

# BULLETIN

FALL 2010

VOLUME 56

NUMBER 3

# PLANT SCIENCE

The Botanical Society of America: The Society for ALL Plant Biologists

ISSN 0032-0919

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## Reports and Reviews

### Planting memories: What students learned about plants from a conservatory field trip<sup>1</sup>

Mary L. Keppler<sup>2,4</sup>, Elisabeth E. Schussler<sup>3</sup>

Done correctly, school field trips extend and enhance the classroom learning experience. In the context of botanical education, local conservatories provide a unique opportunity for students to experience plants. The field trip experience is one that makes a lasting impression on students, and may improve their attitude toward plants. This study used surveys to assess student retention of plant knowledge and attitude toward plants several months after a conservatory visit. The results show that the majority of students not only recalled specifics about plants, but also regarded the event favorably. Students described plants they recalled using several categories such as shape, color, movement, and texture. Results from student feedback were used to make revisions to the program to further increase learning. Teachers and non-formal institutional staff can use the results of this study to build effective botanical education programs, taking into account student perspectives about plants.

**Key Words:** assessment; botanical education; field trip; non-formal; retention; survey

Students need to learn about plants as early as possible so they can discover the origins of their food and understand the basis for all

animal life on our planet. Developing and assessing effective student experiences with plants deserves special attention since most students know little about plants as compared to animals (Uno, 1994; Hallé, 1999; Wandersee and Schussler, 2001; Schussler and Olzak, 2008). The characteristics of plants being static, not having a face, and rarely being viewed as individuals contribute to a general disregard for the producers of our environment despite their importance to everyday life (Hallé, 1999; Wandersee and Schussler, 2001).

Non-formal learning, which can take place at a museum, nature park, zoo, botanical garden, or conservatory, appeals to students on a different level than traditional classroom instruction and can enhance learning by those of varied intelligence levels and abilities (Eshach, 2007; Fraser and Maguvhe, 2008; Melber, 2008). These settings give students a chance to relate practical experiences with what they have learned at school, potentially creating lasting memories and long-term learning. It is imperative that learning outside the formal setting is implemented and studied (Tunncliffe, 2001) because young students identify their out-of-school experiences as the source of most of their botanical knowledge (Tunncliffe and Reiss, 2000; Bebbington, 2005; Falk, 2005).

School field trips bridge non-formal and formal classroom learning, and the most effective field trips provide experiences that reinforce classroom learning. In particular, teacher investment in field trip planning helps to prepare students to be effective learners during the field trip (Lindemann-Matthies, 2002; Tilling, 2004; Bebbington, 2005; Eshach, 2007; Stern, 2008). In a study done in Switzerland, there was a positive correlation between the time teachers spent on preparation activities in class to how much knowledge was obtained out of the classroom (Lindemann-Matthies, 2002). Class time spent talking about the potential of the trip allows students to prepare for their visit and reviewing their experience afterwards promotes retention and synthesizes the experiences with class studies.

Although the total impact of museum and science center visits on student learning is unknown, there is evidence that these visits

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can promote positive attitudes and motivate an interest toward science which can be recalled months later (Stevenson, 1991). Learning from a single visit does not occur only during the event, but is an extended process of compiling observations and information over time (Falk, 2005). Too often, students and visitors are asked what they learned immediately after a science center visit, rather than asking what they understand about the topic months later (Eshach, 2007).

Few published studies contain information about student feedback from field trip experiences; however, it is known that most students enjoy breaks from the typical classroom setting, yet know they are expected to learn during their trip (Eshach, 2007). Some students may find leaving the comfort of school and changing routine to be emotionally taxing. Particular attention needs to be taken to sensitively prepare students for the outing so they can look forward to the experience (Ballantyne and Packer, 2002; Dillon et al., 2006; Eshach, 2007).

