Congress Papers

Ecoclub school nature camp experience in the forest

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Key Words*: Teaching and Learning, Strategy and Future Vision for Greater Impact and Change*

ABSTRACT
Since the late 90's Ecoclubs have been established in almost 80 schools in the southern Indian states of Tamil Nadu and Pondicherry. Ecoclubs are a programme of educational outreach for young children covering a range of environmental issues. A key part of the programme is a 3-day forest experience nature camp, where children are, in most cases for the first time, away from their homes and classrooms. It is designed to awaken their different senses and emotions and to reconnect them with nature through guided walks, observation, self-discovery and practical sessions. This paper explores the issues underpinning a successful eco-camp, from selection of students through to the difficulties to overcome as well as the immediate and long term outcomes.

GENESIS
India has a fascinating ecological tradition developed by people over thousands of years of intimate interaction with the natural world. Nature worship is an ancient tradition in India and all forms of life are considered sacred. The ancient Tamils worshipped nature and set apart sanctified land to propitiate the tree spirits; such sacred groves persist today, although the beliefs that ensured their protection are less steadfastly observed than in the past (Swamy). However the younger generations are moving away from nature worship and are disconnected with nature generally. Over the years such educator-philosophers as Comenius, Rousseau, Pestalozzi, Herbart, Froebel, Spencer, Dewey, James and Thorndike have all pointed out the need for reinforcing abstract learning with concrete experience (Mathur, 1986).

INTRODUCTION
An Eco-club is a group of 40-50 students studying in 6^{th} to 9^{th} Standard and typically between 8 and 12 years old. They are enthusiastic, environmentally concerned and socially committed. The Eco-club programme is tailored to suit the interests of the school taking into account its location (typically poor rural schools), the interests of key staff members, and the land available for such activities as organic vegetable plots or medicinal herb gardens, composting, recycling and waste separation, and finally the funds available. An eco-club adviser visits the school once a week on average for two or three hours to work with the students. More details can be found in Alexander and Britto (2004).

Why A Nature Camp?
Current environmental education takes place predominantly within the four walls of the classroom, and at the same time the culture of a childhood spent playing outside is gone, and children's everyday life has shifted indoors. As a result, children are disconnected from nature (Palmer, 1998). As Richard Louv (journalist, child advocate, and author of "Last Child in the Woods" (Louv, 2005)) says, there is a "nature deficit disorder". Louv sees a direct connection between the absence of nature in the lives of today's 'wired generation' to some of the most upsetting childhood problems: attention disorders, depression, and obesity.

To overcome this deficit, the nature camp is at the core of the eco-club approach. Initially, it was designed for eco-club schools from the foothills on the margins of the forest, but it was later extended to other parts of the

Eco-club network too. The ultimate aim of the nature camp is to create an opportunity to appreciate and better understand nature.

The programme is designed as an emotional journey into the forest. The development of imagination and a sense of wonder have been positively linked to children's early experiences with the natural world (Cobb, 1977 and Wilson, 1994 quoted in Dimensions, 2005). A sense of wonder is an important motivator for life-long learning. It is not just passing on information or teaching the students, but inspiration with admiration to help them to merge with the natural world. We follow L B Sharp's methodology, "teach outdoors that which can best be taught outdoors, and teach indoors that which can best be taught indoors."

Choosing the Nature Camp Students

Participating in the 3-day Nature Camp is a reward for active and passionate eco-club students who have done outstanding eco-club activities in their school and at home. And after the camp it is intended that they will act as role models and eco leaders in their schools. Students must have completed a one day Environmental Education Programme (EEP) but more effectively they are kept waiting at least one year before they can go on camp.

The camp is usually the first time they are away from their parents and the normal school environment, and moreover they spend three days in a remote forest village. Students from different schools learn to live together, sharing their food and time with others.

THE CAMP

The First Day - Preparation

On the first day, the students start with an early morning session of yoga and meditation which helps to prepare their minds and bodies to be active and stay focused on the camp. This is followed by an overview about the forest ecosystem and importance of biodiversity but presented informally, for example by the "web of life" game which articulates clearly how living and non-living organisms are linked together and how nature builds a complex network with different species.

Once students understand the game properly, it gives them grounding for the forest walk and a better understanding about how the forest ecosystem works. They are then taken into a nearby degraded forest for their first experience with nature, being shown the impact of soil erosion and the underlying causes of the forest degradation.

Later on the first day, students visit a local village and are encouraged to practice "enquiry based learning" with traditional healers, honey collectors, animal hunters and other knowledgeable village people. Students learn about traditional herbal medicines, flora and fauna of the hills and some of the reasons for the degradation. This interaction with local people gives a meaningful learning experience and an overall picture of the present status of the forest.

The Second Day – The Forest Walk

This has been a dream for all eco-club students since they never imagined walking in a real forest. Following a briefing on how to behave in the forest, the walk takes them six kilometers inside it. The students are encouraged to observe different kinds of plants and butterflies. They are told about medicinal plants and their uses, which they see in the wild. They also see different kinds of indicator plants for forest degradation like

Lantana camera and other invasive species. They admire the brilliant blooms of wild orchids which they have never seen before. Colourful varieties of lichens and their symbiotic relationship can be seen in the pollution free environment. Each student admires centuries-old huge, wild mango trees and taste different kinds of wild fruits. On the way, they collect dead insects of different shapes, fallen leaves, dead butterflies and other insect parts. For them this was a very important assignment.

Figure 1. *Dr. Stephen R. Kellert of Yale University says that "Play in nature, particularly during the critical period of middle childhood, appears to be an especially important time for developing the capacities for creativity, problem-solving, and emotional and intellectual development." He continues, "Unfortunately, during at least the past 25 years, the chances for children to directly experience nature during playtime have drastically declined" (Kellert, 2005).*

Once they enter the middle part of the forest, walking under the dense dark evergreen forest canopy is a thrilling experience for the students. They experience the smell of the forest soil, and see different kinds of insects and their role in the decomposition process. They are encouraged to sit down and close their eyes and listen to the melodies of the forest stream, the birds and insect sounds.

At the end of their walk, students are advised to observe the stream which has been polluted due to plastic carrier bags and bottles. This is typically greeted with sadness and the students volunteer to clean up the stream themselves. All non-degradable waste is collected and stored in gunny bags and carried away from the forest.

Figure 2.

After leaving the forest, the students interact again with local people through folksongs and with dance. They convey the message of saving the stream from non-degradable waste and explain the role of local people in controlling waste. At the end of the programme, some of the local people voluntarily come forward to bury the non -degradable waste in a deep pit.

The Third Day – Hands-On Training

The third day starts with field based solid waste management which can be practiced in their school and home, following the 4Rs – refuse, reduce, recycle and reuse. Then there is a practical session on vermiculture and biodynamic compost-making with an easy method of rearing earthworms. This is followed by a class on growing plants in nursery bags and then finally a session on propagation and mulching. All of these are practical hands-on sessions. The third day concludes with a communal song and dance.

CONCLUSIONS

Feedback and Evaluation

> *"For all of our eco-club students, it was the first time they'd been in a real forest experience where they had an opportunity to visit or be allowed to explore and study the wonderful uniqueness of plant diversity. The response from the students was thrilling, joy, excitement and adventure... I cannot express enough how much we enjoyed the experience and I hope to see more of these types of children's exploration and discovery areas developed in the future."*

All students are provided with a form for feedback and their opinion on various aspects of the camps. An informal quiz programme is often organized to assess their level of understanding. And back at school the whole experience is revisited, and then individual schools work out their action plans.

Challenges

The programme is not without its problems, the biggest being ensuring the safety and security of the students for the whole three days, especially the walk inside the forest. It is done purely on personal risk and individual responsibility, but it has been overcome with the direct and active involvement of teachers and support from the vibrant eco-club teacher network. The other big issue is finding funding partners for this programme.

Impact of the Nature Camp

The impact of the nature camp manifests itself in different ways. Some students, on reaching home, remove unwanted plants from their family plots and replace them with medicinal plants. Others take responsibility for cleaning their home and water sources. Some become role-models for other eco-club students and still others actively participate in public awareness campaigns.

To paraphrase S K Mathur, why should a student be content with mere words when she or he can see, touch, taste, hear and smell a living lesson? Though we have provided some practical training, we have not told them what they should do once back at home. Once they realize the importance of the natural world and its interconnections, children know what they want – they do not need to be told to go home and plant a tree.

Sir David Attenborough warned that children who lack any understanding of the natural world would not grow into adults who cared about the environment." "The wild world is becoming so remote to children that they miss out," he said.

