ABSTRACT

PROMOTING BOTANICAL EDUCATION THROUGH CHILDREN'S GARDENS AND PROGRAM ASSESSMENT

by Mary Lee Keppler

This internship report describes how the author integrated three internship experiences into a cohesive model of botanical education practices. The three experiences each contribute to the cycle of effective educational programming which includes design, implementation, evaluation, and revision. Teaching experience in informal curriculum development and implementation culminated in the Oxford Children’s Garden. Formal program design took place at Peaslee Garden in Cincinnati, and extensive assessment and revision occurred during The Conservatory Program Evaluation. This report details each internship experience, the proposed and achieved goals, and the impact they had on the author’s outlook on the profession of botanical education. This narrative satisfies the requirements for the Master of Arts degree in Botany from Miami University.
PROMOTING BOTANICAL EDUCATION THROUGH CHILDREN'S GARDENS AND PROGRAM ASSESSMENT

An Internship Report

Submitted to the Faculty of Miami University in partial fulfillment of the requirements for the degree of Master of Arts Department of Botany by Mary Lee Keppler Miami University Oxford, Ohio 2010

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I would like to dedicate this report
to my parents,
and the support they have given me during my program.

To my grandparents
who allow me to meddle in their garden,
and the children
who have made this adventure so exciting and rewarding.

Also to my advisor,
who guided me down paths I didn't even see,
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Introduction

Upon entering Miami University to earn my Master's degree, my goal was to participate in learning experiences that would prepare me for a position in the field of botanical education. I sought experience teaching preschooilers to undergraduates, which would present a wide range of topics and difficulty levels. Through three integrated internships, I attained my goal and acquired resources and a practical background for my future as a botanical educator.

I. Creation and Implementation of Curriculum

A. Internship Goals

My proposal for the internship experience (approved April 2009) stated that I would focus on the following four aspects and their roles in informal programming: curriculum development, implementation, evaluation, and revision. Since these are the key components to effective informal education programs I felt that gaining firsthand knowledge of each would prepare me for a career in the field of botanical education at informal institutions (botanical gardens, zoos, nature centers, visitor centers, etc.).

In October, 2008, I assisted with the implementation of a botanical program at The Conservatory at Miami University-Hamilton (hereafter The Conservatory) for 4th graders from Hamilton City School District. The students seemed to enjoy the field trip and were enthusiastic about plant topics, but I was curious to discover what they were retaining from the experience. I began to investigate how you would evaluate and then revise an informal experience, using qualitative and quantitative assessments. During the summer of 2009, I undertook the task of coordinating botanical education for two separate children's gardens in southwestern Ohio. I sought to create dynamic programs in which my role was to design lessons, implement activities, make observations, and finally revise the program to reflect the needs and abilities of the students.

I formalized the following goals for each internship experience:

- Oxford Children's Garden goal: to create and implement a botany curriculum based on plant life cycles for use with 6-12 year olds in a garden setting.

- Peaslee Garden goal: to create and implement a botany curriculum emphasizing diversity and adaptations for use with preschool aged students in a garden setting, and to gain horticultural experience maintaining a children's garden.

- The Conservatory Program Evaluation goal: to gain experience in informal program assessment by evaluating the effectiveness of the field trip program at The Conservatory at Miami University-Hamilton.

I knew each of these internship experiences would present unique perspectives on informal program development and I prepared myself to meet the challenges each location would present.
B. Approach/Methods Employed

Research

Preparation for the internships began months before the first seed was ever planted in the garden. In the fall of 2008, I took EDT 689, *Field Application Techniques*, to learn about educational research so I could effectively evaluate and assess my lessons. It was through this course I began investigating the appropriate tools to use in The Conservatory Program Evaluation. The following spring, I enrolled in BOT 688, *Biological Science Education*, and explored the theory and psychology behind teaching and learning. After receiving academic challenge funds from the Department of Botany for The Conservatory Program Evaluation and children’s garden internships, I began to collect published literature on working with children outdoors including books of outdoor activities and lesson plans, and methods of informal program assessment. After weeks of research, planning, and editing, I formulated weekly lessons to be used in the Oxford Children’s Garden and the Peaslee Garden. Although some of the activities were similar, the curricula I created for each garden was diverse to reflect the different ages and abilities of the students. The Miami University-Hamilton Conservatory research component required that I obtain permission to work with under-aged human subjects, and I began the process of acquiring certification for human subjects research and submitting an application to the Institutional Review Board to approve my evaluation methods. I attended several conferences during the course of my enrollment to meet fellow practitioners and hear about cutting edge techniques. These conferences included: The American Horticultural Society’s 17th Annual National Children & Youth Garden Symposium, “Common Ground: Gardens for a Greener Tomorrow” held July 23-25, 2009 in Cleveland, Ohio. The National Science Teachers Association Area Conference, “Renewing the Energy in Science Education” held December 4-6, 2008 in Cincinnati, Ohio; and the American Horticultural Therapy Association Annual Conference, “Connecting People with Nature “held October 30-November 1, 2008 in Lexington, Kentucky.

Implementation

The best part of the internships was the implementation stage. Arriving to the Oxford Children’s Garden early in the morning, I set up for the day with carpet squares in a circle and garden gloves at the ready. I had spent the previous week gathering supplies and typing up a lesson plan, but there was always room for student-directed activities. The students would arrive in the garden and instantly go to a plant they were observing and discuss how it had changed from the week before with their family members and fellow campers. At the Peaslee Garden, the students would rush out the door to the playground and several would ask me what I was doing in the garden. I would show them a zucchini that seemed to grow overnight and help them look for worms. The 4th graders flew off the bus towards The Conservatory and could barely keep themselves still while listening to the directions to play the “scavenger hunt” game in each of the collection rooms. Together, the students and I discovered the feel of cactus needles, the fish in the water trough, and the movement of the sensitive plant (*Mimosa pudica*).
Observations

After each lesson, I reflected on the experiences of the students and my impressions of the day in order to revise the lesson and improve student learning. The observations from the Oxford Children’s Garden included student’s reactions to certain activities, the books we read, and events that seemed to spark particular interest. I recorded which plants were in bloom and what was harvested so I could incorporate those things into my lesson the following week. The students at the Peaslee Garden were young, 1-5 years old, and my observations consisted of which portions of the activities they struggled with. For example, some students had great difficulty holding scissors or applying glue, some loved to water plants, and others disliked getting dirty. While I also recorded student actions during The Conservatory Program Evaluation, my formal “observations” came from data I collected from a student survey tool I designed and delivered to each class who had visited The Conservatory.

Revisions

Within three months after the completion of the garden programs, revisions were made to the activities as part of the process of compiling two final sets of curriculum; one complete curriculum was presented to the Oxford Community Arts Center and one to Peaslee Neighborhood Center. These revisions included alignment with both the Ohio State Science Academic Content Standards for grades K-5 and the Ohio Early Learning Content Standards for preschool students. Each module in the curriculum includes a description of an activity, a section titled “from experience” which includes observations made during the implementation stage, a set of questions to guide student inquiry and discussion, and the corresponding state standards met by the activity. By August of 2009, two full binders of place-specific activities were completed, resulting in over 200 pages of kid-tested curriculum (129 pages for the Oxford Community Arts Center-see Appendix A, pages 22-29, for a sample; and 75 pages for Peaslee Neighborhood Center-see Appendix B, pages 30-38, for a sample). The data collected from The Conservatory Program Evaluation resulted in revisions to the field trip so that it better matched the interests and abilities of the students. Recommendations for program revisions and changes in presentation materials used at Miami University-Hamilton are included in Appendix C, pages 39-44.

Culmination of Internships

Since the end of the gardening season, I have given four oral presentations of my internship experiences, one to the Garden Club of Cincinnati, another to the Springdale Garden Club, an Eco Lunch presentation to Miami University students and faculty, and a fourth to Audubon Miami Valley. The final sets of curriculum have been presented to both the Oxford Community Arts Center and Peaslee Neighborhood Center administrative staff, and a manuscript is currently in review at the Plant Science Bulletin on my research with the students who visited The Conservatory and Miami University-Hamilton.

While I wove together all three internships into a culminating set of practical experiences, they were autonomous adventures. Each had a distinct structure based upon the goals and mission of the supporting organization, the students served by each were diverse in their abilities and learning styles, and the resulting outcomes were varied.
The Oxford Children’s Garden is located at the Oxford Community Arts Center (OCAC), previously known as Oxford Women’s College or “Ox College”, in Oxford, OH. The garden at OCAC is a collaboration between the Oxford Community Arts Center and the Des Fleurs Garden Club. The Des Fleurs Garden Club is entirely responsible for building and maintaining this beautiful addition to the community, while the OCAC is responsible for the education programs that take place in the garden. Their joint mission is “to provide a unique and joyful garden environment designed to inspire, empower and connect children with the importance of plants and the natural world in their lives” (Oxford Community Arts Center, 2010).

The Oxford Children’s Garden is a large space, about 20’x20’ square, entirely enclosed by a tall five foot fence. There are nine raised garden beds and the area just outside the fence is planted with perennials. There is a mature oak tree that shades the garden in the morning and a picnic table on site for snack time. A tumbling compost bin and tool box in one corner of the garden, and two additional compost heaps lie just outside the gate. There is ample seating room to arrange a circle of students for morning lessons and story time. Benches are arranged on either side of the space and next to the picnic table. I often would walk past the garden during the week and see local Oxford residents enjoying a meal among the flowers and fruits. During the course of the summer, the benches, trellises, and fence posts were all covered in squash vines with tendrils weaving their way towards the sun. Besides perennial herbs (borage, chamomile, and comfrey), most of the garden was planted with annuals such as sunflowers, tomatoes, and cucurbits. The students planted all the annuals, see Figure Plate 1, page 6 for examples.