Since 2006, students from a primarily suburban town in southwest Ohio have experienced non-formal learning through a field trip program conducted on a local campus. Every fourth grader in the district has had the opportunity to spend two hours in a college laboratory using microscopes to dissect flowers and learn about the basics of sexual reproduction. Additionally, they spent two hours in a conservatory playing a game of plant identification; the goal of the field trip was to expose them to plant diversity and build botanical vocabulary. This fourth grade curriculum focuses on plant biology and is part of the Ohio Department of Education Academic Content Standards for Science (Ohio Department of Education, 2004, p. 11). The content of the field trip correlates to a classroom study that involves experimentation on *Brassica rapa* cv. 'Wisconsin Fast Plant®' (Gladish, 2006).

There are few reports of longer-term post assessments of non-formal programs and how they were used to improve science education programs. The purpose of this study was to assess the field trip portion of the program, with a specific focus on what students learned about plants and their attitudes towards

the trip. Student surveys were used to gather data on long-term content retention and student perceptions. Results support that students recalled specific information about the trip several months after it occurred, but that their learning did not always match the intended outcomes of the experience. The data collected were used to revise the program to facilitate more directed student learning for future field trips.

#### MATERIALS AND METHODS

In 2005, a botanical conservatory with approximately 5,200 square feet of greenhouse space was opened on a regional campus of a public mid-sized university in southwestern Ohio. A native plants garden and prairie grassland occur on the surrounding property (Gladish, 2006). This impressive structure has the potential to enhance the learning of students throughout the area and is currently being used to educate fourth graders in the nearby school district, as well as university students.

The fourth grade students who attend the field trip to the conservatory are enrolled in a large school district located in southwestern Ohio, which serves both urban and rural students. The majority of students are of European descent (78%), 9.4% are African-American, and 6.6% Hispanic, with less than a percent of Asian students, and 5.3% of students from multiracial backgrounds. The majority of the students are from economically disadvantaged homes (57.1%) and 16.4% hold either cognitive and/or physical disabilities. Five percent of students struggle with basic English proficiency skills (Ohio Department of Education, 2008).

From October through December 2008, approximately 700 fourth grade students and their teachers visited the conservatory in groups of about 50 students each day. Students were divided into two groups, one group heading into the conservatory and the other into a science laboratory. Students in the science laboratory were taught about plant reproduction and then dissected Peruvian lilies using dissecting microscopes and a structured worksheet. Students in the conservatory engaged in a question/answer session on plant processes and were instructed on how to play an inquiry-

based game, the goal of which was to accurately describe the features of a specific plant so another classmate could identify the plant (Gladish, 2006). The primary author of this paper assisted with the conservatory portion. After two hours, the students had lunch and then switched locations. By the end of the field trip, each student had dissected a lily in the lab and played the game in the conservatory.

In February and March 2009, a survey (Table 1) was created by the primary author and administered to students by the science teachers of each class. Depending on when the student visited the conservatory, the time from visit to assessment ranged from three to five months. Every student who visited the conservatory had the opportunity to fill out a survey. The science teachers were provided with instructions on how to administer the survey and the students took the survey during normal class time; the primary author was not present in the classrooms when the students took the surveys. An open response questionnaire for the science teachers of these students was posted online during the same time period. All data collection procedures were approved by the university's human subjects review board.

The surveys asked students to recall how they felt about the field trip experience, to describe a plant they saw at the conservatory, and what they learned on the field trip. The survey also included questions to identify students' favorite aspects of the trip and what students would like to do on a future visit. The structure of the survey included both forced choice and open response questions. The responses to the forced choice questions were chosen based on the activities performed during the trip and those that elicited the most excitement from the students during their visit (e.g., the desert room was the topic of many student conversations when waiting for the bus, and the clicker game was mentioned in thank-you letters). Students could select multiple responses on the forced choice questions.

