ (Learning Readiness Quiz).  |
| *Enter approx. class time for learning activity**preparatory**material presentation* | * Write a LRQ (learning readiness quiz) covering carbon cycle and greenhouse effect. The quiz could also review graphing and scientific method concepts taught earlier in the semester.
* Establish a system for sorting students into a jigsaw.
* Distribute graphs for students to view (one per student; equal numbers of students view each graph).

If whiteboards are not available in the classroom, provide students with whiteboard "slates," or paper and post-it notes.  |
| *Enter approx. class time for learning activity #1* |  |
| *Enter approximate time for additional learning activities and associated class**Work/preparatory materials* |  |  |  |
| *Enter approximate time for post-activity summing up or transition* |  |  |  |

*Add additional activities information as needed for the unit.*

Resources for Teaching the Unit

*(other files and information needed/helpful to teach the unit, including files for papers from which original data for class activities is taken, supporting information for the instructor, handouts, in class activities materials, assessments with answer keys, homework assignments, etc.)*

Summary of Origin of the Idea

*(How did you come up with this idea? Where did you get the inspiration?)*

Effectiveness of unit components (if you have used it or part of it in your own teaching)

Summary of Feedback

Acknowledgements

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