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Successes and challenges in IBSE training for teachers and educators in Moscow University's Botanic Garden

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The IBSE training course for teachers and educators in Moscow University's Botanic Garden was one of the outcomes of the garden's participation in the EU project "INQUIRE: Inquiry-based Teacher Training for a Sustainable Future" (2010-2013) under the FP7-SCIENCE-IN-SOCIETY-2010-1 programme (Willison, Derewnicka and Vergou, 2013). The fundamental aims of the project were: to review existing educational resources; update them in line with the IBSE methodology and make them available to teachers; to develop a garden-based course for teachers, to introduce them to the new techniques of, IBSE educational resources and the topical issues of biodiversity and climate change; to encourage botanic gardens to collaborate more actively with school teachers as an education platform; and to establish closer cooperation in the educational sphere between European gardens (Bromley, Regan, Kapelari, Dillon, Vergou, Willison and Bonomi, 2013).

Our INQUIRE course was developed with the help of research staff who have spent many years working on biodiversity issues, including endangered and invasive species, regional flora, etc. These experts were involved in selecting course materials and applying a wide range of techniques developed in the context of other projects. Brief explanations were written for the most interesting of these. Using their new knowledge of IBSE, the educators updated their own lesson plans and provided input to the INQUIRE course. The http://inquirebotany.org website was a very important and valuable resource for organising our pilot INQUIRE course.

In planning the pilot course **"INQUIRE as a Method of Science Education in Schools"** our focus was on teaching the IBSE methodology. During the course itself, however, we realized that the teachers lacked basic theoretical and practical knowledge of biodiversity and climate change; as these issues are not currently prioritized in teacher training and further training courses. We therefore increased the number of on-site lessons and devoted particular attention to lectures and practical work in the garden, including the use of plant guides and excursions (Table 1). We also decided to certify the course, which meant increasing course hours from 60 to 72 to meet the requirements of Russian certification standards.

Table 1: *Revised Structure of the course for teachers and educators*

"INQUIRE as a Method of Science Education for School Pupils" (72 hours of study) – course for teachers and educators.

- **32 hours of workshops and lectures in the botanic garden**
- **26 hours of activities in the botanic garden**
- **24 hours of self-study and on-line communication with teachers to share experiences and to complete the final assignment**

Module 1. How and what to teach? New tasks and new approaches to education. (20 h)	16 h	Introduction to IBSE and the course topics (biodiversity and climate change). (four hour workshop lessons)
	4 h	Independent work using website resources (reading, familiarization with resources, compiling lesson plans).
Module 2. From theory to practice: how to learn about biodiversity and climate change. (22 h)	10 h	Practical lessons in the botanic garden. Applying the outcomes of training in school teaching practice.
	12 h	Independent work using website resources (reading, familiarization with resources, compiling lesson plans).
Module 3. Reflective practice in IBSE and assessment of training quality. *(30 h)*	4 h	Assessment of quality of knowledge. Reflective practice techniques in IBSE.
	10 h	Independent work with website, participation on online surveys. Self-assessment and assessment of student knowledge and effectiveness of the lessons. Collection of materials for portfolio.
	6 h	One-day workshop on outcomes of course lessons, exchange of experience, final assessment.
	8 h	Individual consultations. Write-up of final project (programme of lessons in the botanic garden and lesson plan); writing of report with results of self-assessment, self-monitoring and student monitoring.
	2 h	Project defence, certification.

All teachers on the course had the opportunity to conduct lessons with school pupils in the garden. These lessons were a kind of practical test for them in implementing the ideas behind INQUIRE education; giving them not only practical teaching experience, but also skills in assessing student participation and knowledge gained during the lessons (Figure 1).

Figure 1: *Teachers learning the IBSE method: practical lesson with schoolchildren*

SUCCESSFUL ASPECTS OF THE COURSE

In terms of things that what went well during the INQUIRE course, I would like to highlight five aspects:

1. Practical lessons in the garden including elements of research. The teachers enjoyed pretending to be students and doing everything with their own hands (Figure 2).

This enables the teachers to see the research (lesson) through the student's eyes, rather than as teachers, thereby helping them to understand all the pitfalls and potential difficulties. It also leads to some interesting INQUIRE questions. The teachers took virtually all the practical lessons we suggested back to their schools and developed them in a creative way. From this, we learned that teachers are keen to acquire practical experience and that it is useful for them to see the lesson from the student's point of view; they ask questions like students and become more spontaneous and open.

2. Open discussion of problems and ideas during and after the lessons. The teachers were enthusiastic about sharing their experiences and ideas. Each lesson throws up a lot of new ideas, many of them spontaneously.

This helps to foster an open and creative atmosphere during the lesson, encouraging enthusiasm and new ideas, while helping to create common approaches to issues and develop contacts between the participants. From this, we learned that the teachers are very emotional and are happy to express their ideas and share their experiences. These discussions actively generate new ideas and can produce a lot of valuable information. They help to form a creative atmosphere and develop common approaches, while encouraging communication between the teachers; an important factor in forming a community of practice.

3. The opportunity for specialists to conduct lessons with students in the garden, with the teacher participating as an observer.

This is an opportunity to gain real experience in conducting lessons in the garden, to take a detached view of the students and see the outcomes of the lessons and their impact on the students. During these lessons the teachers began to see their students through different eyes, and students who normally showed no interest during lessons suddenly became actively engaged. This is a good opportunity for practical training

in reflective practice techniques. The practice of using a questionnaire to check the knowledge gained by students during the lessons also worked well.

4. The opportunity for direct communication with specialists and professionals of the very highest calibre, including authors of the Red Book of Russia, the Black Book and descriptions of regional flora, was especially interesting for the teachers.

In their questionnaires and interviews the teachers noted that the lectures given during the course greatly expanded their horizons and improved their professional training on these issues. We discovered that climate change issues are generally of more interest to geography teachers who have little training in plant science, so the lectures were particularly useful for them.

5. The most topical and effective evaluation methods; also the ones best received by the teachers; were interviews and portfolios.

We believe interviews are a very effective way of assessing results, as they provide much greater opportunities than questionnaires and enable you to take an individual approach to each participant. You can ask each participant the questions you are really interested in. With interviews, the participants do not have to do much preparation or spend time filling in a questionnaire. Here are some conclusions based on our experience:

- Direct contact with the participants enables you to assess the emotional impact of the results and their successes.
- Questions can be developed during the course of the conversation, which can be steered as appropriate.
- You can unexpectedly discover things that the participants themselves may not mention when filling in a questionnaire.

The portfolio turned out to be a very effective method of illustrating the work done by each teacher and is a good complement to the interviews. It illustrates the teacher's actual work and how the lessons are perceived by the children. It also helps to assess how creative the teacher is; brings out the emotional impact on the students during the lessons; and evaluates the core content material.

The teacher training course demonstrated that IBSE works very well in the botanic garden, where there are no fixed rules on conducting lessons and the students feel quite free. They love to work with diagrams, to discuss, to make models, construct hypotheses, design concept maps, carry out research and take photographs (Figures 3, 4, 5, 6).

Figure 2: *Practical work during the INQUIRE course – teacher research activities*)

Figure 3: *Discussion and design of a concept map (during an IBSE–lesson in MSU Botanic Garden)*

Figure 4: *Students working on the task "Make a model of a flower and tell a story about it (where and how it lives and how it is pollinated)"*

Figure 5: *IBSE lesson in MSU Botanic Garden: "What story could a twig tell?"*

Figure 6: *Plant investigations in winter during an IBSE lesson in MSU Botanic Garden*

LEARNING OUTCOMES FOR TEACHERS

The outcomes of the course are summarized below, based on questionnaires and selective interviews with teachers.

The teachers:

- improved their theoretical understanding of issues relating to conservation of plant species, biodiversity and global climate change;
- learned how to use the garden's resources in the school curriculum and for extramural education;
- learned about the INQUIRE methodology and began introducing it in school teaching practice, using the resources provided during the course (photographs of teachers, interviews, questionnaires);
- learned about garden-based lesson techniques and received training in them;
- learned about the resources of our European partners (both independently via the website and by using translated resources);
- learned about reflective practice and began using it for self-analysis and compiling portfolios;

- improved their communication skills (by participating in discussions and working out joint procedural guidelines – teacher activity assessment criteria, ethical standards for lessons in the botanic garden);
- revised some of their lessons and started updated lessons within the mandatory school curriculum;
- learned how to make active use of the INQUIRE website as online users;
- some teachers began writing items for publication on the website;
- began actively developing inter-disciplinary contacts by communicating with foreign-language teacher colleagues;
- are independently presenting the project at conferences, workshops and educator organizations.