Every science teacher in the district returned student surveys to the author, resulting in 100% participation of the elementary schools. Student surveys and teacher questionnaires

were analyzed by compiling frequencies of each forced choice response and sorting the open responses of students into categories. Student descriptions of plants they remembered often listed several characters, and these were sorted separately from each other. The primary and secondary author independently identified categories from the data to increase validity of the results. Disagreements in categories were resolved through discussion.

## RESULTS

A total of 560 student surveys were completed and returned. Twenty-seven surveys were disqualified because the students had not attended the field trip, so 533 surveys were used for the results. Six of fourteen science teachers returned the teacher questionnaire.

Student attitudes towards the field trip were assessed through questions 3, 4, 5, and 8. The results of the student survey revealed that 92% of students liked visiting the college; 47% of students had never been to a college before. The most common student response about leaving the school was being happy and excited with 79% of students marking these emotions, however, a significant number of students (35%) were scared, nervous, or sad about leaving school. The majority of students, N=419, responded that they like learning about plants.

When asked to describe a plant they saw at the conservatory (question 7; open response), students overwhelmingly focused on shape and color, or tried to name a specific plant. Many students used several different types of descriptors for the plants they recalled, but overall, 93% of students (N=497) could describe a plant from the field trip using characteristics such as shape, color, type of movement (if observed), and texture. As shown in Figure 1, students chose different ways to describe what they remembered, most using shape, or morphology, (N=224 of the students) to describe plants such as "big," "tree," "spiky," and "tall." The following plants were named specifically; Venus fly trap (18%), the sensitive plant (15%), cacti (11%), and cotton (4%). 37% of students (N= 307) used color (such as the words "green," "purple," "pink," "white," "red," "yellow," or "brown"). Responses (N=111) that fell into the action category included words such as "move,"

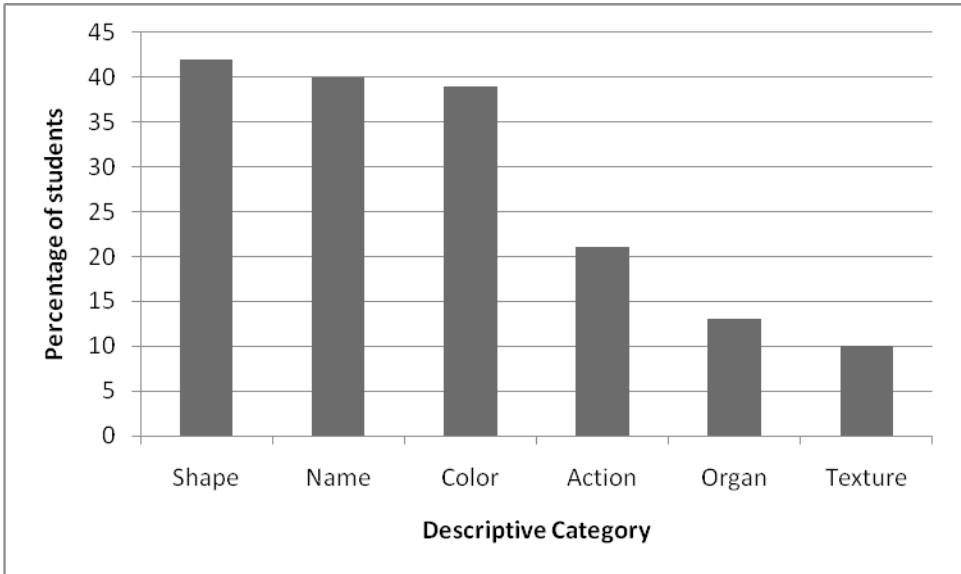


Figure 1. Student responses to question 7; “describe a plant you saw at the conservatory,” grouped into the most frequent descriptive categories.

