Real plants, real tools, real science: Building a conservation ethic through botanical exhibits

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Introduction

At the same time that issues of science and conservation become increasingly critical in public debate, virtual experiences are competing with real ones, and people are growing progressively more alienated from nature. One result of this alienation is that despite the vital importance of plants, people know very little about them and generally cease to notice them in daily life. Wandersee and Schussler (1999, 2001) coined the term "plant blindness" to describe this lack of awareness and understanding of plants. Although exhibitions in many science centers and related venues seek to illuminate botanical concepts, few employ real plants to convey the information. Even botanical gardens regularly rely on models or other abstractions in their educational programs. Yet, botanical gardens are in a unique position to offer direct experiences with plants and the natural environment. People, after all, come to gardens to be close to nature. However, few public gardens take full advantage of the educational potential of their collections.

At the Huntington Botanical Gardens, in San Marino, California, we practice a basic tenet of environmental education that people must develop basic awareness and knowledge of a topic before they can then develop positive attitudes and take actions related to the subject (Stapp, et al. 1969). The more they comprehend the complexity and beauty of the natural world, the more they will appreciate it. Hands-on investigations ranging from viewing stomata under a microscope to measuring the acid levels in pitcher plant juice pull visitors into direct, visceral, and exciting experiences with plants. We believe that these experiences are a prerequisite to a greater public understanding and valuing of the plant world, and ultimately, a stronger conservation ethic.

In this paper, we will present strategies for promoting visitor engagement and understanding through botanical exhibits. We will share successful and less successful interpretive elements; how the public reacted to those exhibits; and how gardens may begin to promote people's positive feelings about plants and the conservation of biodiversity through interactions with real plants, real tools, and real science.

Conservatory for Botanical Science

The Huntington Botanical Gardens, a 103-year-old estate garden of more than 200 acres, is still growing into its educational mission. In 2005, the Huntington opened a Conservatory for Botanical Science aimed at families with children between the ages of 9 and 12. By choosing this target audience, we saw an opportunity for children to have a positive experience with science and nature at a critical age. The focus reflects both the United States' *National Science Education Standards'* (1996) emphasis in grades five through eight on the structure and function of living systems, and the diversity and adaptation of organisms, and the *Science Content Standards for California Schools'* (1998) seventh grade focus on life sciences. Furthermore, the middle school years those during which a child makes the decision to either "like science" and take more science classes in school, or avoid it altogether (George 2000). Positive experiences

with science-related activities such as those offered in the Conservatory can build the confidence and skills a child needs to pursue an interest in science, biodiversity, and conservation.

The Huntington's Conservatory is a 16,000 square-foot steel and glass building with a central rotunda and two symmetrical wings. Three of the four galleries feature habitats: North American coastal bogs, pantropical cloud forests, and pantropical lowland rain forests. In the fourth gallery, the Plant Lab, collections highlight the diversity of plant parts, including roots, stems, leaves, flowers, seeds, and spores. More than seventy exhibits are located throughout the structure, with about half of them in the climatically moderate Plant Lab. Exhibits and plants are integrated, giving visitors the rare opportunity to interact directly with living collections.

Real plants

This project takes full advantage of its greenhouse setting by using real plants in exhibits wherever possible, rather than models or other representations. We feel that real plants have the strongest possible cognitive and affective impact on visitors, and are the strongest antidote to "plant blindness". With this criterion in mind, we limited ourselves to topics that visitors could observe directly from plants during their visit.

For example, one exhibit using living plants is about carnivorous tropical pitcher plants, *Nepenthes*. The exhibit's objective is to show how the plant digests insects, so staff and volunteers gather juice from the pitchers for use in the exhibit. Visitors compare the acid level in pitcher juice with that of purified water using pH meters affixed to exhibit tables. *Nepenthes* growing in hanging baskets and in the ground surround the exhibit. Through examining authentic pitcher juice, complete with partially digested insects, visitors connect the carnivorous habits of the plant to the digestive juices in its pitchers.

> "I thought it was cool, because like I don't see a plant [*Nepenthes*] like that everyday — that digests a bug." — Female, 5th grader (RK&A 2004)

Another successful use of living plants in an exhibit is one focusing on stomata. Rather than make a large investment in a photosynthesis exhibit that would, for example, show changes in oxygen levels within a closed chamber holding grass, we decided to feature the visible structures that plants use in photosynthesis. After some searching, we discovered that the common houseplant *Tradescantia zebrina* has large stomata surrounded by green guard cells within a field of purple epidermal cells. They are quite spectacular under magnification. By viewing a leaf section through a compound microscope, visitors are able to see the actual structures used for gas exchange in a living plant. The leaf section is under the microscope, and living zebrina is on the table and planted nearby. This exhibit has the advantages of highlighting exciting new aspects of a familiar plant, making an abstract concept concrete, being relatively economical, and featuring an easily purchased and cultivated plant.