NEXT STEPS

The next step is to promote closer interaction between gardens and schools, transforming botanic gardens into a major component of contemporary school education for learning about biodiversity and plant conservation. As the university is expanding its work with schools, it is interested in: continuing the INQUIRE course on a permanent basis and in introducing innovative educational techniques; developing a "community of partners" with the teachers and educators by engaging them in various garden programs; maintaining ongoing contacts and inviting them to INQUIRE lessons in the garden. It will also run INQUIRE workshops both in the garden and in schools; establish a series of master classes for teachers and garden educators; develop its relationships with other project partners and seek opportunities to involve them in master classes in our garden.

By introducing us to the IBSE methodology, the project gave us the opportunity to create an effective course that is both interesting and valuable for teachers; a chance to promote the Garden as a base for extracurricular education, and to promote teaching of biodiversity and climate change. Unfortunately, despite the education reform currently underway in Russia, the school curriculum is not changing and is seriously behind the times. Extracurricular education is therefore an effective way of teaching students about these issues and risk factors and of seeking ways of addressing them. This is an area in which botanic gardens can play a very important role.

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Beyond the Gardens: Ramat Hanadiv Reaches Out

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INTRODUCTION

Ramat Hanadiv was established in 1954 as the Memorial Gardens for Baron Edmond De Rothschild, a well-known benefactor who was very supportive of the early Jewish settlers at the end of the 19th century and at the beginning of the 20th century. Ramat Hanadiv's Memorial Gardens (7 hectares) are surrounded by a large nature park (450 hectares) and border two towns Moshavot and Binyamina, named after the Baron and Zikhron Yaakov, named after his father.
For many years, Ramat Hanadiv concentrated its efforts within the borders of the garden and the nature park, constantly working to improve its knowledge on ecology, education, and its visitor's experience. In 2012, 'The Community Department' was established in an attempt to better connect with the nearby communities and to cooperate in a more significant way.
This paper will describe the evolution of the strategy the community department has employed since its inception three years ago, in an attempt to show the most effective way to reach out to the community.

THE STRATEGY

Year One: Objective: To Strengthen The Community's Affinity For Ramat Hanadiv.
The most significant goal of our first year was to expand the presence and role of volunteers within Ramat Hanadiv.

Year Two: Objective: To Enhance Sustainability Issues Within The Community
Throughout our second year, Ramat Hanadiv selected specific environmental issues, identified collaborators, and implemented activities in the nearby communities. Two of the main projects were: *The Quarry Quandary*, a communal process created to generate ideas for the rehabilitation of an abandoned quarry, and *Connect*, an Eco Pass Project for Kindergarteners. Both described below:

The Quarry Quandary
The quarry quandary project invited the community to a series of events at which the participants took part in the planning stage of the rehabilitation of a nearby abandoned quarry. The goals of this project were to develop ideas for rehabilitating the abandoned quarry and to connect the community to the quarry and its heritage. Analysis of the data revealed that residents shared various ideas as to how to rehabilitate the area which included: a recreation and sports park, an environmental education center, a nature park, an entertainment venue for large audiences, an environmental art center, a quarrying heritage center and *A Man and Nature Park.* These concepts were analyzed on the basis of the following criteria: the extent to which they are in alignment with values of sustainability; how much they allow multiple and continued use; how well they serve the community; and to what extent they open and enable future opportunities. The steering committee reached the consensus that the best option was the concept of *A Man and Nature Park*, as described by the following vision statement:

> *"The park will serve the community for purposes of enjoyment, interest, and inspiration, while raising awareness regarding the relationship between man and the environment, heritage, and future.*
> *The site will serve as a link between values related to nature, landscape, and heritage in the surrounding area, incorporate community activity, and offer a meeting place to a variety of people and cultures."*

Connect

Connect: an Eco Pass Program for kindergarteners. For several years Ramat Hanadiv monitored animals as they crossed roads in and out of its borders, and in 2013, conducted a study *Lifelines for Ramat Hanadiv, An Analysis of the Necessity for Ecological Corridors* in cooperation with Alterra Wageningen University and Research Centre, The Netherlands. This study showed the necessity for ecological corridors and proved that without change most animal populations will be unsustainable, in particular, the emblematic gazelles that move between the open areas in the densely populated region.
In discussion with the mayor of a nearby town regarding the conclusions of the study, it became evident that Ramat Hanadiv could assist in raising support for the necessary changes to the already approved plans for the development of an industrial zone. The Connect Program was established to raise awareness of the importance of connectivity for the sustainability of wildlife. This program focuses on kindergarten children who then serve as ambassadors to their families and communities.

Year Three: Objective: Striving For a Community Initiative
Two years after the inception of the community department, Ramat Hanadiv instituted a new organizational strategy to promote sustainable development throughout the region. This initiative, The Partnership for Regional Sustainability, which engages the leaders, decision makers, and residents of the five neighbouring communities, together with the projects that had already been implemented by the community department, helped to set the tone for proactive participation by the community at large.

The main goal of year three was to promote collaboration with neighbouring communities through environmental projects in order to strive toward sustainability in the region. To best achieve this goal, Ramat Hanadiv published a call for proposals, named, Environment Builds Community, inviting the nearby communities to initiate environmental and community projects that will promote sustainability in the region. Ramat Hanadiv chose the top 15 projects that promote sustainability principles and that create a connection between the communities. As a continuation to this process the community department established a hub like environment to support those projects in the shared learning process. At the hub, the participants meet every six weeks, each time visiting a different project, in a different location, gaining a deeper understanding of the projects, sharing thoughts and ideas, and expanding their knowledge of sustainability concepts.
These projects include:

- The Happy Herb - An attractive herb nursery, located in the deserted Roman quarry on the grounds of Kibbutz Ma'agan Michael, it's geared towards educating the public about sustainability, healthy foods and organic horticulture.
- The Nurturing Garden at the Well-Baby Clinic - In a new community garden in the courtyard of the well-baby clinic, next to the school for special-needs children, the children themselves are responsible for building and maintaining the garden.
- Like the Flower of the Field - Ultra-religious women are learning how to create and nurture a community garden, featuring both edibles and ornamentals, in their neighborhood.
- Forest Garden - A new community garden takes shape and colour in the underdeveloped neighborhood of Givat Ada.
- The 'Edible Forest' - Strips of land next to the railroad embankments are being transformed into an ecological community garden for the pleasure of residents.
- Boostaninim - An orchard is being planted in the back yard of the village's primary school, alongside a tributary of Nahal Taninim.
- Nir Garden - Development of the public space between a kindergarten and the Nili School will bring the spirit of Mediterranean landscapes and the 'edible forest' to Zichron Ya'akov.
- Women Snap the Environment - Taking photographs of their homes' and surroundings, women from the village of Jisser el-Zarka develop their observational skills and awareness of the

environment as they create a photo archive and organize an outdoor exhibition.

- Heritage Trees - Using an online system, the most venerable trees in Givat Ada are being mapped, with annotations based on historic archives providing additional details about each tree.
- Grow Wild! - Residents of Binyamina-Givat Ada 'adopt' sections of the streets, bordering their homes, and sow wildflowers there, in keeping with the principles of sustainable gardening.
- Between the Field and the Plate - This project for kindergarten and primary school children, located in the agricultural farm in Zichron Ya'akov, graphically demonstrates the links between people and their food while deepening the kids' understanding of healthy eating.
- Community Fly - The Mediterranean fruit fly causes severe damage to fruits. In this collaborative effort, educational, hands-on activities for kindergarten children help raise awareness of this locally important subject.
- Peace Garden - With an eye towards the 'edible forest', village youngsters develop and maintain a special plot in Jisser el-Zarka's Peace Garden.
- Where Are the Crocodiles? - A group of environmental activists from Binyamina are helping advance the rehabilitation of the Taninim (Crocodiles) Stream. This project includes experiential activity days and construction of a bench alongside the stream, in cooperation with the Carmel Drainage Authority.
- KinderGARDEN - Together, kindergarten tots and their parents plant and care for a small, ecologically-sound community garden.

The evolution, scope, and objectives of Ramat Hanadiv's Community Department represent a worldwide approach to sustainability and to environmental education. The goal of raising awareness is an important one, but it is not enough. In order to make the necessary changes to reach our goal of a sustainable region, we must strive toward behavioral change. To actualize this change, we have created a process that allows individuals to identify and express their passions and personal wishes and to implement them in a supportive environment. This initiative enables the community to establish connections and work together toward the shared goal of sustainability.