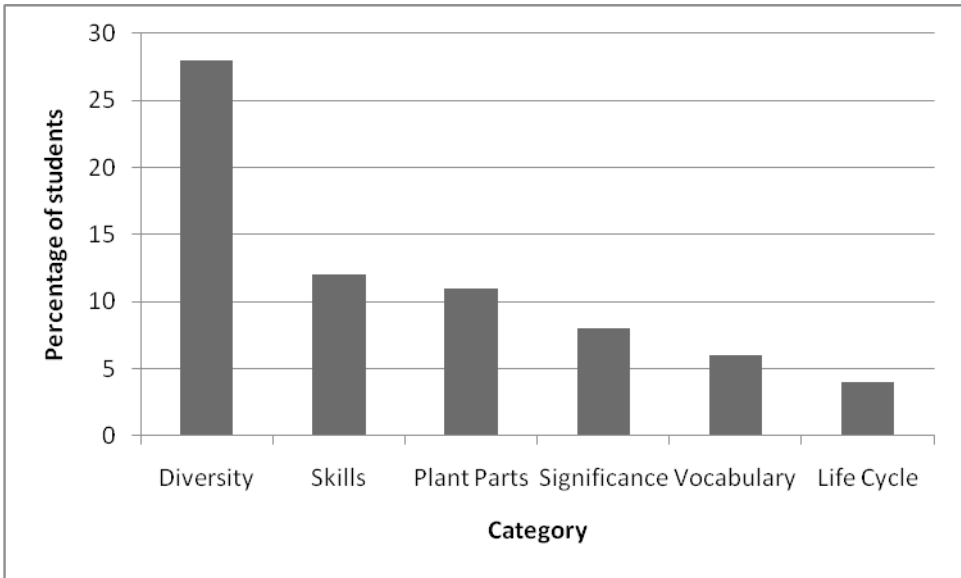


Figure 2. Student responses to question 9; “what did you learn on your field trip,” grouped into the most frequently used categories.

“close,” “eat,” “fold,” and “curl.” The organ category (N=70 responses) included “leaves,” “flower,” “fruit,” “stem,” and “trunk.” While texture (N=51) was inclusive for “fuzzy,” “sharp,” “sticky,” and “fluffy.”

When asked what they learned on their field trip (question 9; open response), both the lab dissection and the conservatory exploration were catalysts to learning (Figure 2). Overall, 481 students (90%) gave a plant-related response. Many students (N=149) wrote that they learned that plants are diverse, writing phrases such as “there are many different plants in the world,” “there are many kinds of plants that can do cool stuff,” and “there are cool exotic plants then [sic] the ones in Ohio.” Students also responded that they learned how to dissect plants and how to use microscopes (N=65), showing a gain in skills. Students frequently noted that they learned that plants have parts, writing “there is a female and male part of a plant,” “about different parts of a plant like a pistil,” and “about the four parts of a flower.” After the experience, some students understood the significance of plants in the world saying, “plants aren’t just pretty they help the environment,” “how they give us oxygen,” and “that the most important thing in the world is plants.” Several students mentioned vocabulary terms that they had learned including “stamen,” “pistil,” and “pollen.” Students also referred to learning the plant life cycle on the trip writing, “how they grow and live,” and “when pollen spreads the female part of the plant reproduces.”

The activities chosen by students (question 6; forced choice) as their favorites during the trip included; leaving school (54%), using the microscopes (52%), and using the clickers (47%). Touching the plant that moved (46%), learning about plants (45%), and dissecting the flower (42%) followed close behind. When asked what they would like to do if they returned to the campus, (question 10; forced choice) students overwhelmingly chose to “take pictures” (70%). “Bringing family” came second (65%), “touch the moving plant” followed (58%), and “bringing friends” ranked fourth (57%).

Teachers who responded to the questionnaire enjoyed the opportunity to visit the campus, the hands-on experiences for the students, and

the correlation to the classroom curriculum (namely the Fast Plants project). The use of microscopes and models, the background information and handouts that were provided and the exotic plants in the conservatory were also mentioned as positive aspects of the trip. All six teachers who responded to the questionnaire enjoyed the trip and were looking forward to it in 2009.