I was approached in March of 2009 about taking the lead teacher position for the OCAC summer garden camp (a.k.a. “gardeneering camp”). I ran the camp for sixteen weeks, Saturday mornings from 9:30 – 12:30, for children ranging in age from 6-12. I designed a curriculum in which the sessions were divided into four, 4-week units. The first unit, Seeds, focused on planting the garden and explored concepts such as heredity, germination, and seed dispersal. The students dissected seeds and put together seed packets for their home gardens as well. The second unit, Leaves, correlated to the seedlings sprouting in the garden. The campers learned about photosynthesis, studied and experimented with different herbs, and traced food chains to their source, discovering that plants are the basis for all life on our planet. Unit three, Flowers, engaged the students in investigating flower function through dissection, pollination activities, and the construction of pollinator habitats. The final unit, Fruits, incorporated field trips to the farmer’s market to emphasize harvest times and USDA zones, fruit diversity, and food preservation. Examples of activities from these units are in Appendix A, pages 22-29 and a sample daily lesson plan is found in Appendix D, page 45. The activities presented in Appendix A were chosen because they each represent a unique aspect of the program. “Recording the Weather” (p. 23) represents clear alignment with the Ohio State Science Academic Content Standards for grades K-5, “Pollination Creation” (p. 26) was the result of an improvised activity that arose due to a spontaneous rain storm, and “Seed n’ Feed” (p. 28) was a wildly popular student-created activity I included each week. For each activity, I sought to guide the students to their own revelations through inquiry and peer interaction. The summer ended with student presentations on topics they chose individually ranging from butterflies and moths, to spaghetti, fossils, and guinea pigs!
Gardeneering camp was a great success; the registration was limited to 16 students per session and by the end of the summer there were several potential students on a waiting list. The ability levels of the students and the interests they brought to the garden were extremely diverse. Each week we had circle time to read a book and review the previous week’s lesson. We discussed a basic botany topic and then dispersed to the garden to plant, weed, harvest, and dig for grubs. Volunteers from the community were very helpful in guiding explorations and assisting younger students with challenging tasks. After garden work, the students would come together to complete a craft such as making salsa, painting pots, pounding flowers, or measuring plants and recording the weather in their journals.

Hard work was followed by a tasty organic snack either from the goodies we bought at the farmers market, the local grocer, or picked straight from the plants in the garden. I purposefully kept time available after snack for “unstructured play” which is mentioned in the literature (Louv, 2005; Sobel, 1996) as being a good tool for children to test their knowledge and develop new questions. Students would often be found playing together as bunnies in the carrot patch, creating habitats for worms in the compost bucket, and reading library books as their parents came to pick them up.

My day did not end when the last student left the garden. I would do some general clean-up, dry some of the dishes we used during snack, and then settle down for a few hours of reflection. I would walk around the garden and write down which species were blooming, which were having pest problems, and what needed to be harvested the following week. I would record which snack items the students most enjoyed and which ones were left over. I then reviewed each aspect of the lesson—from circle time to pick up—and documented the conversations I shared with students, the questions they asked, and feedback from the volunteers. I would look through student journals to see which students were still struggling with their writing and would brainstorm ways their peers could help them develop their skills. After recording several pages of notes, I packed up my things and left the garden for the day, already buzzing with ideas for the following week.
Figure Plate 1. Oxford Children’s Garden.
D. Peaslee Garden Overview

Peaslee Neighborhood Center is located in Cincinnati. The center is in a low-income neighborhood called Over-the-Rhine (OTR) in reference to the German immigrants who settled that area of the city. Historically, OTR has had a varied history of successes and downfalls, but it is now shadowed by crime and poverty. Most of the unique German architecture is in disrepair and the streets are lined with abandoned buildings. People loiter on the streets at all times of the day and night and most are disabled African-Americans. The children who grow up in this neighborhood are enveloped by a rich culture and proud heritage but also lack safe places to play and explore. Peaslee Neighborhood Center provides childcare for local children aged 6 weeks to 5 years old. Their mission is to “provide a peaceful place where OTR residents create and participate in dialogue-based educational programs that foster creative expression, self-determination, personal voice and social change” (Peaslee Neighborhood Center, 2010). Music lessons and small group discussions are held on the upper floor while the bottom floor and surrounding property is a dedicated Child Development Center. They accept about 45 students on state vouchers, which is the lowest subsidized form of childcare available in Ohio.

The Peaslee Garden is located adjacent to the playground and is comprised of four raised beds, several stacked tires, and plantings around the yard, which is about 50' x 20'. Although the physical space is larger than the Oxford Children’s Garden, about 60% of it is taken up by play equipment and asphalt. The children enjoy sitting under the shade of the central maple tree and a shade garden has been planted close by. There is also a butterfly garden, which holds buddleia bushes and herbs to attract wildlife. Along the chain link fence, a row of sunflowers was planted, creating a sort of jungle atmosphere to the yard. A compost station and several beds of annual flowers and vegetables take up most of the available green space; see Figure Plate 2, page 8, for examples.

Students begin arriving to the center around 7:00 am and are picked up before 6:00 pm, making for a full day of pre-school. In the morning, children recite their ABCs or walk to the library for story time. They engage in art and music class once a week and have both structured play in the form of exercise and unstructured play using dramatic representation and exploring the outdoors. Prior to my involvement at Peaslee, garden time was not structured and began when the children who were outdoors initiated it. They would approach either the garden manager or another volunteer and would inquire as to what they were doing. The adults would engage the child and ask them if they would like to help harvest the sunflower seeds or eggplants, which usually resulted in an excited “yes!” Upon starting my internship, I took the initiative to set up outdoor garden stations for children to look for worms, and use hand lenses to closely observe leaves and fruits. Collaborating with the garden manager, I designed games with an environmental emphasis such as pictorial scavenger hunts and using the five senses to identify herbs. We also took the garden indoors and designed classroom activities which included building paper sunflowers, and watching bean roots grow through clear cups. Three examples of the activities I developed are found in Appendix B, pages 30-38. The activities I chose to highlight in Appendix B are those that engaged the most students for an extended period of time. The “Outdoor Exploration Station” (p. 31), hit 27 Ohio Early Learning Content Standards and covered each of the four content areas. The “Pollen Matching” game (p. 34) was the result of a cooperative effort between the toddler classroom teacher and myself and held the attention of entire classes of students. The “Build-A-Plant” (p. 36) activity was an indoor extension of our
sunflower study and involved looking at how plants grow over time. If I was present at the Peaslee Garden on the day the activity was to be completed, I assisted the teacher during the implementation stage but the teachers of each class were responsible for daily implementation of curriculum. Through each activity, the teachers and I sought to interest students in the current subject by asking questions and considering their responses, even if they were incorrect.

At early stages of child development, it is important to understand that students are forming ideas and the ability to answer a question correctly should not be valued above the ability to respond appropriately in some fashion.

The students at the Peaslee Garden were limited by their physical capabilities and comfort with being outdoors. Younger children tended to explore an object through disassembly and many of our plants were torn apart. Although this was a useful exploration activity for the child, it was unfortunate due to the tight fiscal strain on the organization itself. We had limited funds available and many of the activities I designed cost no money at all. For a game to work on writing skills outdoors, I wrote each letter of the alphabet on colored paper (upper and lowercase) then laminated the sheets and hung one a day from the maple tree. We cut small sticks for the students to write in the soil and this idea was successful in promoting fine motor skills and literary practice. Soliciting donations helped keep the garden plots full with plants, and there was a constant flow of volunteers through the center.

The Peaslee Garden was different in many ways from the Oxford Children’s Garden, not the least of these being that the children who were enrolled in the gardeneering camp in Oxford chose to be there while the students at Peaslee were enrolled for different purposes, and usually coming home dirty was not one of them. Also, I was not the regular teacher of the students at Peaslee and gaining their trust and respect took time. Understanding the established methods of each teacher and integrating our individual goals into common objectives was a difficult process. Working in a more formal school environment as compared to an informal one was a valuable learning experience and taught me volumes.

Even through the challenges, the association of teachers, community leaders, volunteers, parents, and children at Peaslee made everyday worthwhile.
Figure Plate 2. Peaslee Garden.
E. The Conservatory Program Evaluation Overview

The Conservatory Program Evaluation was entirely different from the garden internships. The students were not in a camp or their formal school environment; they were on a field trip. The students varied little in age because they all attended 4th grade in Hamilton City School District. In spite of this, there was a wide range of cultural and economic diversity among the students. The district in which the students attended had a majority enrollment of European descent (78%), 9.4% were African-American students, and 6.6% Hispanic, with less than a percent of Asian students, and 5.3% of students held multiracial backgrounds. Most students were from economically disadvantaged homes (57.1%) and 16.4% had disabilities. Five percent of students struggled with Basic English proficiency (Ohio Department of Education, 2008). With these considerations in mind, the program administrators carefully planned the delivery of the content material. I was an assistant during the implementation stage of the program and in the spring of 2009, I became an active participant in the assessment and revision stages.

The students came to the campus on Tuesdays and Thursdays from October through December. Each day about 50 fourth graders were bused from their school and upon arrival, would split into two groups; one group followed the science instructor responsible for implementing the lab portion of the trip and the other group filed into The Conservatory. I did not observe the entire laboratory portion but through interviews with the science instructor, I have learned that the students were taught about flower parts, Mendelian genetics, and pollination syndromes during a PowerPoint presentation. At various points during the lecture, the students used clickers to show their understanding of the material. The last portion of the lab consisted of students dissecting Peruvian lilies and filling out structured worksheets (the students taped the parts of the flower in concentric circles on the sheet). After completing their morning session, the students had lunch and then completed the afternoon session in either The Conservatory or the lab. Each student experienced both lab and conservatory activities.