The Jerusalem Botanical Gardens Children's Discovery Trail: An innovative approach to designing a Garden for Children within a Botanical Garden

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INTRODUCTION
The JBG is the biggest botanical garden in Israel, hosting a large variety of flora from around the world; this, in a city which is known for its own variety of peoples, faiths and traditions.

Like other botanical gardens in the world we too, have decided to apportion part of our grounds to a garden which would be geared towards children from all possible backgrounds.

Our vision for the children's garden was to invite children to discover and experiment with the treasures of nature through an exciting hands-on experience. Specifically, in the context of a botanical garden, we have aimed to familiarize children with basic botanical ideas. We wish for children to understand every plant's dependence on natural elements**.**

Having decided that we asked ourselves, what's necessary for a garden to make it appealing to children as young as three years old? What would engage them? What would captivate their curiosity? To answer these questions we did some research: we studied child development theories, consulted with educators and learned about the activities of other institutions similar to ours. We soon put together a list of desirable attributes for what we dubbed 'the Children's Garden'.

Having collected much data about children and their needs, we formulated the desirable attributes for our Children's Garden. It had to:

- Take into account child development theories.
- Merge with the topography of the landscape – The Jerusalem Botanical Gardens are built into a narrow riverbed including one of the slopes descending towards it. They are at no point flat and level. We wanted the Children's Garden to reflect these topographical conditions and make use of them.
- Expose lesser-known areas within the gardens – our gardens are big and we have noticed that visitors usually keep to certain parts of them. We want the Children's Garden to help us acquaint visitors with previously less accessible areas within our gardens;
- Be of equal relevance to a diverse, cross-cultural demographic: we want the Children's Garden to appeal to Jerusalem's diverse linguistic humanscape.

HOW CAN ONE GARDEN ACHIEVE ALL THESE GOALS? HOW CAN ONE PROJECT FULFILL OUR VISION?
We thought of a number of options for the structure of the new garden. At first we thought we should designate and fence a part of our grounds as the new Children's Garden, but that would not have achieved the goal of exposing the children to the botanical and topographical variety of the gardens as a whole. Then we were thinking about setting up "islands", as it were, of designated exhibits, but we soon realized that by doing that we would not be able to create the thematic sequence we were striving for. That is why we eventually decided upon the Children's Trail.

A TRAIL: LINEAR, THEMATIC COHESIVE
To ensure its accessibility to a wide range of audiences, the trail uses a non-verbal language: symbols and icons. In the rest of the garden, signs contain the Hebrew and Latin names of the different plants and trees,

while here the signs are non-verbal and graphically easy to understand. They are user-friendly, regardless of your age or native tongue.

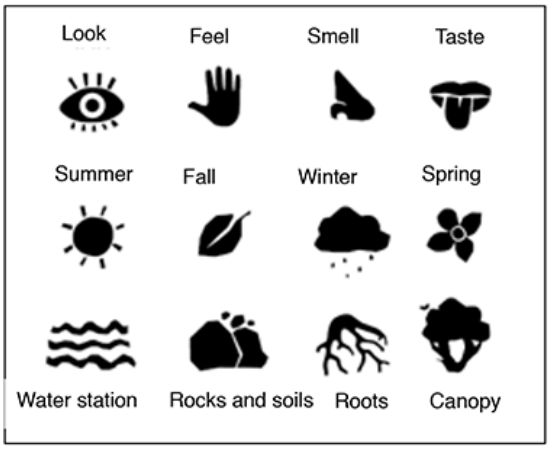

Figure 1. *The non-verbal language on the trail.*

An example of this is the map at the beginning of the trail, providing visitors with a sense of the entire trail and its different sections.

Figure 2. *Map of the trail on the floor at its entry.*

The new trail has its own defined architectural language; unlike other paths in our gardens, the trail path is made of concrete, it is intentionally fractured and is painted yellow. This makes it unique and appealing. It has thematic activity sections (detailed below) but it also runs through the different sections of the gardens merging with the existing topography. Thus, while being a defined path it also remains a part of the garden, leading to lesser known areas within the existing landscape of the garden.

The over-arching theme of the trail invites children to explore the basic components for the development of the natural world through five defined sections.

WATER

In the water section, children have the opportunity to observe and study water plants, using, for example, magnifying glasses and underwater observation buckets.

Figure 3. *The water section of the trail.*

ROCKS AND SOIL

The rocks and soils station features six exhibit areas that invite children to play, dig, break, sift, arrange and combine, using sifters and sieves. Children will learn how soil originates from rocks and the roots of plants. A focal point of this section is **Miniature Land "Lilliput"** - A collection of rocks equipped with miniature features along four different themes, where children can let their imaginations "run wild" and create their own miniature stories. Their search for props will take them to unexpected elements of the plant world: mosses, lichens, plants growing out of rock, little pools of water and more.

Figure 4. *Play in the miniature land 'Lilliput'*

UP IN THE TREES CANOPY WALK

The canopy walks consists of a 135m (443 foot)-long bridge reaching 10.5m (34 foot) high. There is some botanical merit here – seeing the canopies at eye-level, learning of their role in plant development – but first and foremost this walk will "allow children to be children" and give them the simple and pure joy of climbing, descending and seeing the world from an unfamiliar vantage point. Fully allowing for child safety, the Canopy Walk will also enable our young visitors to engage in basic bird watching.

ROOTS – CYCLE OF LIFE
This will essentially be a sculpture representing a fallen tree. The children will be able to go inside and see how a seemingly dying or dead tree keeps on living through sustaining lesser plants which "feed" on its detritus.

CONCLUSION
In building the path and its content, child development theories were kept firmly in mind. For example the Lilliput area within the rocks and soil section encourages imagination – the area is sub-divided into different "worlds", *down in the mines*, *fantasy land*, *around the world* – within this environment children are invited to bring their own toys or create them from materials lying around to spark their own imagination games, together or alone. Elsewhere in the section the giant sand pits and blackboards create a fun platform addressing physical and motor development, be it through the different textures of chalk, sand, pebbles and gravel, through the sifting, weighing and digging apparatus in the sand pits, the blackboards or simply through safely climbing the natural boulders in the area.
The water section is equipped with research apparatus encouraging independent discovery – through telescopes, periscopes and magnifying glasses children can observe, investigate and compare water plants, stimulating their cognitive development.
Throughout the trail, icon signage prompts visitors to use their senses – to look, listen, feel and even taste, thus creating a playground for sensory development. The trail as a whole addresses visitor interaction by calling for joint activities with one's own group or with new friends found along the trail.

As we complete the construction of the trail and visitors start to enjoy it, we are assessing and learning the interaction between it and our visitors. We are building new programs which utilize the many opportunities the trail offers for education. So the trail is not just a discovery trail for children but also a platform through which to achieve other aims we set for the JBG: attracting new audiences; advancing new programs; strengthening the garden's brand as a family institution; and most importantly breathing new life into the Gardens.

What plants are you wearing today? What parts of the plants are we using?
Ideas how to make education alive

Kristina Bjureke & Maria Bellet
Natural History Museum (NHM), University of Oslo, Norway & Real Jardin Botanico, Madrid, Spain

In this workshop we focused on how to make both students and the general public aware of that they are using a lot of different plant species every day, and different parts of the plants, without giving it a thought. The workshop could have had edible or medical plants as topics, but here we wanted to share our experiences from the botanical gardens in Madrid and Oslo on how we try alternative methods to engage the audience in understanding what their clothes and textiles are made of. Our aim is to make the students/public more aware of how important plants are, that we use different fiber plants in different geographic regions, and what parts of the plant we use. In addition our aim is to involve students/public in the traditional methods of obtaining fibers from different plant species, and finally to discuss fiber plants and the Earth's resources.

We started by discussions two and two: what plants did the participants in the workshop wear this day? Second task was to group a large collection of different fiber products into the animal, plant or synthetic kingdom. Third task was to investigate the different fiber products made from plants. From what plant originated the threads, cords, baskets and cloths? (figure 1) Fourth task was to discuss in the groups what parts of the different plants species that are used (example in figure 2). At the workshop all knew that it was the seed hairs in cotton, the leaves of sisal and the stalk of ramie. Finally we talked about in which continent these plant species grow naturally and commercially.

Figure 1. *Learning by doing*

A task in our fiber education is to investigate different fiber products. From what plant originates the threads, cords, baskets and cloths? Participants at the workshop made the same exercise, and expressed that it was quite difficult.

