Implementation Plan and Teaching Notes

**Context for Use**

**Instructor**: Carissa Ganong

**Department/Institution**: Department of Biology, Missouri Western State University  
**Audience Level**: Undergraduate

**Undergraduates**: Majors

**Instructional Setting**: Lecture/Lab

**Number of Students**: 30

**Dates of implementation**: March 1-April 26, 2023

**OCELOTS Module Title**: Healing the scars: Tropical rainforest carbon cycling  
  
**Link to Module on Gala**: <https://www.learngala.com/cases/tropical-rainforest-carbon-cycling/>

**Learning Goals of Module:**

* Explain how the processes of photosynthesis and respiration determine carbon stocks in plant biomass.
* Compare how different tree species differ in their carbon cycling (plant-level carbon cycling).
* Describe the processes that influence global carbon cycling.
* Explain how streams contribute to rainforest carbon cycling.

**Pedagogical techniques used**:

I covered the basics of carbon cycling in lecture, incorporating worksheets from the “Plant- to global-level carbon cycling” section of the module. Part of the following classes included addressing the four topics listed above via discussion of module units, use of a worksheet included in the module, and discussion/interpretation of data from an additional paper. I implemented the module over parts of six class periods, with topics covered as follows. Instructors should set aside ~30 minutes for each of these activities, with 40-45 minutes for the final class.

(1) Before beginning the module, I presented the basics of the carbon cycle to the class. Next, students worked in pairs to complete the “Photosynthesis and Respiration” worksheet, which we then discussed as a class. Over the next four classes, students read units of the module prior to class and we discussed each unit as follows.

(2) The “Background: Why Do We Care?” unit, which established the relationship between carbon cycling and tropical conservation.

(3) The “Conceptual Framework and Hypotheses” unit, which provided more detailed information on carbon-cycling processes and hypothesis development.

(4) “The Experiment” and “Methods” (study system and experimental design).

(5) “Results” (data interpretation).

(6) In the final class, the class discussed “Bringing Home the Global Carbon Cycle: Human-Environmental Interactions” (discussion/application of results). Additionally, I presented the concept of aquatic as well as terrestrial systems. See below for information about this adaptation.

**Adaptations made or parts used if the entire module was not used**

* I added a brief explanation of stream carbon fluxes and their role in landscape-level carbon cycling. The class examined, interpreted, and discussed the ecological implications of four figures (2-4 and 7) from a published paper describing stream carbon flux in the same rainforest in which the research for this module was conducted (Marzolf et al. 2022, “Partitioning inorganic carbon fluxes from paired O2–CO2 gas measurements in a Neotropical headwater stream, Costa Rica,” *Biogeochemistry*; <https://doi.org/10.1007/s10533-022-00954-4>).

**Supplemental materials created**

* I added a brief discussion about carbon cycling in streams; see the attachment “Stream carbon cycling teaching notes” for a guide to this discussion.

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**Assessments**

* Student comprehension of key concepts in the module and the Marzolf et al. 2022 paper was assessed by questions (mostly multiple-choice, two short answer) on weekly quizzes and on the final exam.

**Changes Made (If any)**

* I did not change the module itself, although I did add a discussion focused on carbon cycling in aquatic systems.
* This change/addition was not absolutely needed, but I think it was a good addition that gave students a broader view of carbon cycling processes at the ecosystem level and also enhanced students’ awareness of the importance of aquatic systems in landscape-level biogeochemical cycles.

**Teaching Notes**

1. Overall, how did your implementation go?

Overall, the implementation went well: the information in the module was presented clearly and logically, and students seemed genuinely interested in the concepts and engaged in the worksheet and discussions.

1. What was the prep like?
   1. How much time went into prep? I spent ~30-60 minutes per class period preparing for the discussion.
   2. Did you have to do any prep ahead of implementation?

Yes; I reviewed the material from each unit, noted key points to emphasize in class discussions (and subsequent assessments), and planned discussion questions to ask the class. For the final class, I also planned which concepts to introduce prior to paper discussion and which parts of the paper to incorporate into the class discussion.

1. What feedback (positive or negative), if any, did you get from your students about this experience?

Many students commented favorably on this series of activities/discussions.

1. What do you wish you’d known before you ran the activity?

N/A

1. Do you plan on continuing to use this module in your future courses?

Yes; this module is a useful way to demonstrate application of a key ecological concept (carbon cycling) to conservation.

1. What would you do differently if you were to implement this module again?

(1) I would provide more time for discussion and a more structured discussion format – for example, have students discuss specific questions about the module in small groups, then report back to the class.

(2) I would also use lab time to have students work through the modeling activities provided.

(3) In the review session prior to the final exam, I would review/emphasize specific misconceptions about photosynthesis and respiration.

1. How does this activity fit in your overall course curriculum?

It fits in well and links the concepts of biogeochemical cycling and tropical rainforest conservation.

1. In what ways, if any, did you modify your teaching practice with this activity?

This is the first time I have included an independent online module in a class, so the entire implementation was a new teaching practice for me.

1. Is there anything else you would like to make note of?

N/A