In The Conservatory, the students were asked a series of questions to get their thoughts focused on plant function, significance, and plant diversity around the globe. The instructor introduced The Conservatory and described the collection rooms, of which there are four: the atrium (a.k.a. the BIG room), the tropical room, the horticulture room (“hort” for short), and the desert room. Mention of the desert room always seemed to illicit a buzz of excitement from the students. The students were informally quizzed as to where the tropics are located, and whether or not plants are “the most important things on Earth”. This question / answer session, which represented a form of guided inquiry, went smoothly and enjoyably with most groups, although some groups required additional assistance from the teachers. After the introduction, the instructor described the game the students would be playing. First, each student chose a partner and pencils and pads of paper were passed to everyone. The partners entered different rooms and chose a plant to describe so that their hidden partner could identify it using the description, see Figure Plate 3, page 12, for examples. This game is a sort of scavenger hunt and the descriptions are the clues to finding the plant. After the student was done describing their plant, without using the name of it, they rushed to find their partner and traded clue sheets. Entering the room their partner had just vacated, the student compared plants with the characteristics listed on their clue sheet until they felt they had discovered the correct specimen. Writing down the name of the plant from the white tag in the pot, the triumphant student then found their partner to confirm their success. If the guesser was correct, they had the sheet initialed by an adult, and
began the process again, keeping track of their papers for the final tally which determined the winner of the game! If the partner did not identify the plant correctly, they tried again (usually with the help of another clue or some not so subtle pointing). After about 30 minutes of game play, the students congregated in The Conservatory Meeting Room and counted up their number of signed sheets. The winning pair earned “the eternal respect and admiration of their classmates, teachers, and The Conservatory Director”. During the remaining time, the instructor asked the students to recall their favorite plants and what characteristics made them so unique. This concluded the field trip and the students were escorted to the bus to return to school, where they were presented with a packet of native Ohio wildflower seeds.

I chose to integrate this program into my internship experiences for several reasons. First, the large student population visiting the campus was a good sample size for assessment. Second, the program was in its fourth year and the visiting teachers and staff had consistent lessons in place. Third, I had several unanswered questions from my observations in the fall of 2008. One day in November 2009, I was in The Conservatory waiting for the students to arrive and I came across a stack of thank you letters students had written. In those letters, the students repeatedly mentioned that they enjoyed “seeing the spider on the dollar bill” (I later learned that this referred to the use a dollar bill to practice focusing the dissecting scopes in the lab portion of the trip). Since this clearly did not relate to the learning goals of the program, I wondered what the students were learning from the field trip and if the curricula were aligned with the desired outcomes of the experience. I also wondered if there was a better way of keeping them captivated when introducing taxonomic and morphological concepts such as plant margins and structure. Although I had some ideas about how to make certain changes, I wanted to collect data as a basis for any revisions. I began the process of initiating a research project on informal education assessment. The results of that research project are shown in Appendix E, pages 46-54, which is the text of a manuscript currently in review at the Plant Science Bulletin.
Figure Plate 3. Conservatory Program Evaluation.
II. Reflection, Evaluation, Revision Based on Assessment

On the first day of gardeneering camp at the Oxford Children’s Garden, I waited for the children with a mix of excitement and anxiety. I had been preparing lessons for weeks and had gathered all the necessary materials for the day’s activities. I felt my preparations were “kid-proof” and any unforeseen surprises could be handled easily. While being prepared is a great start, I also quickly learned that letting go of strict schedule adherence is crucial to the success of the program. If I had not taken cues from the students to keep my lessons fluid and incorporate their needs, the summer could have easily become a power struggle between my objectives and student expectations. By setting aside time for daily reflections, I was able to more objectively judge the reality of how the curricula had worked and how it could be revised to better suit the needs of the students.

A. Oxford Children’s Garden Reflection and Revision

Having lofty goals for students is a good start for any teacher. But holding onto unrealistic aspirations is counterproductive. For instance, at the Oxford Children’s Garden I wanted each student to keep a journal in which they would record the life cycle of a specific plant in the garden, and measure that same plant each week to record its growth. I had planned on using the journals as an assessment tool to measure student progress during the summer, hoping to see gains in botanical knowledge. I made the journal activity quite theatrical, calling all the campers together, pulling them from their garden duties, and handing out their journals one by one. I gave each camper a ruler and ordered them to visit their plant and measure its height. I went on about my busy work with preparing snack and gathering tools and when I looked up, several journals were abandoned—their owners caught up in filling the bird feeders. Feeling a bit irate at the blatant disregard these students had for my directions, I asked them why they weren't measuring their plant. One little girl replied, “I don’t know how to write my numbers”. Another stated, “I’m embarrassed with my words”. I accepted these excuses and decided that I would have to rethink the activity. As I wrote my reflection that afternoon, I decided the younger campers could draw pictures instead of using numerical measurements. The next week I proposed this idea to the girls and they gladly accepted the challenge, taking a fair time to draw in their journals. If I had not approached these seemingly delinquent students, I may have misunderstood their actions as being disobedient and would have missed an opportunity to meet them at their ability level.

A defining struggle of the first weeks of garden camp came not on two, but dozens of legs. Instead of planting the salsa garden, two students were in the corner, turning over rocks and making excited gasps and giggles which attracted more students. When I realized I was just about the only one digging holes for the peppers, I came to the spot where the children had gathered. To my dismay, they were collecting animals; roly poly bugs, worms, grubs, centipedes, and beetles. They had made homes for the critters by turning their garden gloves inside out and covering the holes in the bottoms of empty pots so their new “friends” would not escape. I quickly ended the activity, confiscating the pots, dumping the bugs into the compost, and making an effort to refocus the students on planting the peppers and tomatoes. Some gladly went back to their work, but the original two students were very put off by my actions and grudgingly shuffled back toward the intended salsa garden plot. I wrote in my reflection that day about the “plant blindness” (Wandersee and Schussler, 2001) that I had observed firsthand.
and the personal conviction I felt to reverse this trend. I wrote that I had to keep the students on task so they would not be able to find a distraction in the form of animals. The next week, I had planned each minute outside of garden tasks to be taken up by crafts and stories, but even so, I still caught a few students “red handed” with worms and pill bugs. Out of desperation and annoyance, I said, “this is garden camp, we are here to learn about plants, animals are not why we are here and you should not be handling them”. I said this to the students but also in front of a volunteer who happened to be a zoology graduate candidate. I felt justified in my decision to ban consumers from the curriculum and would not let plant blindness happen on my watch! As I began to write my reflection, however, I felt a deep regret. Who was I to separate a future entomologist from their subject? Where did I get the authority to claim that plants are so superior to animals that the latter were unworthy of study? I had a hard time sleeping that night, trying to come to grips with my role and my goals for the students. While preparing for the next week’s lesson I came to a hard truth, I didn’t want the students to be interested in animals because I didn’t want them to ask me questions I wouldn’t know the answers to. I do not have a fear of bugs but I am not well versed in their habits and felt inferior when students would ask me to describe the diet of a centipede. I decided that my own discomfort was not a valid reason to keep a child from exploring their interests and so “garden ecosystems” became the topic of the day. We read a book about worms and the benefits of having them in the garden. We made habitats for the roly poly and looked through field guides to identify the beetles. We put the grubs into the compost bucket and watched them munch on our leftovers from snack. The whole day was nothing but animals, and everyone had a great time, myself included. I apologized for being close-minded and explained to the students that I enjoy plants most of all but they are free to explore any aspect of the garden they wish. After I relinquished my duty to uphold a “plants only” camp, the atmosphere was much improved. My overarching goal was to expose students to new ideas through gardening that would develop their sense of place and help them connect to the natural world. Including animals and their important role in our garden was in line with this goal.

Incorporating time to reflect after each day of camp allowed me to think deeply about the curriculum and come to realizations I would not have discovered, such as the recognition that animals were important in the garden too. I would not have been able to adapt my lessons to reflect the abilities or interests of the students if I had not taken time to reflect, writing detailed observations and suggestions for the future. The curriculum that I created would not be nearly as complete without the “from experience” sections giving examples about which parts of the activities the students enjoyed or struggled with. I cherish those times I spent in the garden after the students had left when I could go over my lesson, remembering student conversations, recalling times when I observed learning, and laughing to myself at some of the silly games we played. Without this time to review, I would be prone to repeat mistakes and become discouraged. I learned from my experience that reflection and revision are at the heart of effective curriculum.
B. Peaslee Garden Reflection and Revision

My first attempt at delivering botanical curriculum to the students at Peaslee was fruitless. I spent two weeks sitting in the administrator's office devising activities that focused on central themes such as worms, soil, water cycles, and colors in nature. I wrote these themed activities for the teachers to implement in the preschool and toddler classes, as my role at the garden was to maintain the garden plots and operate as a resource, but not to teach. I used an approach very similar to the Oxford Children’s Garden, thumbing through my texts of published activities for ideas and adapting those activities in accordance with my goals and the abilities (as I perceived them) of the students. Working with the garden manager, who was trained in child development, we included several areas of study into each theme such as science, math, writing, language arts, and games that encouraged development of gross motor skills. Gross motor indicates using the whole body, fine motor refers to subtle movements such as writing. After several long days of research and writing, we had composed “teacher-proof” curriculum that used activities to engage students with worms and soil. Since I was not at the center daily and expected the activities would be done without my assistance, I provided written background information for the teachers on worms and soil and included space for them to write their reflections on each activity so I could make revisions before they were finalized. I proudly presented each teacher with the completed activities and returned to the office to continue working on the next theme. After another week of toil, I went into the classrooms and asked for the reflections from the teachers, as well as offering them new activities. To my surprise and dismay, the teachers had not done the activities, and did not seem enthusiastic when I showed up with more. My first impression was that the teachers simply did not understand the imperative nature of the program. I felt that it was urgent to get the students outside and in the garden ASAP! It was not until much later that I would begin to understand the actual truth; that the fault was my own and was a result of my naïve notions of how things should be done.