## DISCUSSION

From the 533 student surveys used in the analysis of the results, students indicated that although most enjoyed the field trip and the act of leaving school, many were nervous about the experience. Three to five months after the field trip, students had strong recollections of the experience and what they learned. They used familiar words and identifiers to describe plants they recalled, mentioning shapes, common names, colors, and textures. In spite of the fact that leaf arrangement, leaf type (simple v. compound), and leaf margins were presented during the conservatory lesson, students did not use these attributes to describe plants. Students never mentioned petioles, nodes, internodes, or apical meristems during the game or afterwards in the survey. These findings were an inspiration to alter the program materials to reflect what students were focusing on about plants. The students learned how to dissect plants and use microscopes, that plants are an important part of our ecosystem and come in many different forms. The students understood that plants have parts and these parts are responsible for growth and reproduction. They recalled specific terms presented to them during the trip in regards to plant parts such as stamens, pistils, petals, and sepals. The retention of these terms could be the result of classroom reinforcement prior to and after the field trip. They rated the use of tools and touching plants as the activities they most enjoyed, and these aspects of the program were maintained.

**Implications of Study—** Teachers who have completed pre-visit activities, are fully engaged during the field trip, and reinforce learning in the classroom can significantly increase the level of student enjoyment, understanding, and retention in regards to non-formal field trips. Strgar (2007) found that the enthusiasm and competency of the teacher was positively

correlated to student interest in the non-formal experience. The conservatory staff encourages teachers to look over the plant descriptions the students are writing during the game and help their students to use botanical vocabulary and make accurate observations. The overheads used during the conservatory portion of the trip were also made available to the teacher of each class prior to the visit so they could review the material before and after the visit. This helps to reinforce the content and also gives students familiarity with the institution they are visiting. The surveys indicated that although a majority of students were happy or excited about the visit, many others were scared or nervous about visiting the college; this attitude has also been found in other studies (Ballantyne and Packer, 2002; Dillon et al., 2006; Eshach, 2007). Eshach (2007) noted that anxiety can result in undesirable behavior such as acting out and an inability to focus on learning tasks. Ballantyne and Packer (2002) established that although students valued the experience of leaving the classroom, and remembered the visit as enjoyable, those students who had engaged in pre-visit activities tended to mark the visit as more enjoyable than those who had not. Their study included data collected from both primary and secondary schools, supporting the fact that these results can be applied to a wide range of students.

Students and botanists differ widely in the terms they use to describe plants, and it is important to understand students' perspectives when designing botanical programs. Greenberg (2006) found that students often rely on a mixture of newly-acquired scientific terms and previously learned vocabulary to describe novel objects. Tunnicliffe (2001) analyzed student conversations in a botanical garden and found that the majority of students used dimensions, colors, and sizes to describe plants. The students in her study noted leaves, visible flowers and fruits, and other unique characteristics to refer to specific plants. The fourth grade students who visited the conservatory in 2008 also used layman terms to describe plants including colors, textures, movement, and common names instead of the more technical terms introduced by instructional staff during the program. Encouraging students to learn and use new botanical vocabulary

meant making revisions to the materials currently used during the program.

The revisions were aimed at increasing student use of botanical vocabulary about common plant characteristics such as growth habit, number of petals, and shapes in addition to the frequent use of colors and texture. To accomplish this goal, the results from the survey were used to construct new overheads, which provided visual examples of growth forms, leaf shapes and margins, flower shapes, and fruits. Instead of seeing black and white drawings of oak, maple, and locust tree leaves, the students were presented with color representations of actual plants in the conservatory such as papaya leaves, palm trees, and pitcher plants. The overheads also emphasized the use of words like "tree," "vine," "needles," and "lobes" by marking them in bold letters beneath examples depicting each character state. The directions for the game were rewritten to emphasize the characters that the students should focus on in their descriptions, such as number of petals, the plant growth form (tree, vine, hanging plant), and leaf or flower shape. Based on recent observations, the photos of plants on the revised overheads clearly excited the students and increased their level of anticipation for exploration of the conservatory.