To be sure, not everything can be shown with living plants. To illustrate phenomena that are too quick, too slow, too small or too difficult to demonstrate live, we selected short video clips. We have videos showing growth, pollination, seed dispersal, and the actions of various carnivorous plants. The intent of using video was not to draw attention away from the living plants, but to help visitors see them with new understanding.

Real tools

During early testing with our target audience, we learned that children appreciated using authentic scientific instruments. They were eager to spend long periods engaging in activities such as measuring the sugar level in nectar samples with a Brix refractometer. Rather than becoming distracted by the tool, students reported that they were surprised to learn that flowers had different kinds of nectar (RK&A 2003). With minimal armoring, we were able to set up an exhibit consisting of: three nectar samples; three vases of corresponding flowers; boxes of tissues for cleaning; and tethered refractometers. This became one of our most successful exhibits with visitors spending a median of almost 3 minutes at the exhibit and expressing understanding of the main message: different pollinators prefer nectars of different sugar levels (RK&A 2006).

It remains an important project goal that the tools be used to enhance observation and understanding of the plants, rather than become an end unto themselves. One exhibit we are still evaluating in this regard uses an underwater camera for examining the underside of aquatic plants. Currently we have tropical water lilies in a pond with an acrylic wall. Visitors can view the plants through the clear wall or with the aid of the camera. The camera is controlled with a joy stick so younger visitors seem to find it compelling, although we are less certain that use of the technology is creating a deeper understanding of the organism and its adaptations to aquatic life. We recently replanted a giant Amazon water lily and will evaluate the exhibit to learn if visitors now use the camera to examine the lily rather than manipulate the camera for its own sake.

Sometimes the tools can be quite simple. During one evaluation session, we asked students to use and comment on an exhibit about flower parts (RK&A 2003). The prototype exhibit consisted of cut flowers in a vase, and labeled, scanned images of flowers. The activity was to identify and count the flower parts. The students rightfully pointed out that they were not motivated to do that. They said it was “too much like school” and that they did not see the point in the activity. Our content focus was reproduction, so we simply added a dry paintbrush and asked the students to move the pollen to the stigma, to pollinate the flower, just as is done in the field and nursery. Suddenly, there was a reason to know what the reproductive parts of the flower were and how they worked. We later added a videoscope and monitor so that visitors could see this process more closely, but a hand lens would work as well.

Real science

Our third project goal was for visitors to build scientific skills and confidence. In order to incorporate the practice of science into the exhibits, we asked ourselves what visitors would do at each exhibit, rather than what they would learn. This filter helped us to eliminate many ideas, and to focus the remaining ones. As a result, exhibits encourage visitors to engage in the practice of science – to touch, smell, observe, measure, and compare.

One straightforward method of encouraging visitors to engage in observation was to create flipbooks that describe the trapping and digesting methods of carnivorous plants. The plants themselves are located adjacent to these flipbooks and each comes with a tethered magnifying lens. A similar exhibit asks visitors to identify orchids that mimic insects. The orchids are growing on a tree overhanging the exhibit, again accompanied by magnifying lenses.

Measurement is the main activity in another exhibit where visitors compare two 5-gram samples of *Sphagnum* moss. A lightweight plastic basket holds each sample. The dry sample is sealed in

a plastic bag to prevent it from taking on water. The wet sample has no bag, but is free to absorb water. The length of basket handle compensates for the slight difference in weight between the samples. Visitors dip the wet sample in a basin of water and weight it on a waterproof scale. They then compare the weight of wet sample to the dry one. A close up image of *Sphagnum* cells on the main label shows the hollow cells that give the moss its unique water-holding character. In this way, visitors gather their own data from real samples of moss and learn that "wet moss weights a lot more than dry, because moss soaks up a lot of water" (RK&A 2003).

Impact

We conducted evaluation throughout the process of exhibit development; testing prototype exhibits with the target audience, visiting public, and museum colleagues. Altogether, formative evaluation included approximately 250 people. Summative evaluation included exit interviews (of 100 visitors) and focused observations with interviews (of 79 visitors). About two-thirds of Conservatory visitors could give specific examples of how they engaged in science during their visit. They mentioned using the scientific tools, practicing scientific skills, interacting with the collections, and the general assemblage of exhibits.

While nearly all exit interviewees said they had a positive attitude toward plants before they visited the Conservatory, one third said they had a heightened appreciation of and respect for plants after the visit. They had gained insights through experiencing new habitats, viewing new species, and learning about plants' habits and characteristics.

> "I learned all about plants — where they come from and how they live — so that makes me respect them more." — male, 50 years (RK&A 2006)

In summary, gardens can counteract visitors' "plant blindness" through offering them real plants to see, and real tools and real science to help them understand those plants. Seeing and understanding are the first steps toward developing a conservation ethic.

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Biographies

Karina White has been developing botanical exhibits and programs for nine years. Before coming to the Huntington, she worked at Descanso Gardens and the Brooklyn Children's Museum. She has an architecture degree from UCLA.

Kitty Connolly has eleven years experience developing exhibits and programs for the Huntington Botanical Gardens and the Smithsonian Institution. She recently joined the board of the American Public Garden Association.