I felt very discouraged. What was I doing wrong? How could I convince the teachers to do the activities? What were they doing with the students instead? That was when I hit upon the key to my problems. I had not spent a single day with the teachers, observing their classroom, getting to know their interests, learning about their students, or enjoying their talents for teaching. I could not assume these teachers were as enthusiastic as I was about taking the children into the garden, and so I could not employ the same methods I used at the Oxford Children’s Garden. The teachers at Peaslee were in the profession because they had their own talents and I did not take the time to see them as individuals. I closed up my books, turned off the computer, and went into the classroom. The students were learning about their neighborhood, they were drawing pictures of the grocery, the post office, and the hospital. They were pretending to buy produce from each other and drive to the library. They were impersonating cooks and making cakes in the sand. I had been missing out on the most important aspect of my project-the relationship the teacher had with their students. Walking into the room I was clearly an outsider, interested yet uninformed about their daily activities. I did not know that they walked to the library on Mondays, went swimming on Thursdays, and looked forward to long periods of outdoor play on Fridays. The classroom community was already established and I was the stranger who was trying to change their routine.

Sure I had good ideas, I had read some books, but those paper and pen exercises were not going to be applied without a catalyst. The teachers had their hands full with students learning to be
social, having difficulty falling asleep during nap, and just trying to keep their hands to
themselves. I spoke with the garden manager and together we set up outdoor activities that the
two of us would supervise. We set up a water table for the students to experiment with, and an
opportunity to water the garden. We also invented a game involving the use of weeds to engage
the students in “cooking” and developing fine motor skills cutting eggplants. I sat with the
teachers during naptime and asked them for ideas of garden-based games and activities they felt
the students would enjoy. Getting input from the teachers increased their involvement and
built a relationship of trust, which in turn resulted in many of those collaborative ideas coming
to fruition. I realized I did not understand the community and so I could not effectively engage
with it. I grew up in Oxford, did my grocery shopping there, bumped into parents of my
gardening camp students at the post office and was very involved with the community. The
students and I also had a good relationship; we had become friends and greeted each other each
week with new stories. How would I have reacted if someone waltzed in and told me how to
run my class? Needless to say, I learned daily from the experiences I had in Cincinnati. I am so
thankful for the supportive nature of each employee at Peaslee who put up with my ignorance
and helped me gain an appreciation for the uniqueness each teacher and student brings to the
table.

Once I began to oversee the students during activities, I was able to reflect on the day’s events.
The observations I made after the activities at Peaslee were focused on student ability and
success. I would remark on a particular action such as a toddler who picked up a clover flower
and held it to their nose instead of tearing it apart, of a preschooler who helped me gather leaves
on the walk to the library, and the ability of a four year old to glue leaves and petals in the
“correct” places on their paper. It was a great learning experience for me to see child
development in action. The students would take unfamiliar ideas and situations and apply them
to a familiar setting. For example, I brought out trays with different soil mixtures and as the
students were feeling the sand, one boy simply said “sandals” and I understood this to mean he
was correlating sand with the beach. Another example occurred during evening pick up time,
when I had several herbs in trays in the “outdoor exploration station” (a low table). Two little
girls were playing with the herbs, using the hand lenses as stirring devices and they were
putting the trays underneath the table, tapping their toes for a few seconds, then putting the
trays back on top of the table. I asked them what they were doing and they replied that they
were microwaving their dinner (referring to the action of putting the herbs under the table). I
was quite surprised that they had extended the intended activity of using tools to explore
details of plants into using the plants to make imaginary dinners. This type of development is
referred to in the literature as dramatic play and is appropriate for students of this age.
Understanding how children develop and organize new information allows me to create lessons
that effectively integrate novel concepts.
C. Additional Site Observations

As I slowly began to uncover the community that Peaslee was a part of, I began to wonder how other preschool centers ran their classrooms. Did they also struggle with basic behavioral issues such as biting and hitting? I wanted to see schools that had established garden programs, and how they involved the students in activities. There are many organizations and institutions in the Cincinnati area that offer environmentally-based programs and I wanted to take the opportunity to observe other techniques before the summer season ended. I looked at these visits as a time for rigorous data collection. I was collecting data on the teachers, the children, the activities, and my impressions, creating a pool from which I could draw when I met with future challenges. I scheduled visits to ten different centers in the area, and compared each with my observations to both the Oxford Children’s Garden and the Peaslee Garden. While there were similarities between some of the teaching methods of the centers, there was also a wide range of differences.

First, I visited a Montessori pre-school. I noticed the children completing individualized “work” projects, for Montessori philosophy holds that a child’s play is their work. The classroom was quite structured and I felt it was a bit stifling, however, these children could write legibly and were learning about cumulus and cirrus clouds with little difficulty. There was a garden in the schoolyard, and the teacher showed me with pride her classes’ raised bed. She pointed with disdain at other beds which had not been tended, and I thought of the teachers I knew who also did not use the garden as a teaching tool. I visited Mini University at Miami University and played with the children in their expansive outdoor yard which housed several lookout towers, slides, a stage, and a track for riding bikes. The students at Peaslee would have had to extend their yard into the next block to obtain this much free space for play. I observed the students using real hammers and nails, and reminding their peers to put on safety goggles. At Arlitt, a development center at University of Cincinnati, I saw two students have a disagreement that ended in tears and the teachers tried for several minutes to calm them down. Waldorf School’s Meshewa campus at Turner Farm was entirely outdoors, and the children were led in song and dance through fields of flowers and into a bubbling brook, finally taking snack under a willow tree. While each of these approaches provided different styles for the students to grow and excel, they were similar in the fact that they had resources different from those I had (or didn’t have) at Peaslee. The students came from less diverse backgrounds and the majority of them were not disadvantaged. Students with disabilities were able to have their needs accommodated. But at each center the students still required discipline, to be told right from wrong; they still explored by dismantling things, and were nervous around worms. Each child had unique strengths and vulnerabilities to take into account.

Once I began the process of observing other programs in action, I decided to include centers that reflected the ages of the students at the Oxford Children’s Garden. I visited Cincinnati Nature Center and participated in a day camp. We went on a walk in the woods and I couldn’t help but point out jewel weed seed pods (Impatiens capensis) for the students to pop. We looked for salamanders under boards and sang songs about nature. It began to rain and I pulled out my clipboard to take notes on how they handled unexpected weather changes. The students ate snack inside, using coffee filters for bowls, but I noticed during the reptile presentation that there were issues with restroom use and several times a counselor had to quiet the campers. I had similar problems with the students in the Oxford Children’s Garden the first few weeks,
until I established a schedule. I assisted with a garden program run by the Civic Garden Center, which attracted students from the same neighborhood as Peaslee. Again, rain interfered and the program was altered, becoming more of an art class than a weeding session. The sun came out and children poured into the garden, demanding snack. The entitlement of some children who had not participated in the program resulted in rude behavior and fortunately the staff was quick to respond. The garden was “a safe place” and there was no tolerance for disrespect. I spent a day at Gorman Heritage Farm, Cincinnati Waldorf School, Wegerzyn Children’s Garden, and Highfield Children’s Discovery Garden. At each center, I observed students interacting with plants, nurturing and manipulating them, all the while using their senses to discover new things about life.

In addition to the programs I observed at separate centers, I conducted several of the same activities at both the Oxford Children’s Garden and the Peaslee Garden. I had planned to use these parallel activities to compare the two groups, but after just two weeks at each location I knew that there would be numerous other ways to compare and contrast the two experiences. It was evident, however, through the observations I made during each parallel activity and the methods of the other centers, that there is no one right formula, no sure-fire technique and a variety methods appeal to different learning styles. During my observations of local programs, I noticed things I would have done differently, but my way would have been unique to my personal interests, and I realized that diversity in teaching methods allows for students of varied backgrounds and abilities to succeed.

D. The Conservatory Program Evaluation Reflection and Revision

Through my work with The Conservatory Program Evaluation, I was able to practice assessment of a nonformal experience. While the revisions I made in the Oxford Children’s Garden and Peaslee Garden curriculums were based on observations, the assessment of the program at Miami University-Hamilton resulted in quantitative and qualitative data upon which I could recommend adjustments.

The assessment and revision process I conducted for The Conservatory Program Evaluation is detailed in a manuscript I’ve submitted to Plant Science Bulletin and is currently in review. See appendix E, pages 46-54, for a copy of the manuscript.
III. Lessons Learned

As a result of my experiences this past year in Oxford, Cincinnati, and Hamilton, I have learned valuable skills I will take with me into the workforce. The following is an excerpt from the preface I included with both sets of curriculum to future instructors:

“After experience conducting educational programs, attending conferences, observing environmental education centers, and reading extensively on the subject of botanical education I have the following advice to offer...

1) Use the resources at your disposal, and do not be afraid to experiment. Books and experts can provide a starting point for your program; however, the students are your best source of creativity and direction. Explore their ideas and follow through on their questions. Seeing you respond to their input will encourage them to take responsibility for their learning as well as boost their confidence in themselves and the student-teacher relationship.

2) Be prepared, but flexible! This is vital to the success of any outdoor program. Being prepared for the day is mandatory before you begin; however, you need to be ready to change plans at a moment’s notice. Rain? Employ your alternative plan. Pests or disease in the garden? Pull out plants and start again—use the incident as a teachable moment. Keep a couple of activities and lesson plans as a backup, just in case you find yourself in a bind.