EXHIBITION: THE THREADS OF LIFE

At NHM in Oslo, Norway, we have a temporary exhibition about fiber plants: the threads of life. In connection with this exhibition we invite both school classes and groups of adults to an educational programme. We start by doing the same group exercises that we did in our workshop. Afterwards we present old traditions to make fibers from plants. Preparation of fibers from flax, with drying, removal of seeds, retting, scutching, heckling and spinning are demonstrated and students/public have to try for themselves (figure 3 and 4). Students are difficult to stop scutching, and they are amazed how much time and work is behind a hand woven linen shirt. In addition we sometimes present how to dye with plants on textiles made of plant fibers. Finally we invite the group to our greenhouse so they can learn what the plant looks like.

Figure 2. *The relationship plant-fiber-product*

It is important to make students/public aware of what the fiber plant looks like, the fiber itself, and some product made of it. Here is linden, *Tilia cordata*, as the well known fruit, but as the less well fiber and a rug made of linden bast. Extracting the fibers is a time-consuming process of soaking the bark until unwanted pulp softens or rots away. The remaining bast fibers resist rotting and were much used for ships' cordage and fishing gear. Linden bast has been used by human beings since the Stone Age. It can also be woven, often in combination with cotton, flax or wool.

Figure 3. *Outdoor demonstrations of fiber plants. Scutching and heckling flax fibers is demonstrated on dry days by Kristina Bjureke, NHM, Oslo.*

Figure 4. *Demonstrations*

Invited guests, as here the president of the Norwegian Flax Society Hanne Gjendem, present different techniques in preparing fiber plant products at NHM, Oslo, on special Sundays. The public is invited to try.

FIBERS IN THE FUTURE

Today, cotton stands for 40% of the world market and the synthetic fibers 50%. Other fibers only account for 10%! Is it wise to invest so much in one species, cotton? And what do we do when the oil becomes more expensive, or in short supply? Fiber plants are a suitable theme for a discussion on sustainable development.

The cultivation of cotton depletes the Earth's resources. The cultivation of cotton requires massive amounts of water, arable land, fertilizers and pesticides. With increased prosperity, the demand for cotton increased. Now we need to stop and reflect. Do we want to deplete the earth to get even more cotton? How will we produce our clothes in the future? A fiber plant exhibition can create important discussions. Not every student has thought about plants that can be an alternative to cotton, as hemp, jute, flax, bamboo, kenaf and pineapple. We must find new tracks. We must use other plants for production of fiber! There are hundreds of species suitable for textiles, paper, mats, baskets and rope.

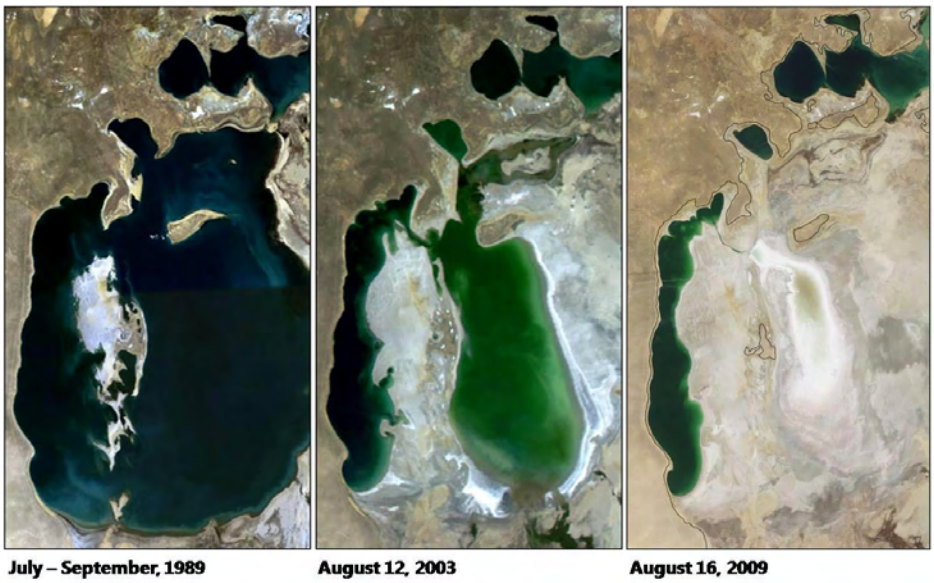

Figure 5. *Ecological catastrophe*

The Aral Sea has shrunk to a fifth of its original size. This happened because the rivers which used to feed the lake are now diverted into the desert in order to grow cotton, melons, grains and rice on a massive scale. This was part of the Soviet Union's plan to make cotton an important item for export. The plan succeeded – Uzbekistan is one of the largest exporters of cotton today. This picture (from Wikipedia) is used in educational programs to start a discussion.

REFERENCES

Photos (except figure 5): Kristina Bjureke, Per Aas and Karsten Sund, NHM, Oslo, Norway

Innovative Uses of Online and Computer-mediated Teaching to Expand Audiences and Facilitate Learning

Convener: Susan Caldwell,
Panellists: Gregory Kenicer and Jane Robertson, Lori Trexler, Elizabeth Farnsworth
Longwood Gardens; Royal Botanic Garden Edinburgh; Longwood Gardens; New England Wild Flower Society
Key Words: *Technologies for Engagement and Learning, Teaching and Learning*

With the explosion of smart phones and tablets; wearable computing devices; cloud based apps and services; and open education providers; digital learners are poised to consume online resources. We have a great opportunity to take advantage of innovative, web-based technologies to connect with learners far beyond our regional locations. These online technologies allow us to easily provide information to those whom might never otherwise learn about the importance of; horticulture, sustainability, and environmental stewardship; to our society and in our lives. Our panel, on Innovative Uses of Online and Computer-mediated Teaching to Expand Audiences and Facilitate Learning, discussed and demonstrated three different online technologies for delivering high-quality horticulture programs and botanic information to expanded audiences. These inventive programs include: a learning management system for distance learning, interactive video-conferencing lessons for K-12 schools, and a multi-faceted online tool for plant identification.

Gregory Kenicer and Jane Robertson, of the Royal Botanic Garden Edinburgh, discussed PropaGate, a virtual learning environment for delivering distance and blended learning courses that reach a global audience. Lori Trexler, of Longwood Gardens, described how live sessions are delivered to classrooms using an interactive-video conferencing system. Elizabeth Farnsworth, of New England Wild Flower Society, demonstrated an online tool for identifying native and naturalized plants of northeastern North America that can be used by children, adults and professionals.

PROPAGATE LEARNING: EXPLORE THE WORLD OF PLANTS, WHEREVER YOU ARE
With most learning institutions now adopting Virtual Learning Environments (VLEs), Botanic Gardens are starting to make wider use of them too. PropaGate Learning is the Royal Botanic Garden Edinburgh's VLE; established in 2012, it is built on the Moodle platform (Figure 1). This program is open-source, versatile and user-friendly, but is not without challenges.

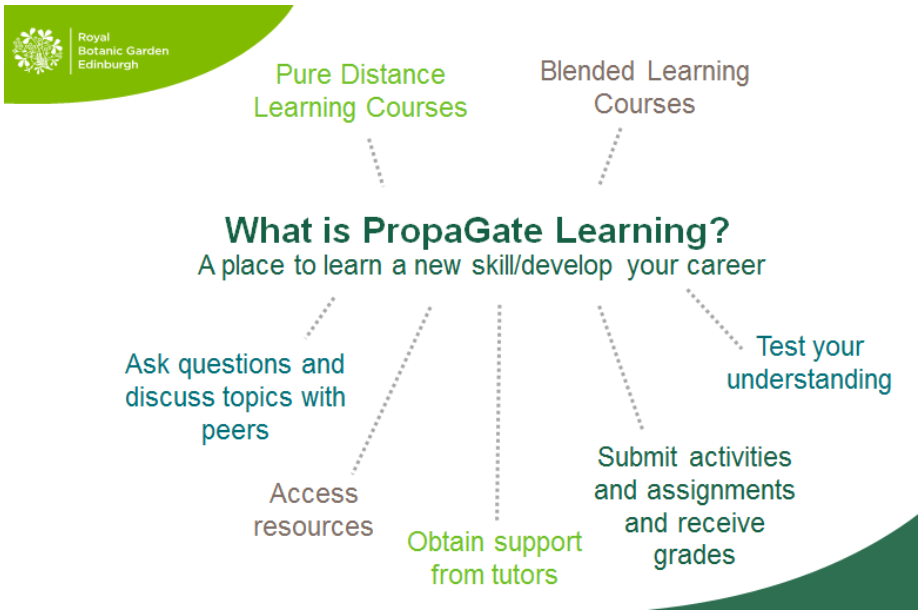

Figure 1: *RBGE PropaGate Learning*

PropaGate Learning has allowed RBG Edinburgh to access a global audience for capacity building. For people with busy lives, for people who don't live close to a Botanic Garden, or who don't have the finances to attend regularly, the use of online technology is making learning more accessible (Figure 2).