Providing students with experiences with familiar plants and allowing them to touch plants is critical to conservatory programs. Instructors should take advantage of student fascination with carnivorous plants and familiar crops to demonstrate leaf attributes, flower function, and fruit production. For example, a picture of a Venus fly trap is now used during the program to demonstrate leaf margins, and to explain that the teeth are not actually used for chewing. When discussing fruits, the students are shown a picture of a cocoa pod and many go searching for this fruit in the conservatory after the lesson. Students take great pride in identifying an object that they are familiar with (Tunnicliffe, 2001), and the majority of students are aware of Venus fly traps and chocolate. Letting students touch the plants clearly made a positive impression on the students in our study because variations in texture were mentioned by several students in their plant descriptions. Being able to touch and smell the plants gives students additional ways to

observe differences between species. They were also fascinated by the sensitive plant, which has inspired the staff at the conservatory to grow one sensitive plant (*Mimosa pudica*) for each elementary school science room so the students can extend their exploration into the formal classroom setting.

The students were impressed with the technology used during the field trip, especially the dissection microscopes and clickers used during the laboratory portion. These results have prompted the lab instructor to include the use of document cameras and compound microscopes mounted with prepared slides of pollen and ovules. Younger generations of students are very tech savvy and respond well to the appropriate use of modern tools during instruction. The conservatory staff is currently looking into how cameras can be used in response to the 70% of students who wanted to perform this activity on a repeat trip.

*Results of improvements*— During the 2009 field trips, clue sheets were collected from the students after they completed the conservatory game, and analysis of these sheets showed that students were describing plants using terms discussed in the lesson such as “oval leaves,” “needle-like leaves,” “small teeth,” “long spikes on edge of leaves,” “starfish flowers,” “bell-shaped flowers,” “3 petals,” “5 petals,” “tree-like,” “water plant,” and “vines.” Students mentioning leaf margin attributes, specific numbers, and growth forms was a goal of the program and supports the notion that the revisions are having an impact.

This study shows that student surveys can be used to assess non-formal programs for long-term student retention, and that students recall specifics about a botanical field trip months after it has occurred. These types of assessments can be used to revise programs to facilitate additional student learning about plants, by bridging the gap between what students and botanists know about plants.

#### ACKNOWLEDGEMENTS

The authors would like to thank Dr. Daniel Gladish and Terry White for access to the program, and Dr. Daniel Gladish and two anonymous reviewers for comments that improved the manuscript. The Department of

Botany at Miami University and the Garden Club of America provided project funding to the primary author. We would also like to convey our gratitude to the students and teachers who visited The Conservatory and assisted with the study.

#### LITERATURE CITED

- Ballantyne, R. and J. Packer. 2002. Nature-based excursions: school students' perceptions of learning in natural environments. *International Research in Geographical and Environmental Education*, 11(3): 218-236.
- Bebbington, A. 2005. The ability of A-level students to name plants. *Journal of Biological Education*, 39(2): 62-67.
- Chawla, L. 2007. Learning to love the natural world: a unifying message for parents and teachers. *The NAMTA Journal*, 32(1): 152-170.
- Dillon, J., M. Rickinson, K. Teamey, M. Morris, C. Young, Mee, D. Sanders, and P. Benefield. 2006. The value of outdoor learning: evidence from research in the UK and elsewhere. *School Science Review*, 87(320): 107-111.
- Eshach, H. 2007. Bridging in-school and out-of-school learning: formal, non-formal, and informal education. *Journal of Science Education and Technology*, 16(2): 171-190.
- Falk, J. 2005. Free-choice environmental learning; framing the discussion. *Environmental Education Research*, 11(3): 265-280.
- Fraser, W. J. and M. O. Maguvhe. 2008. Teaching life sciences to blind and visually impaired learners. *Journal of Biological Education*, 42(2): 84-89.
- Gladish, D. K. 2006. The conservatory at MUH and the 4<sup>th</sup> grade project. *Plant Science Bulletin*, 52(4): 112-114.
- Greenberg, J. 2006. Growing Vocabularies for Plant Identification and Scientific Learning. *Bulletin of the American Society for Information Science & Technology*, 32 (5): 17-19.
- Hallé, Francis. 1999. *In Praise of Plants*. Portland, OR: Timber Press, Inc.
- Lindemann-Matthies, P. 2002. The influence of an educational program on children's perception of biodiversity. *The Journal of Environmental Education*, 33(2): 22-31.
- Mebler, L. M. and K. D. Brown. 2008. Not like a regular science class: non-formal science education