3) Ask questions. If you are unsure about how to conduct an activity, when would be a good time to plant beans, or how to get funds for supplies—ask someone! The nice thing about working with children is that there are a lot of people who are willing to help—either by volunteering time, providing advice, or rounding up materials.

4) Assess your program. Are you fulfilling your goals? Are the students enjoying and learning during outdoor exploration? Is the administration onboard with your progress and plans? What do the volunteers think about the activities? Keeping observations and open conversation with your coworkers and students will improve your efforts and enable you to tailor activities to the needs of each class. Most of all, keep in mind that the process of working with children, albeit stressful at times, ought to be rewarding and enjoyable. If everything crashes down around you, just remember: there’s always next season!”

To say that this is what I learned “in a nutshell” would be a gross understatement. I have tools to deal with unruly children, methods to engage parents, coordinate volunteers, keep funds flowing in times of need, reach out to the members of the community for ideas and support, keep a level head when chaos is looming, and maintain a perspective on the purpose of the program. I developed improvisation skills and ways to relate to the students. Perhaps most importantly, I learned my limits, when I have to be firm and say no to a request. If I am ragged, how can I be a good teacher? When I am not mentally present during a program because I am concerned with another task, how can I focus on my students? Saying no does not mean that I am letting someone down or leaving my students in the lurch. Saying no ensures that I do not over commit myself and that I do not let my students down. In developing lesson plans and revising activities I learned the importance of reflection and recording observations. Just as a scientist keeps an accurate journal of their methods, so too should teachers be aware of their student’s successes and complications. Curriculum is more than just a lesson plan; it is an atmosphere of learning, the creation of an environment where critical thinking and contrasting ideas can be discussed.
In 2009, I set goals for my internship experiences, and I feel that I exceeded each in the following way:

- **Oxford Children’s Garden goal**: to create and implement a botany curriculum based on plant life cycles for use with 6-12 year olds in a garden setting.
  - Not only did I create botanically-focused curriculum, I also aligned each activity to the Ohio State Science Academic Content Standards. The lessons went beyond plant life cycles to include ecosystem interactions and community engagement.

- **Peaslee Garden goal**: to create and implement a botany curriculum emphasizing diversity and adaptations for use with preschool aged students in a garden setting, and to gain horticultural experience maintaining a children’s garden.
  - During my time working with preschool students, I extended the curriculum activities beyond plant diversity and adaptations to include additional subjects such as math and physical education. I also maintained their garden space which involved diagnosing pests, watering, weeding, and pruning.

- **The Conservatory Program Evaluation goal**: to gain experience in informal program assessment by evaluating the effectiveness of the field trip program at The Conservatory at Miami University-Hamilton.
  - Through my preparation for assessing the program at The Conservatory, I learned about different methods of data collection and interpretation. I engaged with teachers in a formal classroom setting and got an inside look at the ideas of 4th grade students. I designed a survey tool and ensured its administration, then collected and reviewed the data to make recommendations on program revisions.

I exceeded the goals set for each portion of my internship experience. I simply cannot wait to establish a children’s garden program of my own, involving community members, sharing the life skills of nutrition and botanical knowledge, and evaluating the effectiveness of the program in fostering student learning.
Literature Cited


# Oxford Children’s Garden

## Gardeneering Camp Manual

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Recording the Weather

Materials:
Journals, writing utensils, thermometer, rain gauge, scarf, poster board

Description:
This ongoing activity should be practiced weekly. Three stations around the garden supply weather information to the students. A thermometer attached to the central trellis, a rain gauge attached to the bird feeder stand, and a scarf, which is tied to the garden cart. The students should record the temperature, rain amount, and wind strength every week in their journals. They can also draw a picture of the sky if they wish. After several weeks, discuss trends in the student’s records.

From Experience:
It is helpful to have a large poster board displayed with an example of how their journals will look. Try to keep the time of day when they record the weather constant. The temperature in the garden varies significantly from early morning to mid afternoon. The younger children (6 year olds) will have difficulty writing down words and numbers. They are eager to learn and enjoy the instruction so be sure to have a volunteer dedicated to assisting these students. In addition, the direction of the wind can be recorded. It is developmentally appropriate for younger students to use landmarks such as the road or building to denote direction instead of north, south, east, or west. Remember to empty the rain gauge at the end of the day so it will read the weeks’ rainfall accurately.

Inquiry/Discussion Questions:
1. What is the temperature today?
2. Is it the same as last week?
3. How much rain did the garden get this week?
4. Do we need to water our garden?
5. How hard is the wind blowing?
6. What direction is the wind blowing?
7. Will the temperature be different in the winter?
8. Would the wind blow harder during a storm?
Corresponding Ohio Academic Content Standards:

Science Indicators:

Earth and Space Sciences
K.4 - Observe and describe day-to-day weather changes (e.g., today is hot, yesterday we had rain).
K.5 - Observe and describe seasonal changes in weather
2.4 - Observe and describe the some weather changes occur throughout the day and some changes occur in a repeating seasonal pattern.
2.5 - Describe weather by measurable quantities such as temperature and precipitation.
4.4 - Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure.
4.5 - Record local weather information on a calendar or map and describe changes over a period of time (e.g., barometric pressure, temperature, precipitation symbols and cloud conditions).

Scientific Inquiry
K.5 - Draw pictures that correctly portray features of the item being described.
K.7 - Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers and other appropriate tools).
1.6 - Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, timers and simple balances and other appropriate tools).
2.7 - Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, non-breakable thermometers, timers, rulers, balances and calculators and other appropriate tools).
2.8 - Measure properties of objects using tools such as rulers, balances and thermometers.
2.9 - Use whole numbers to order, count, identify, measure and describe things and experiences.
3.2 - Discuss observations and measurements made by other people.
3.5 - Record and organize observations (e.g., journals, charts and tables).
4.1 - Select the appropriate tools and use relevant safety procedures to measure and record length, weight, volume, temperature and area in metric and English units.
4.2 - Analyze a series of events and/or simple daily or seasonal cycles, describe the patterns and infer the next likely occurrence.
5.1 - Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g., thermometers, timers, balances, spring scales, magnifiers, microscopes and other appropriate tools).
Corresponding Ohio Academic Content Standards Continued:

Science Indicators:

Scientific Ways of Knowing

1.2-Demonstrate good explanations based on evidence from investigations and observations.
3.2-Keep records of investigations and observations and do not change the records that are different from someone else’s work.
4.2-Record the results and data from an investigation and make a reasonable explanation.
5.5-Keep records of investigations and observations that are understandable weeks or months later.
Pollination Creation

Materials:
Paper plates, hole punch, twine, coloring utensils, scissors, tissue paper, paint sticks, yarn, duct tape, paintbrushes (optional)

Description:
This is an excellent extension of the pollinator preference discussion. Review with the students what colors, shapes, and scents that certain pollinators prefer. Then, challenge the students to create real or imagined pollinators and their preferred flower. Explain to the students that they will be a pollinator for a day and will construct masks of their chosen pollinator and a flower to accompany it. Have them draw on the paper plate and then punch two holes on either side for twine to secure around the back of their head and cut two eyeholes. Use the tissue paper to construct flowers by laying sheets flat on top of one another, gathering the center of the pieces and forming into a stalk. Using twine, tie the gathered centers together and viola! You can duct tape your flower creation to a paint stick and put it into the garden to see if it attracts fellow pollinators. For additional pollination practice, distribute a paintbrush to each student and send them into the garden with their masks on, having them pollinate their preferred flowers with the brush.

From Experience:
This activity resulted from a sudden outburst of rain. We clamored inside and I pulled out several things from the art closet to see what we could create. The students got really ingenious in their designs, some of them choosing to imagine pollinators from different planets that only pollinated by accident when they were searching for liquid nitrogen!

Inquiry/Discussion Questions:
1. What color of flower would your pollinator enjoy?
2. What shape does your flower need to be so they could land on it?
3. What type of nectar would the flower produce?
4. Would the flower attract other pollinators?
5. Why are flowers colored and/or scented?
6. How many pollinators can you name?
Corresponding Ohio Academic Content Standards:
Science Indicators:
Earth and Space Sciences
K.2-Explore that animals and plants cause changes to their surroundings.

Life Sciences
K.1-Explore the differences between living and non-living things (e.g., plant-rock).
K.6-Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community.
1.4-Investigate that animals eat plants and/or other animals for food and may also use plants or other animals for shelter and nesting.
3.3-Classify animals according to their characteristics (e.g., body coverings and body structure).
4.2-Relate plant structures to their specific functions (e.g., growth, survival and reproduction).
4.3-Classify common plants according to their characteristics (e.g., tree leaves, flowers, seeds, roots and stems).
4.5-Describe how organisms interact with one another in various ways (e.g., many plants depend on animals for carrying pollen or dispersing seeds).

Physical Sciences
K.1-Demonstrate that objects are made up of parts (e.g., toys, chairs).
K.3-Describe and sort objects by one or more properties (e.g., size, color and shape).
1.1-Classify objects according to the materials they are made of and their physical properties.

Science and Technology
K.1-Explore that objects can be sorted as “natural” or “man-made”.
3.4-Use a simple design process to solve a problem (e.g., identify a problem, identify possible solutions and design a solution).

