

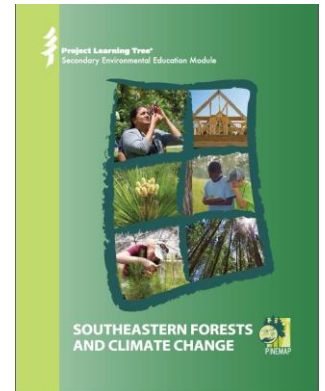
# Measuring the Effectiveness of Educational Materials on Climate Change and Forests

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## Introduction

A new resource for secondary teachers, Southeastern Forests and Climate Change, has been developed through a partnership between the University of Florida (UF) and the national environmental education program Project Learning Tree® (PLT). The module includes 14 activities that focus on climate change impacts on southeastern forest ecosystems; strategies for managing forests in an uncertain climate; life cycle assessment to explore how consumers can affect atmospheric carbon; and opportunities to practice data analysis, critical thinking, and systems thinking skills in the context of forests and climate change. It is based on Pine Integrated Network: Education, Mitigation, and Adaptation project's (PINEMAP) research framework.



## Objectives

To test the usefulness and effectiveness of this module, the team conducted a formative evaluation during fall 2013. Formative evaluation is used to improve programs by pilot-testing materials with intended audiences and incorporating their feedback into the final document (Ernst et al., 2009). The formative evaluation plan was developed with input from the PINEMAP/PLT Education Advisory Committee (n=5) and designed to answer the following questions:

- What are teachers' perceptions of the secondary teaching module? How can the activities be improved?
- What are teachers' perceptions of the online training resources? How can the online training resources be improved?
- To what degree did students meet the activity objectives?
- To what extent did these activities change students' knowledge, skills, and attitudes?

## Procedure and Instruments

After approval from the Institutional Review Board at UF, an invitation was sent through several email lists to recruit pilot testers. From the 123 applicants, 64 teachers were selected to represent regional and grade-level diversity. Twenty-eight teachers (46.4% from high schools and 53.6% from middle school) agreed to use two activities and complete the online teacher evaluation form. Although the activities are designed for high school students, we involved middle school teachers in the pilot test and asked them how they would adapt the material for their students. Thirty-six high school teachers agreed to use four activities, complete the online teacher evaluation form, and involve their students in pre- and post- activity surveys. Teacher evaluation forms were developed, reviewed by 10 experts, revised, and pilot tested with 2 teachers. Student pre- and post-tests were developed, reviewed by 9 experts, revised, and pilot tested with 89 students who participated in the UF's Center for Precollegiate Education and Training Student Science Training Program over the summer of 2013.

## Results

Forty-four pilot testers completed their evaluation forms, and about half (53%) of the teachers used the activities in environmental science or advanced placement (AP) environmental science classes. About 15% used the activities for middle school integrated science classes and 14% used the activities in biology and AP biology classes. About 10% used the activities in earth science classes. The remaining teachers (8%) used the activities in courses such as land resources, economics, ecology, and environmental issues and investigation (Figure 1).

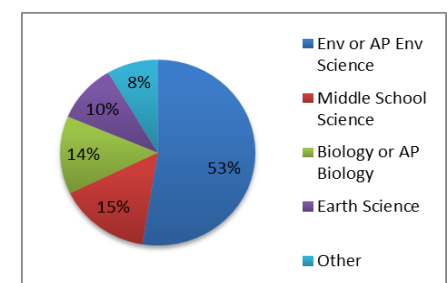


Figure 1. Course distribution of responding teachers

**Teachers' Perspectives** The pilot testers were from Florida (45%), Kentucky (16%), Virginia (14%), Arkansas (11%), North Carolina (9%), and Georgia (5%). They provided positive comments about the organization and detail of the materials and online supplemental resources. About 90% of high school teachers said the activity they pilot tested was ready for classroom use. On average, high school teachers agreed that their students were able to meet the activity's stated objectives ( $Mean=4.27, SD=0.78$  on a scale of 1 to 5, with 5 = strongly agree) and the activity procedure was appropriate for their students ( $Mean=4.27, SD=0.80$ ). As expected, data from middle school teachers suggests that the activities were more challenging ( $Mean=3.76, SD=1.2$ ) and the students were slightly less able to meet stated objectives ( $Mean=3.91, SD=0.90$ ) as compared to high school students. Pilot testers indicated that the online training resources and module website effectively prepared them to use these activities ( $Mean=4.58, SD=0.58$ ) and built their confidence to teach about climate science topics ( $Mean=4.54, SD=0.56$ ). The results of the formative evaluation suggest that these activities are written in an appropriate tone and provide sufficient background information for high school teachers to effectively use them in their classrooms. Nevertheless, most teachers also provided comments to improve the activities.

**Student Learning** Dependent t-tests were employed to compare pre- and post-tests. We grouped the activities into 4 packages in order to measure changes in different learning outcomes. Data suggest that there was a significant increase in knowledge of forest management, carbon cycle, life cycle assessment and externalities, and the role of forests in mitigating climate change. Hope concerning climate change was significantly improved among all packages. Decision-making skills about consumption and systems thinking skills were significantly increased among students who received the packages that featured these skills (Table 1).

Table 1. Dependent t-tests results from students' pre- and post-tests

Learning Outcome	Pre-test Mean (N)	Post-test Mean (N)	T
Knowledge of forest management, carbon cycle, and the role of forests in mitigating climate change	4.61 (238)	6.33 (238)	9.05***
Knowledge of LCA and externalities	2.83 (114)	4.25 (114)	5.97***
Systems thinking skills	2.21(194)	2.40 (194)	2.15*
Hope concerning climate change	58.48 (873)	60.31 (873)	5.93***
Decision making skills	29.24 (174)	30.24 (174)	2.16*

Note: \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

“Thank you for great materials. I have tried a couple of pioneer lessons in the past and this is by far the most organized; having the video clip to show teachers what to do is priceless. Thank you.”

~North Carolina environmental science teacher

## Recommendations and Future Steps

Teachers provided many excellent suggestions for improving the materials. After reviewing the teachers' feedback and recommendations on all the activities, the module development team completed the following overall changes:

- Included an adaptation of each activity for middle school or basic high school students.
- Developed a new introductory activity to connect forests and climate.
- Added comments from teachers about their classroom experience and suggestions.

Many pilot testers indicated that they would like to implement the lessons with future classes and were very pleased with the formative evaluation process. We revised the activities over the spring and summer and launched regional facilitator workshops to introduce the module in fall 2014.

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## Reference

Ernst, J.A., M.C. Monroe, and B. Simmons. 2009. *Evaluating your Environmental Education Programs: A Workbook for Practitioners*. Washington, DC: North American Association for Environmental Education.