for students with disabilities. *Clearing House*, 82(1): 35-39.

Ohio Department of Education. 2004. Academic Content Standards K-12 Science. Office of Curriculum and Instruction, Columbus, Ohio, USA.

Ohio Department of Education. 2008. Hamilton City School District 2008-2009 school year report card [online]. Website <http://www.ode.state.oh.us/reportcardfiles/2008-2009/DIST/044107.pdf> [accessed 29 December 2009].

Schussler, E. E. and L. A. Olzak. 2008. It's not easy being green: student recall of plant and animal images. *Journal of Biological Education*, 42(3): 112-118.

Stem, M. J., R. B. Powell, and N. M. Ardoin. 2008. What difference does it make? Assessing outcomes from participation in a residential environmental education program. *The Journal of Environmental Education*, 39(4): 31-43.

Stevenson, J. 1991. The long-term impact of interactive exhibits. *International Journal of Science Education*, 13 (5): 521-531.

Strgar, J. 2007. Increasing the interest of students in plants. *Journal of Biological Education*, 42(1): 19-23.

Tilling, S. 2004. Fieldwork in UK secondary schools: influences and provision. *Journal of Biological Education*, 38(2): 54-58.

Tunncliffe, S. D. 2001. Talking about plants-comments of primary school groups looking at plant exhibits in a botanical garden. *Journal of Biological Education*, 36(1): 27-34.

Tunncliffe, S. D. and M. J. Reiss. 2000. Building a Model of the Environment: How do Children See Plants? *Journal of Biological Education*, 34(4): 172-177.

Uno, G. E. 1994. The state of precollege botanical education. *The American Biology Teacher*, 56(5): 263-267.

Wandersee, J. H. and E. E. Schussler. 2001. Toward a theory of plant blindness. *Plant Science Bulletin*, 47: 2-9.

Table 1. Student Survey

- 1 Did you go on a field trip to [university] to learn about plants? YES/NO/Don't remember
- 2 If yes, when did you play the "find the mystery plant" game in the conservatory? BEFORE Lunch/AFTER Lunch/Can't remember
- 3 Was this your first time at a college? YES/NO/Maybe/Don't know
- 4 Did you like visiting the college? YES/NO/Maybe/ Don't know
- 5 How did you feel about leaving school for the field trip? Scared/Nervous/Happy/Excited/None of these/Other\_\_\_\_\_
- 6 What was your favorite thing about visiting the lab and the conservatory? Leaving school/ Using the microscopes/Touching the plant that moved/ Dissecting the flower/Using the clickers/ Looking at the Venus fly traps/The Desert room/ Eating lunch/Learning about plants/ Seeing all the different plants in the conservatory/ Other\_\_\_\_\_
- 7 Describe a plant you saw at the conservatory. (open response)
- 8 Do you like learning about plants? YES/NO/Maybe/Don't know
- 9 What did you learn on your field trip? (open response)
- 10 If you went to the lab or the conservatory again, what would you like to do? Look for neat plants/Touch the moving plant/Use the microscopes/Bring my friends/Ask questions about plants/Use the clickers/Bring my family/ Dissect another flower /Take pictures/ Look at the Venus fly traps/ Other\_\_\_\_\_