Scientific Inquiry
K.1-Ask “what if” questions.
K.2-Explore and pursue student-generated “what if” questions.
K.4-Use the five senses to make observations about the natural world.
1.8-Use oral, written and pictorial representation to communicate work.
1.9-Describe things as accurately as possible and compare with the observations of others.
Seed n’ Feed

Materials:
Sunflower heads ready to be harvested for seeds, sharp knife, wild birdseed mix from ACE, at least two plastic bins, bird feeders, stir sticks

Description:
As the summer moves on, the sunflowers in the garden will begin to lose their petals. As this happens, you can cut off the sunflower heads and harvest them for seeds. Birds will gladly pluck the seeds while they are still on the head, however, you can have fun making your own seed mix for our feathered friends. First, chop a few sunflower heads off their stalks for easy harvesting. The simplest way to get to the seeds is to break the head in half and push the seeds out with your fingers. Collect the seeds into a plastic bin and compare the different colors of the seeds from each head. You can add wild birdseed to the mix and any other garden items. Pour the mix into a bird feeder and during the next week, you can check to see how popular your mixture is!

From Experience:
I did not have this activity planned for the students; however, they repeatedly initiated it on their own. They involved dramatic play by imagining which birds would like the meal best, mommies, daddies, or babies. Due to the abundance of mix they carefully made each week, I took the liberty of scattering any additional seed on the beds. One time I did not scatter the excess and the following week it had grown a significant amount of fungus. This activity was also a favorite for a student with learning disabilities. The rhythmic nature of pushing out seeds is simple and productive. This activity also provides a wonderful chance to discuss food chains and tie in plant/animal relationships within the garden and our local ecosystem.

Inquiry/Discussion Questions:
1. How did the seeds develop?
2. What could have pollinated the flowers?
3. Can you see the differences between the seeds?
4. Why do you think birds like seeds so much?
5. Do people ever eat seeds?
6. Do you think sunflowers make their seeds tasty just so they can be eaten?
**Corresponding Ohio Academic Content Standards:**

**Science Indicators:**

**Life Sciences**

K.3 - Describe how plants and animals usually resemble their parents.
K.4 - Investigate variations that exist among individuals of the same kind of plant or animal.
K.5 - Investigate variations that exist among individuals of the same kind of plant or animal.
K.6 - Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community.

1.2 - Explain that food comes from sources other than grocery stores (e.g., farm crops, farm animals, oceans, lakes and forests).
1.4 - Investigate that animals eat plants and/or other animals for food and may also use plants or other animals for shelter and nesting.
2.4 - Compare similarities and differences among individuals of the same kind of plants and animals, including people.
4.2 - Relate plant structures to their specific functions (e.g., growth, survival and reproduction).
4.5 - Describe how organisms interact with one another in various ways (e.g., many plants depend on animals for carrying pollen or dispersing seeds).
Appendix B – Table of Contents and Sample Curricula for Peaslee Garden

Toddler & Preschool Garden Curriculum

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Outdoor Exploration Station

Materials:
Water, sand, vegetation such as kale leaves, nasturtiums, herbs, eggplants, zucchini, maple leaves, bins, trays, hand lenses, spoons, knives, low table

Description:
Students under the age of five are hesitant to pick items from the garden and use them as toys. To facilitate creative play with garden items, make the items available and accessible on a table in the garden. For example, get out a potting tray with dividers, put a different herb or colored leaf in each section, and provide hand lenses for in-depth exploration. The students engaged in dramatic play by putting kale leaves in trays, using spoons to stir their “cakes”, even putting them into the “microwave” under the table. If you are comfortable allowing the students to have plastic knives, they will also use these to cut the leaves-developing fine motor skills and the ability to use tools.

From Experience:
The students enjoyed using the hand lenses and played well mixing sand and water. Once they had been using the vegetation for a while (~20 minutes), you can challenge them to find the matching object in the garden. Having the table set up and supervised maximizes teaching opportunities. It’s a free and simple way to engage the students with the garden without the risk of destruction.

Inquiry/Discussion Questions:
1. Which one is a leaf?
2. Which one is a flower?
3. What color is the leaf?
4. What does the leaf look like with the hand lens?
5. What does a hand lens do?
6. What does the mint taste like?
7. What does the basil smell like?
Corresponding Ohio Early Learning Content Standards:

English Language Arts Indicators:

Communication: Oral and Visual for Early Childhood
4. Speak clearly and understandably to express ideas, feelings and needs.
6. Present own experiences, products, creations or writing through the use of language (e.g., share and talk about a drawing with others).

Mathematics Indicators:

Number, Number Sense and Operations for Early Childhood
2. Touch objects and say the number names when counting in the context of daily activities and play (e.g., cookies on a plate, steps on a set of stairs).
4. Determine “how many” in sets of 5 or fewer objects.

Measurement for Early Childhood
4. Begin to use terms to compare the attributes of objects (e.g., bigger, smaller, lighter, heavier, taller, shorter, more and less).

Geometry and Spatial Sense for Early Childhood
2. Sort and classify similar two-and three-dimensional objects in the environment and play situations (e.g., paper shapes, 2 balls of different size).
3. Identify, name, create and describe common two-dimensional shapes in the environment and play situations (e.g., circles, triangles, rectangles and squares).

Data Analysis and Probability for Early Childhood
1. Gather, sort and compare objects by similarities and differences in the context of daily activities and play (e.g., leaves, nuts, socks).

Science Indicators:

Earth and Space Sciences for Early Childhood
5. Explore how their actions may cause changes in the environment that are sometimes reversible (e.g., hand in flowing water changes the current) and sometimes irreversible (e.g., rock dropped that breaks).

Life Science for Early Childhood
5. Recognize physical differences among the same class of people, plants or animals (e.g., dogs come in many sizes and colors).

Physical Sciences for Early Childhood
1. Explore and identify parts and wholes of familiar objects (e.g., books, toys, furniture).
2. Explore and compare materials that provide many different sensory experiences (e.g., sand, water, wood).
3. Sort familiar objects by one or more property (e.g., size, shape, function).
5. Explore ways of moving objects in different ways (e.g., pushing, pulling, kicking, rolling, throwing, dropping).
Science and Technology for Early Childhood
1. Identify the intended purpose of familiar tools (e.g., scissors, hammer, paintbrush, cookie cutter).
2. Explore new uses for familiar materials through play, art or drama (e.g., paper towel rolls as kazoos, pan for a hat).
4. Demonstrate the safe use of tools, such as scissors, hammers, writing utensils, with adult guidance.

Scientific Inquiry for Early Childhood
2. Show interest in investigating unfamiliar objects, organisms and phenomena during shared stories, conversations and play (e.g., “Where does hail come from?”).
5. Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about).
6. Explore objects, organisms and events using simple equipment (e.g., magnets and magnifiers, standard and non-standard measuring tools).
7. Begin to make comparisons between objects or organisms based on their characteristics (e.g., animals with four legs, smooth and rough rocks).
8. Record or represent and communicate observations and findings through a variety of methods (e.g., pictures, words, graphs, dramatizations) with assistance.

Scientific Ways of Knowing for Early Childhood
3. Participate in simple, spontaneous scientific explorations with others (e.g., digging to the bottom of the sandbox, testing materials that sink or float).

Social Studies Indicators:
Geography for Early Childhood
7. Explore ways we use the natural resources found in our environment (e.g., water to drink, dirt to plant).

Citizenship Rights and Responsibilities for Early Childhood
1. Demonstrate cooperative behaviors, such as helping, turn taking, sharing, comforting and compromising.

Social Studies Skills and Methods for Early Childhood
1. Gain information through participation in experiences with objects, media, books and engaging in conversations with peers.
3. Represent ideas through multiple forms of language and expression (e.g., drawing, dramatic play, conversation, art media, music, movement, emergent writing).
Pollen Matching

Materials:
Construction paper shapes: seven blue squares, seven red triangles, seven green circles, seven purple hearts, seven orange stars, seven pink diamonds, six laminated construction paper flowers with matching shape cutouts, duct tape

Description:
The students will practice their matching skills with colors and shapes while using plant pollination as the theme. First, arrange the laminated flowers around the playground (without being watched by the students) behind posts, low to the ground, under a bench, etc. Then, hand out a shape cutout to each student and tell him or her to find the matching flower. After they have found the flower, they can attach their shape and try another.

From Experience:
The students excelled at this activity. At first, they had difficulty finding the flower shapes (which I hid in the tunnel under the slide, behind the brick wall, on the backside of a bench, on a post, and around the fence) but after some encouragement, they gained confidence in their abilities. They got very excited when they found the matching shape and continued to play the game for ~20 minutes. They used shape and color vocabulary when asking for a new form. They extended the activity without instruction and matched the green circles to nasturtium leaves and purple hearts to other purple flowers.

Inquiry/Discussion Questions:
1. Where did you find the matching flower?
2. Did you know that pollen is in the center of the flower?
3. Did you know that different flowers have different pollen?
4. What color is your shape?
5. What is the shape?
Corresponding Ohio Early Learning Content Standards:

English Language Arts Indicators:
Acquisition of Vocabulary for Early Childhood
4. Demonstrate or orally communicate position and directional words (e.g., inside, outside, in front of, behind).

Communication: Oral and Visual for Early Childhood
3. Follow simple oral directions.

Mathematics Indicators:
Geometry and Spatial Sense for Early Childhood
1. Match identical two- and three-dimensional objects found in the environment in play situations (e.g., 2 squares of same size, 2 stop signs).
2. Sort and classify similar two- and three-dimensional objects in the environment and play situations (e.g., paper shapes, 2 balls of different size).
3. Identify, name, create and describe common two-dimensional shapes in the environment and play situations (e.g., circles, triangles, rectangles and squares).
5. Demonstrate and begin to use the language of the relative position of objects in the environment and play situations (e.g., up, down, over, under, top, bottom, inside, outside, in front, behind, between, next to, right side up and upside down).

Patterns, Functions and Algebra for Early Childhood
1. Sort, order and classify objects by one attribute (e.g., size, color, shape, use).

Science Indicators:
Physical Sciences for Early Childhood
3. Sort familiar objects by one or more property (e.g., size, shape, function).