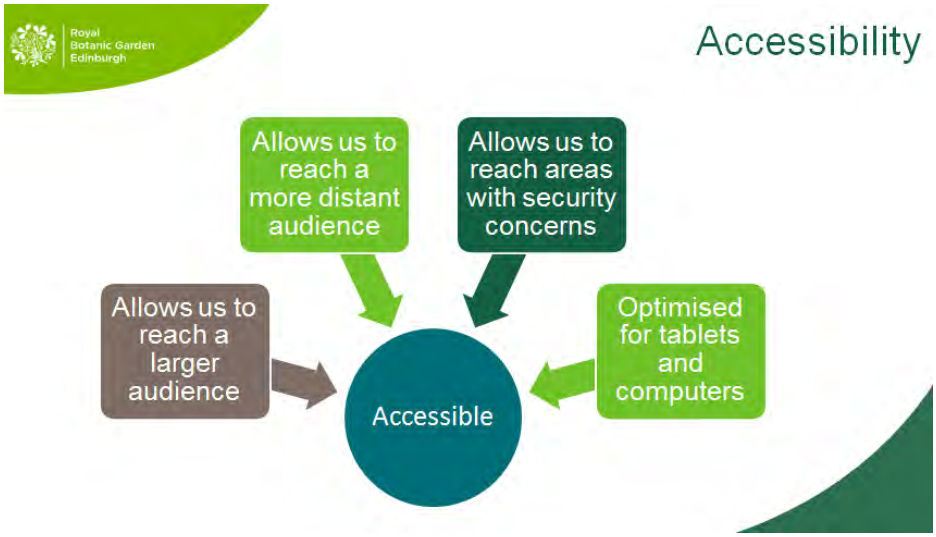

Figure 2: *PropaGate Increases Accessibility*

This VLE also provides support for students by giving them access to useful resources and providing an environment for communication and collaboration. Various models are used for delivering learning through the VLE, including distance, blended and supported learning models across a wide range of subjects (Figure 3).

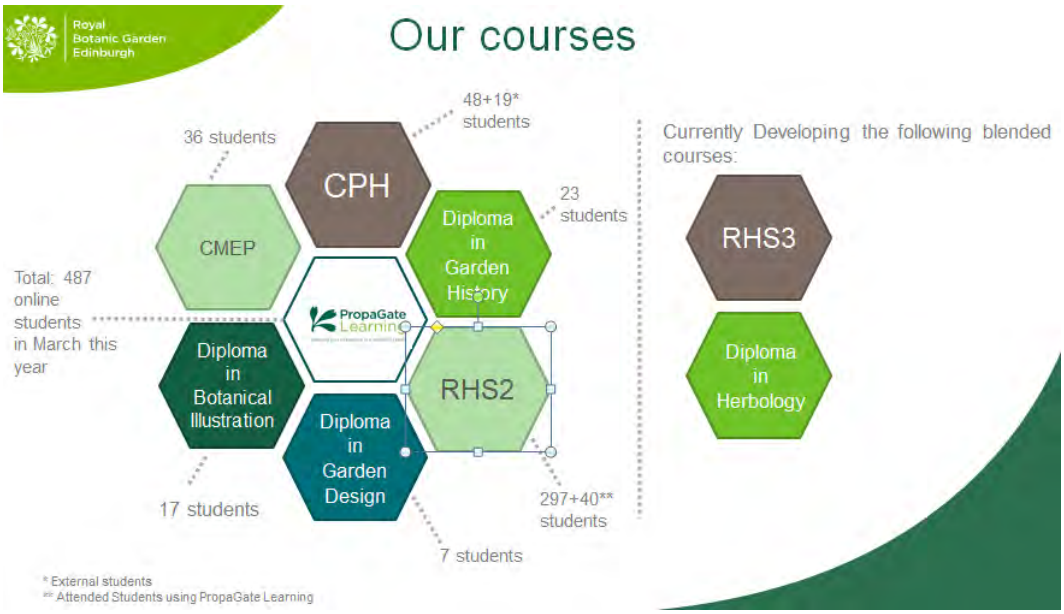

Figure 3: *PropaGate Learning Courses*

What Have We Learned?

- Keeping students on track is important
- Courses don't run themselves
- Support is required for tutors and external centers
- Significant development work is required to convert an attended course to an online course
- Students aren't just learning a new subject – they're learning the technology
- A working relationship with the hosting company is very important
- It is essential to establish netiquette guidelines at the start of the course
- A lot of images take up a lot of space!!

EXPANDING HORTICULTURE EDUCATION THROUGH INTERACTIVE VIDEOCONFERENCING

Online learning provides an opportunity for gardens to share their programs with individuals around the world. Longwood Gardens offers interactive videoconferencing lessons for K-12 students, which enhance classroom curricula through live sessions with our talented and knowledgeable Educators (Figure 4).

Figure 4: *Instructor with green screen technology*

During these exciting curriculum-based lessons, delivered through H.323 technology, our Educators engage students in discussion and problem-solving activities (Figure 5).

Figure 5: *Participating students*

Benefits include:

- Exposing students to institutions they may not be able to visit
- Connecting students to the experts
- Reducing the cost and time associated with school trips by eliminating travel

Video, images, and live plants are used throughout the lessons to provide an in-depth look at our gardens. Teachers receive a variety of interactive tools to use with their students before, during and after the lesson. Current lessons include:

- Desert Plant Adaptations (Grades 1 – 12)
- Tropical Plant Adaptations (Grades 1 – 12)
- A Plant's Life (Grades 1 – 4)
- Tremendous Trees (Grades 1 – 6)
- Operation Pollination (Grades 1 – 6)
- Arbor Day: Celebrating Our Trees (Grades K – 12)
- Free Demo for Teachers

Important facets of program development and delivery include marketing and registration. Virtual field trips are described on the Longwood web site (http://longwoodgardens.org/education/k-8-programs/online-lessons-and-activities) and listed with Center for Interactive Learning and Collaboration (http://cilc.org) and FieldTrip Zoom (http://www.fieldtripzoom.com/). Programs are scheduled by request with the date and time selected by the teacher.

Virtual field trips have been conducted in 17 states in the U.S., extending horticulture education to new audiences.

GO BOTANY! A 21ST-CENTURY TOOL FOR TEACHING AND LEARNING ABOUT THE PLANTS.

Imagine being able to identify and learn about plants in the field using an innovative set of tools on your iPad or smartphone. That is the vision of Go Botany (www.newenglandwild.org), New England Wild Flower Society's award-winning, definitive on-line Flora of New England, funded by the National Science Foundation.

Elizabeth Farnsworth, Senior Research Ecologist at the Society, introduced this richly illustrated interactive key to over 3,500 native and naturalized plants of northeastern North America; a dichotomous key for more experienced botanists; and PlantShare, where plant enthusiasts, teachers, and students can share discoveries, develop checklists, and gather citizen-science data that help botanists understand shifting plant distributions.

Identification Keys

Identification keys to species of New England plants include:

- Traditional dichotomous keys (Figure 6)
- Simple key to 1200 species
- Advanced keys to 3500+ taxa (Figure 7)

Figure 6: *Go Botany! Dichotomous Key*

Figure 7: *Go Botany! Taxon Information Page*

PlantShare

The PlantShare network pages provide opportunities for data sharing and mentoring. Participants can create checklists and share sightings of plants (Figure 8).

Figure 8: *Go Botany! PlantShare*

The program is flexible and provides the ability to tailor the on-line guide to a local flora and present information of interest to specific audiences.

Go Botany has been adapted by the Concord Museum for a recent exhibit on climate change, the Smithsonian Institution (Go Orchids!), and the Native Orchid Society of South Australia. Go Botany is a great resource for anyone, age 8-80, fascinated with plants.