Science and Technology for Early Childhood
3. Use familiar objects to accomplish a purpose, complete a task or solve a problem (e.g., using scissors to create paper tickets for a puppet show, creating a ramp for a toy truck).

Scientific Inquiry for Early Childhood
5. Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about).

Social Studies Indicators:
Geography for Early Childhood
1. Demonstrate and use terms related to location, direction and distance (e.g., up, down, over, under, front, back, here, there).

Social Studies Skills and Methods for Early Childhood
1. Gain information through participation in experiences with objects, media, books and engaging in conversations with peers.
Build-A-Plant

Materials:
Blank paper, pre-cut construction paper forms: soil, stems, leaves, petals, chalk, birdseed or sunflower seeds, glue, contact paper

Description:
This activity is useful for teaching students about the parts of a plant while utilizing visual and tactile methods of instruction. First, distribute a blank sheet of paper to each student and explain that they will be constructing a plant. Pass out glue sticks and the soil cutout. Ask them where the soil would go and have them glue it to the paper. Continue to pass out one plant part at a time and keep the class pace even. Stems should follow soil, leaves third, and petals fourth. Once the plant is built, collect the glue sticks and pass out a half piece of chalk to each student. Ask them where the roots would go and have them use the chalk to draw roots on the soil. Finally, using liquid glue, attach seeds to the middle of the flower head and allow to dry. To keep the seeds from falling off the paper, cover the area with contact paper.

From Experience:
If you are building the plant in their journals, you may want to remove the pages first or be sure they are thick enough to withstand repeated opening and closing. Most students were very successful at this activity and those who struggled did so mainly with the dexterity of holding the glue stick and arranging the pieces. I made an example and the students requested it several times as a reference. Ask questions of the students throughout the session to increase retention and discovery.

Inquiry/Discussion Questions:
1. Why do plants need soil?
2. What color is the stem?
3. What is the job of the stem?
4. What color are the leaves?
5. Where do you find the seeds on a sunflower?
6. Where are the roots of a plant?
Corresponding Ohio Early Learning Content Standards:

**English Language Arts Indicators:**

**Acquisition of Vocabulary for Early Childhood**
3. Name items in common categories (e.g., animals, food, clothing, transportation, etc.).
4. Demonstrate or orally communicate position and directional words (e.g., inside, outside, in front of, behind).

**Reading Process: Concepts of Print, Comprehension Strategies and Self-Monitoring Strategies for Early Childhood**
4. Begin to visualize, represent, and sequence an understanding of text through a variety of media and play.

**Reading Applications: Informational, Technical and Persuasive Text for Early Childhood**
1. Use pictures and illustrations to aid comprehension (e.g., talks about picture when sharing a story in a book).

**Writing Applications for Early Childhood**
2. Name objects and label them with assistance from adult cues (e.g., table, door).

**Research for Early Childhood**
3. Recall information about a topic dictated or constructed by child.

**Communication: Oral and Visual for Early Childhood**
1. Attend to speakers, stories, poems and songs.
3. Follow simple oral directions.

**Mathematics Indicators:**

**Number, Number Sense and Operations for Early Childhood**
2. Touch objects and say the number names when counting in the context of daily activities and play (e.g., cookies on a plate, steps on a set of stairs).
15. Join two sets of objects to make one large set in the context of daily routines and play (e.g., combining 2 bags of raisins, each containing 3 pieces; combining 2 groups of blocks, each containing 3 blocks).

**Geometry and Spatial Sense for Early Childhood**
5. Demonstrate and begin to use the language of the relative position of objects in the environment and play situations (e.g., up, down, over, under, top, bottom, inside, outside, in front, behind, between, next to, right side up and upside down).

**Physical Sciences for Early Childhood**
1. Explore and identify parts and wholes of familiar objects (e.g., books, toys, furniture).
Science Indicators:
Scientific Inquiry for Early Childhood
3. Predict what will happen next based on previous experiences (e.g., when a glass falls off the table and hits the tile floor, it most likely will break).
5. Use one or more of the senses to observe and learn about objects, organisms and phenomena for a purpose (e.g., to record, classify, compare, talk about).
8. Record or represent and communicate observations and findings through a variety of methods (e.g., pictures, words, graphs, dramatizations) with assistance.
Scientific Ways of Knowing for Early Childhood
1. Offer ideas and explanations (through drawings, emergent writing, conversation, movement) of objects, organisms and phenomena, which may be correct or incorrect.

Social Studies Indicators:
Geography for Early Childhood
7. Explore the ways we use natural resources found in our environment (e.g., water to drink, dirt to plant).
Social Studies Skills and Methods for Early Childhood
1. Gain information through participation in experiences with objects, media, books and engaging in conversations with peers.
2. Begin to make predictions (e.g., guess whether other countries around the world celebrate birthdays).
Appendix C - The Conservatory Program Revision Recommendations and Examples

EXECUTIVE SUMMARY

Through the analysis of 560 student surveys and six teacher questionnaires, the assessment of the program conducted at The Conservatory and Miami University-Hamilton campus for the fourth graders of Hamilton City School District yields the following conclusions:

92% of students liked visiting the college, 47% of students had never been to a college before
   Of these, 23% were scared, nervous or sad about leaving school
   12% of students who had visited a college were also scared, nervous or sad

83% of students were happy and/or excited about leaving school

79% of students liked learning about plants

The activities chosen by students (from a provided list - see Survey in appendix for options) as their favorites during the trip include; 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, students overwhelmingly chose (from a provided list - see Survey in appendix for options) to take pictures (70%). Bringing family came second (65%), touch the moving plant followed (58%), and bringing friends ranked fourth (57%).

When asked to describe a plant they saw at The Conservatory (an open-ended question), students focused on colors and morphological characteristics. 37% of students used the words green, purple, pink, white, red, yellow, or brown to describe a plant. 38% of students used shapes to describe plants such as big, tree, spiky, and tall. 37% of students used names to describe a plant. The following plants were mentioned specifically; Venus fly trap (18%), the sensitive plant (15%), cacti (11%), and cotton (4%). 497 students could describe a plant 4-5 months after their visit (93%).

When asked what they learned on their field trip (an open-ended question), both the lab dissection and exploration in The Conservatory were catalysts to learning. 26% of students answered generally that they learned about plants, and 7% learned “a lot”. Students recalled learning that there are many types of plants (22%), that flowers and plants have parts (11%), and how to dissect a flower or plant (9%). 4% of students mentioned that they learned there was a spider on a dollar bill. In all, 481 students (90%) gave a plant related response.

Teachers who responded to the questionnaire enjoyed the opportunity to visit the campus, the hands-on experiences for the students, 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, the exotic plants in The Conservatory, as well as the organization, locality, and low cost of the field trip. All six teachers who responded to the questionnaire enjoyed the trip and are looking forward to it next year.
Teachers suggested that a spot needs to be designated for lunch away from classrooms to reduce disturbance to Miami University-Hamilton students, the opening lecture of the plant dissection lab ought to be shortened to allow for in-depth exploration of the flowers, the instructional supplements need to be provided prior to the trip, and the documents ought to exclude information that is beyond the developmental stages for the students (“some of the material was too difficult for fourth graders to comprehend”).

In regards to the Fast Plant experiment, teachers noted that the bees are fragile and fall apart easily, more stakes are required to support the growing plants, and the number of seeds provided needs to be increased.

In light of this feedback, the following suggestions are provided:
1) Adequately prepare the students for the trip to reduce the number of scared, nervous, and sad attendees. I suggest showing pictures of the campus and addressing the fact that they will be leaving school for #hours and will return @... This will aid in the transition for uneasy students.

2) Continue to use tools in the lab such as microscopes and clickers. Extend the use of tools in The Conservatory through hand lenses or a projected microscope on a television screen.

3) Due to the ease of propagating Mimosa pudica plants, The Conservatory could donate one per classroom so students could experience its motion daily and in doing so become interested in learning more about plants. This would involve growing 13 Mimosa pudica plants prior to the field trip. During the exploration of The Conservatory, some Mimosa pudica plants ought to be prominently displayed with room for students to explore its features.

4) Capitalize on the student’s fascination with carnivorous plants by using a Venus fly trap to discuss leaf margins or plant requirements. During the exploration of The Conservatory, Venus fly traps, pitcher plants, and other carnivorous plants ought to be prominently displayed with adequate room for students to explore their features.

5) Demonstrate the rules of the conservatory game with a colorful and unique plant. A cotton plant, a pitcher plant, a Venus fly trap, or a Mimosa pudica are all great examples. A plant with brightly colored petals or leaves and a unique shape would also be appropriate.

6) Send the students home with information on how to visit The Conservatory; hours of operation, phone numbers to reach staff, instructions on where to park, a map of the campus, and a self-tour guide would all enable students to easily bring their family members and friends to The Conservatory.

7) Decrease the amount of content covered during the opening lecture of lab portion.

8) Designate an area for the students to eat lunch away from active lecture rooms.

9) Choose instructional supplements for the teachers that are appropriate for the students and provide these to teachers prior to the field trip. Teachers could provide feedback on the materials so they can be revised for maximum benefit to the students.
10) Incorporate a photography session into the activities of The Conservatory. It could include actual cameras or simply handing a cut out paper frame to each student and asking them to “take a picture” of a plant. This will enable them to focus closely on features and will satisfy their need to be photographers! A photography contest could be another planned activity for future visitors. Sending actual pictures of some of the plants in The Conservatory to the classrooms would prepare students for the trip and would be fun for a scavenger hunt. These pictures could be labeled with captions such as “toothed margin” or “compound leaf”.

Notable Quotations:

7) Describe a plant you saw at The Conservatory...