PANEL QUESTIONS & ANSWERS

1. For RBGE (PropaGate Learning). What online portfolio system do you use for botanical illustrations?
    a. Mahara: an open-source product that integrates with Moodle and provides assessment.
2. For Longwood (Interactive Video Conferencing). How do you deliver lesson materials prior to the video class, online or through the post? Is there a fee for classes?
    a. Currently, there is a fee of $150 USD for a program. Materials, which include booklets and activities are delivered via postal mail.
3. How do your market your online programs?
    a. GoBotany – email campaign; press releases; newspaper articles; talks and workshops at national and regional conferences; teacher professional development programs
    b. IVC – offered a free class as a way to try the program; invite local teachers to visit the facility; presentations at national conferences
    c. PropaGate Learning – social media, work of mouth, survey indicated majority of people found the program via Google search; mentioned need to promote the fact that the Garden offers courses in general

4. For Longwood (Interactive Video Conferencing). Have you seen any impact on schools that visit the garden?
    a. Currently we are at capacity for the on-site programs. We don't anticipate that local schools choosing online programs will impact our on-site attendance. We hope that local schools will use both.
5. In Panama, we have the technology and organizations, but how do we get the content developed for online learning? The question is about funding, methodology and content.
    a. Content development takes time and is not a matter of delivering material in the same way or format as you would in person. You need personnel with expertise in computer programming and botany to build the program.
6. For RBGE (PropaGate Learning). What considerations are there regarding support for instructors developing and delivering content?
    a. Tutors need weekly support for ensuring that the online class is working properly and student questions are answered. There is a steep learning curve.
    b. Regarding development, if materials are to be prepared with bells and whistles, tutors need to have time and training or someone to do it for them. Again, this entails a steep learning curve.

Developing training for scientists to engage with the public: the story so far…

Dr. Kate Castleden
University of Oxford Botanic Garden
Key Words: *Science Communication, Teaching and Learning*

INTRODUCTION
The University of Oxford Botanic Garden was founded in 1621, with a mission "*To promote the furtherance of learning and to glorify nature*". Originally a Physic Garden, the plant collection has always been a valuable resource to students from the University.

Today the Botanic Garden welcomes over 100,000 visitors each year and engages with them in a number of ways, through events, lectures, courses, and activities. Some of the audience are reached remotely, through outreach sessions, and *via* the website and social media. In addition there is a wide-ranging training programme, for teachers, trainee teachers, horticultural trainees and others.

The garden's work focuses on understanding, valuing and conserving biodiversity, and includes collaborations with research scientists from the University and further afield, who in turn play a significant role in the public education programme. Thus, the garden's mission today spans research, education and widening engagement, which are core strategies of the University of Oxford.

"GETTING THE PUBLIC EXCITED ABOUT YOUR SCIENCE"
In 2010 the Garden's Education Team were approached to work more closely with the PhD students in the Department of Plant Sciences. Science communication and public engagement were to become embedded in their training from the beginning of their postgraduate research, with the aim that the students would continue to develop and use these skills as their careers progressed.

Students come from all around the world to complete their PhDs at Oxford. The existing training programme included topics such as plant biodiversity, statistics, bioinformatics, presentation skills and scientific writing, however there was nothing about engagement. As the Garden's Education Team had experience of communicating with a range of audiences, and one team member had particular experience with science communication and public engagement, the development of a bespoke training module for these students was a logical step. The "*Getting the public excited about your science*" module was conceived.

The first iteration of the course in 2010 comprised 4 sessions:

- Meet and greet, including a tour of the Garden and a communication challenge (*Can you describe your research in 3 sentences?*)
- Science communication masterclass, to explore a range of audiences and activities, and provide the opportunity to have a go at developing and delivering mini sessions
- Plant Sciences departmental seminar, for an audience of the non-scientific and support staff, members of the department rather than the research scientists
- Participation in "Discover Plants" school sessions at the Botanic Garden during British Science Week (for pupils aged 7 – 11 years)

The course was deemed a success, and after careful evaluation and review each year, this module has been fine-tuned into its current format of 8 sessions (see Figure 1):

- Meet and greet
- Public engagement masterclass – part 1, this session has been divided to enable time to explore the

various elements in more detail
- Participation in Cells study day (for pupils aged 16 – 18 years), students introduce their research in 3 minutes
- Public engagement masterclass – part 2
- Development of activities for and participation in the "Wow! How?" family friendly event for British Science Week at the Oxford University Museum of Natural History
- Participation in "Discover Plants" school sessions
- Plant Sciences departmental seminar
- Development of activities for and participation in the "Fascination of Plants" family friendly event at the University of Oxford Harcourt Arboretum

Figure 1: *Students participating in some of the "Getting the Public Excited About Your Science" activities*.

The additional sessions were included to provide the students with a greater breadth of experience with different audiences, and provided them with the opportunity to practice delivering their own activities in a range of venues.

In the five years since the course started, 36 students from 12 countries have completed the module. Typical feedback has included:

- *It has helped me feel more confident in presenting and talking about my work to non-specialists.*
- *It has made me more aware of the importance of science communication.*
- *I have never worked with children before and was pleasantly surprised that I quite enjoyed it.*
- *On the primary school session one girl told me she would like to be a scientist too when she grows up; that really made my day!*

As part of the module evaluation, feedback was also gathered from the various audiences who have participated in the students' activities:

- *I found the talks really interesting and it made me consider pursuing the field of plant science as a career.* (Pupil after the Cells study day)

- *The matching vegetables game was my favourite!* (8-year old child after "Wow! How?" family friendly event)
- *Hearing the science explained in an accessible manner by enthusiastic researchers was very stimulating.* (Audience member after the Plant Sciences departmental seminar)

CHALLENGES & SUCCESSES

Developing and delivering a new training module was challenging. Firstly, many of the students who attended the module did not speak English as their first language. Finding the right words to describe concepts to non-specialists in an easily accessible way is tough when colloquialisms are not used in scientific English. Students came to the module with a range of attitudes towards public engagement and science communication, some were committed and valued the opportunity, whereas others were resistant to this compulsory part of their training. The dynamic of each cohort of students has varied, and this has had a bearing on the outcome of some of the activities. Motivating students who are not committed to the training was a significant challenge. The administration of the module required time, and careful planning and co-ordination of the various sessions was essential to its smooth running. Effective collaboration both within the Education Team and with external experts proved invaluable to the module's success.

Alongside the challenges, the module also provided successes for the Education Team. As mentioned above, since the module was first delivered in 2010, it has continued to run every year since and is now a core part of the postgraduate training provided by the Department of Plant Sciences. The practical opportunities that the students have participated in have provided added value for the Botanic Garden, for example the "Discover Plants" school sessions are now advertised as including the opportunity to meet with research students from the University. For some of the students in the department, this module has not been compulsory (due to the source of the funding supporting their research), however, some have chosen to participate to gain the additional training. There have also been some reluctant converts, who began the training quite skeptical, but who enjoyed and valued it by the end.

As many of the students have come to Oxford from far afield, and with the nature of scientific research, it is likely that these individuals will continue to work abroad during their careers. Thus, the legacy of this foundation in public engagement will be international, as the students continue to use their skills in their future research groups around the world. Closer to home, successful collaboration between departments of the University of Oxford has provided internal advocacy for the module.

As with other successful projects, new opportunities have arisen since the "Getting the Public Excited About Your Science" module was first designed. The Education Team has developed science communication and public engagement training for education trainees and horticultural trainees. It has also worked with the University's Museum of Natural History and the Museum of the History of Science to provide public engagement training for other researchers at the University. In addition, it is in talks with Edinburgh Zoo to be involved with "Train the Trainer" training for its scientists.

TOP TIPS

There are a few key elements to consider when setting up this type of training. Firstly, who are your audience? What's their field of expertise? What stage of their career are they at? Where will you find them? Be clear about these things, and design your course from here. Pre-course questionnaires are a good way to ascertain levels of understanding, experience and expectation. When it comes to developing the course content, start with what you know and what you have done before, and adapt it. Collaborating with colleagues and bringing in guest speakers for different topics works well, especially those who have experience of certain audiences or particular types of engagement. Evaluate your sessions thoroughly, considering both the scientists' perspectives and the audiences' perspectives. Use this feedback to inform any changes you make to the programme.

Providing your course participants with the opportunity to practice their skills is an important part of the training process. Do you have existing events or programmes in which they could participate? Or could you set something up to provide the opportunity? Think carefully about which audiences are most appropriate for them to engage with. Botanic Gardens have such a varied audience overall, that it is good to pinpoint a type of audience more specifically, rather than being too general.

CONCLUSION

The aims of this project were to develop a bespoke science communication and public engagement training module for the PhD students in the Department of Plant Sciences at the University of Oxford. Five years later, the "Getting the Public Excited About Your Science" module is a core part of the students' postgraduate training, and has been well received by both the students and the various audiences they have worked with. The other training that has developed since then is testament both to the increasing importance and demand for scientists to have these skills and experience. It will be interesting to see how the training develops over the coming five years.