“All kinds of different plants and trees that live in different habitats.”
“I saw a plant that moved when you touched it, to protect its self.”
“I saw a Venus fly trap for the first time!”
“It was about 6 feet tall and there was 3 flower bud and it was purple.”
“Pointy, prickly, green, usually seen in the desert.”
“The one that moved when you touched it I loved, it was very engrossing.”
“Vinise fly trap the vinise fly trap eat the minarl of bugs.”
“White, purple, 5 petals, green stem, small plant.”

9) What did you learn on your field trip?

“That there are cool exotic plants then the ones in Ohio.”
“That there are many different plants in the world.”
“That there are many kinds of plants that can do cool stuff.”
“That there is a female and male part of a plant.”
“The parts of a plant because I didn’t know the parts.”
“What all the parts of plants were and what names of plants are.”
“What the life cycle of the plants are, different kinds of plants, and what is inside of a flower.”
“You can never learn enough about plants.”
“About different parts of a plant like a pistil.”
“About the four parts of a flower.”
“All about plants and how they give us ouxigin.”
“How plants systomes work and how to disect a flower without tering it apart.”
“How to describe and search for plants.”
“I learned that might have to help your partner sometime.”
“I learned about all the different plants in the conservatory.”
“I learned about different kinds of plants and how most of them lived.”
“I learned about plants and what they really do.”
“I learned about seaples peatles pistils and other things like that.”
“I learned new plants and the clicker game taught me a lot.”
“I learned that all fruits have seeds.”
“I learned that learning about plants are fun.”
“I learned that peppers were a fruit.”
9) What did you learn on your field trip? (Quotations Continued)

“I learned that plants aren’t just pretty they help the environment.”
“I learned that the most important thing in the world is plants.”
“That it does not matter how old you are, you can learn anything.”
“That flowers come from different families.”
“That learning about plants is called botany.”
“A Venus fly trap doesn’t just eat flies.”

The images used in the introductory lesson were revised to better reflect the skills and interests of the students. Original images are shown on the left and revised images on the right.
Original Version

Figure 29.14 Common leaf forms of (a) dicots and (b) monocots. Examples of (c) simple leaves and (d) compound leaves.

Revised Version

The Conservatory at Miami Hamilton has lots of plants! When you come to visit, look for unique leaves like these.

How are these leaves different from each other? How are they the same? Can you find a leaf shaped like a heart? Can you find a leaf with teeth? Are all of the leaves green?

Lily Pad — what shape is this?
This Papaya leaf has lobes. Can you count all of them?
Australian Pine — these leaves are small needles!
Palm trees live in the tropics, do you know where the tropics are located?
These croton leaves are colorful!

A fern leaf is called a frond.
What plant is this? Why do the leaves have teeth?
A cotton leaf has lobes, can you find them?

Leaves have adaptations to help them live in different environments. Can you notice the adaptations these leaves have to collect sunlight, repel water, and collect minerals?

Plants come in all shapes and sizes. These are some of the forms that plants grow in. When you visit the Conservatory at Miami Hamilton, look for plants of different forms like these!

This is a palm tree. Trees have one main stem.
This is a cactus, it grows on rocks and other plants for support.
This pitcher plant is an example of a hanging plant.

Some plants live in the water, like these lily pads. These are aquatic plants.
This cactus has a chalk stem to store water. It has adapted to live in dry environments.

We can’t wait to see you at the Conservatory at Miami Hamilton!
The game directions used to review the rules were also changed, the original version is on the left and the revised version is on the right.

### Original Version

1. Each partner must choose different rooms; Big Room, Tropical Room, Hort Room, or Desert Room.

2. Find a special plant and write clues to describe it **without** writing down the name.
   - Use colors of flowers, colors of fruits, number of petals, if it is a vine, tree, cactus, or shrub, the shape of the leaves, the texture of the plant.

3. Find your partner and trade clues.

4. Go find the plant your partner described with the clues.

5. Write down the **name of the plant found on the tag**.

6. Find your partner and check to see if you found the right plant.

7. Get a signature from Dr. Gladish, or your teacher, and keep on playing!

#### RULES

1. **DO NOT EAT ANYTHING**

2. **DO NOT PICK ANYTHING**

3. **NO RUNNING**

### Revised Version

1. Each partner must choose a different room; either the Big Room, Tropical Room, Hort Room, or Desert Room.

2. Find a unique plant and write clues to describe it **without** writing down the name.
   - Use **colors**, **shapes**, **plant forms** such as "tree", "vine", or "hanging plant", and **numbers** of petals to describe your plant.

3. Find your partner and trade clues.

4. Identify the plant your partner described with the clues.

5. Write down the **name of the plant**, it will be written on a white tag next to the plant.

6. Find your partner and check to see if you found the plant they described.

7. If you are correct, get a signature from Dr. Gladish or your teacher, and keep on playing!

#### RULES

1. **DO NOT EAT ANYTHING**

2. **DO NOT PICK ANYTHING**

3. **NO RUNNING**
Appendix D- Sample Daily Schedule from Oxford Children’s Garden

LEAVES IV: June 20
Goals: Students realize that plants form the basis of all foods
Students demonstrate the concept of a food chain
Students understand that plants are vital to the existence of life

Materials: food chain images, props, snack, soap balls, tulle, ribbon, herb handouts, certificates, coloring page

9:30-Take attendance, pass out nametags

9:45-Review last week’s lesson–Herbs
Remember how many herbs we smelled last week?
What were the herbs used for?
Read Trout are Made of Trees by April Pulley Sayre
What is a food chain? What is at the bottom? What is at the top?
What would our food chains look like without plants?
What did you have for breakfast this morning? Trace back to plants
Can you think of any food that does not originate from a plant?
What types of food chains exist in our garden?
Play food chain game w/puppets

10:00-Decide what garden work needs to be done
Review garden rules

10:15-Garden work

11:15-Journals START COFFEE POT
Wrap soap balls in tulle and tie with ribbon
Record weather: temp, wind, rain
Measure plant
Discuss trends in weather, getting hotter? Staying the same?
Discuss trends in plants, getting taller? Shorter?
Why is it important to keep records?
Play food chain game again?

11:45-Snack GET POT FROM KITCHEN, ADD HERBS
What did you learn today?
Clean Up
Unstructured time

Optional game/craft: scavenger hunt, leaf rubbings, animal masks

Pass out certificates-reminders from last session
Planting memories: What students learned about plants from a conservatory field trip

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Abstract: Done correctly, school field trips extend and enhance the classroom learning of students. 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. The feedback was 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 for future visitors, taking into account student perspectives about plants.

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

INTRODUCTION

Students need to begin learning 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 due to how little students know about plants as compared to animals (Uno, 1994; 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 (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 (Tunnicliffe, 2001) because young students identify their out of school experiences as the source of most of their botanical knowledge (Tunnicliffe and Reiss, 2000; Bebbington, 2005; Falk, 2005).

School field trips bridge non-formal and classroom learning and, when the two are integrated effectively, mutually reinforce classroom experiences with concepts learned on the field trip. Appropriate classroom activities can 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 in class to how much knowledge was obtained out of the classroom (Lindemann-Matthies,
Class time spent talking about the potential of the trip allows students to prepare for the visit and reviewing the experience afterwards promotes retention and synthesizes the experiences with class studies.

Research into how trips to museums and science centers influence long-term visitor learning is limited, however, there is evidence that a visit to a museum creates a powerful memory that can be recalled months later (Stevenson, 1991). In some instances, attitudes towards science can change to be more positive (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 studies have reported on the collection of feedback from students on their field trip experiences; however, it has been reported that students enjoy breaking the classroom routine to visit a science center, and they are aware that they are expected to learn during their trip (Eshach, 2007). Some students find leaving the comfort of school and changing routine to be emotionally taxing, and particular attention needs to be taken to sensitively prepare them 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 and two hours in a conservatory playing a game of plant identification, the goal of which is to expose them to plant diversity and build botanical vocabulary. 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 can be used to improve these types of 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. The 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 during future field trips.

**MATERIALS AND METHODS**

In 2005, a botanical conservatory was opened on a regional campus of a public mid-sized university in southwestern Ohio. The building boasts about 5,200 square feet of greenhouse space, as well as a native plants garden and prairie grassland 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 disabilities. Five percent of students struggle with basic English proficiency (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. These students were divided into two groups, one group heading into the conservatory and the other into a science laboratory. The students in the science laboratory were taught about plant reproduction and then dissected Peruvian lilies using dissecting microscopes and a structured worksheet. The 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 in every fourth grade science class in the district (all of whom 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 also posted online during the same time period. All data collection procedures were approved by the university’s human subjects review board.

The surveys asked the 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 were allowed to 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, for a total of 560 student surveys. The student surveys and teacher questionnaires were analyzed by compiling frequencies of each forced choice response and sorting the open responses of students into categories. The primary and secondary author independently identified categories from the data to increase validity of the results. Disagreements in categories were resolved through discussion.
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______________

RESULTS

A total of 560 student surveys were completed, but 27 of those indicated that they 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, 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
used color (such as the words “green,” “purple,” “pink,” “white,” “red,” “yellow,” or “brown”).
Responses that fell into the action category included words such as “move,” “close,” “eat,”
“fold,” and “curl.” The organ category included “leaves,” “flower,” “fruit,” “stem,” and “trunk.”
While texture 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 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.

Figure 1. Student responses to question 7; “describe a plant you saw at the conservatory,” grouped into the most frequent descriptive categories.
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 now actively encourages teachers to look over the plant descriptions the students are writing at the conservatory and to encourage 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) notes 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 previous 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 will mean making revisions to the materials currently used during the program.

The revisions are 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, they 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 also 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 a growth form 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 also be used to revise programs to facilitate additional student learning about plants, by bridging the gap between what students and botanists know about plants.

LITERATURE CITED


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