FURTHER INFORMATION

www.botanic-garden.ox.ac.uk
www.plants.ox.ac.uk

Environmental Education As A Tool For Societies' Transformation

Yair Cristina Colorado López and Andrés Felipe Cañas Rueda
Botanical Garden of Medellín Joaquín Antonio Uribe, Colombia
Key Words: *Social Inclusion and Community Engagement, Teaching and Learning*

Like all botanical gardens in the world, the Botanical Garden of Medellín, JBMED, performs actions, programs and projects aimed at conservation, research, environmental education, culture and recreation (Figure 1), highlighting the role of plants in societies.

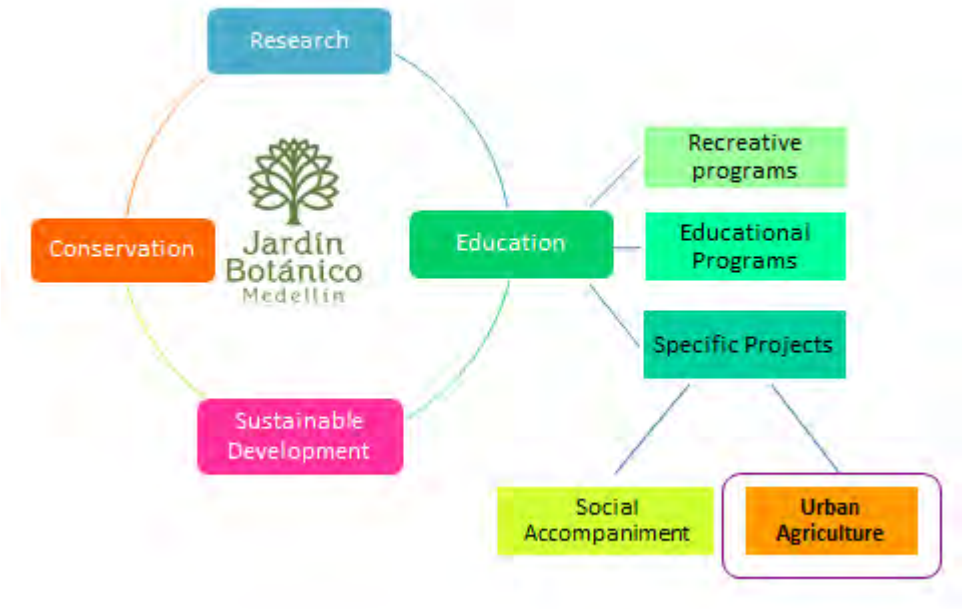

Figure 1: *JBMED's organization chart of strategic goals.*

However, at the Botanical Garden of Medellin, education is both a tool and a goal. It ensures scientific knowledge is disseminated, gets validity, and is developed from an understanding of flora as a teaching tool. What the area of education aims to do is: to generate adaptation to climate change, encourage the conservation of biological and cultural diversity through social appropriation of knowledge, in order to promote suitable environmental practices for a positive change in the public's relationship with their surroundings (Restrepo and Colorado, 2015).

A LIVING MUSEUM IN THE HEART OF THE CITY

The best tool for educational processes is the garden itself, a green lung nested in the heart of the city (Figure 2) which represents a living museum that conforms of a biological reserve and an invaluable gene bank with emphasis on Tropical Forests. Its flora is made up of native and exotic species with different habits and, as a result of its wealth, it has a great diversity of wildlife. Collections are scientifically organized into twelve thematic and five taxonomic assemblages, so it is possible to provide areas where scientific and cultural interests are combined, including the: Tropical Forest, Lagoon, Palm garden, House of Butterflies, Zamial,

Desert Garden, Medicinal Garden, Guadual, Restaurant, Sowing beds and Urban Agriculture station. Furthermore, it has the Andrés Posada Arango Library, specializing in botany, created for the purpose of supporting scientific research on the flora of Colombia and in which there are two key areas to arouse interest in flora, the herbal and didactic children's room.

Figure 2. *Aerial picture of the Botanical Garden inside the city.*

TEACHING, RECREATIONAL PROGRAMS, COURSES AND WORKSHOPS

Playful, exploration and creativity, are the pillars of our other programs designed to use recreation as a vehicle for learning about environmental issues. In this sense we build and implement projects, programs and activities with leisure time in mind, focusing on nature and conservation. From the "Escuela de la Biodiversidad" (School of Biodiversity) we promote scientific knowledge in people of all ages, through the educational processes of research, conservation and propagation defined within courses and workshops. Specific programs are described below.

Social Accompaniment

Social accompaniment, which is part of the Law 21 of 1991, Law 99 of 1993 and Law 134 of 1994 (Lineamientos sociales, 2014) states that communities must be aware of the activities and projects developed in their territory, with the aim of gaining their support. Public support contributes to the sustainability of urban projects which can be further enhanced by utilising environmental education as a dynamic and participatory process. It means that communities better understand the environmental and social issues that relate to them. This program seeks to strengthen and support technical, scientific, economic and educational processes all with an environmental angle and relevant to JBMED's work.

From 2013 to date we have implemented five projects including:

- Secretaría de Medio Ambiente: Nine districts of the city. 1,926 participants. 36 participants in the process of employment insertion.
- Hatovial (Road development concession, Northern Aburrá): 99 workshops, 2,970 participants.
- Caña Flecha: 1,020 indigenous Zenú in the three Antioquia's participating communities on the recovery of traditional usage of cane (Figure 3) (JBMED, 2015).

Figure 3. *Socialization stage, delivery of support material to the indigenous community Zenú, Resguardo de los Almendros, Bagre, Colombia.*

Urban Agriculture Program. Sowing Knowledge, Harvesting Flavors…

There is a need to promote agriculture inside and near the cities, as well as agro-ecological practices that contribute to the food security of families in the different communities of Medellin. JBMED aims to do this through the Urban Agriculture Programme, where educational opportunities are generated, encouraging the exchange of knowledge and the teachings of traditional practices; the programme has been running since 2012.The main objective of the program is to develop pedagogical processes from the creation of agroecological systems, applying different techniques used in urban agriculture.

What Do We Do?

1. Educational projects

In 2011, the Urban Agriculture station was born, created with the aim of becoming a living collection, it consists of several subsystems where different agroecology principles are introduced and explored. This living laboratory, helped to create a pedagogical proposal and produce fantastic results, thanks to the many organizations involved, such as: Rotary Club Medellin, Ecopetrol, Secretaría del Medio Ambiente, Cruz Roja Colombiana seccional Antioquia and United Nations Program PNUD; who have sponsored several projects (Figure 4) benefiting different communities. Results obtained between 2012 and 2015 are:

- 11 executed projects

- 14 workshops
- 1,775 participants
- 177 installed systems:
    - 19 schools
    - 85 families
    - 23 communities
- 44 familiar systems
- 10 systems in process (JBMED, 2015)

Figure 4. *Gardens installed through the Urban Agriculture project funded by the Rotary Club Medellin in 2012.*

2. Projection activities

- Green Market

It is carried out once per month, attended by lovers of nature and healthy practices. It is the opportunity for families to enjoy a day full of color and flavor, where organic and environment friendly products are the protagonists. Also, academic and cultural activities around food sovereignty are developed and there is a place for the exchange of seeds and knowledge. This program is free for the public, with more than 40 agro-ecological producers and marketers who exhibit and sell their products in a natural environment with a wide

cultural offer.

- Workshops and courses

From the Escuela de la Biodiversidad, general courses and practical workshops are offered to teach the concepts and principles of agroecology and urban agriculture. The topics covered are: history of agriculture, green revolution and its consequences, agroecological concepts, soil management and conservation, integrated pest and disease management, good agricultural practices, cultivation of plants in urban areas, rainwater harvesting, processing organic products, fertilizers and biological preparations.

- Virtual Network.

Since the program began, a social network was created in Facebook as a strategy of continuous interaction and learning among urban farmers.

- Manuals

As educational material for the development of programs in different communities, a first edition of the manual "Urban Gardens" was created, which describes a simple and practical way to understand an orchard as a system; how it is constructed, what materials are required and what to do in each subsystem. In addition there are some tips and botany information (Ramírez et al, 2012). For the second edition the book focused on recipes, consisting of ingredients from 25 different species and companion planting vegetables that grow easily in our weather (Ramírez et al, in press). It also includes indigenous myths about the origin of several of them.

- Seed Festivals

Since 2014, there have been two seed festivals , where many locals and academic presenters have met, with the shared desire to protect nature, allowing the opportunity to share their knowledge and opinions.

- Participation in city spaces

Talks, Fairs, exhibitions, conferences, seminars and other academic activities organized by various public and private institutions of the city, the province and the country, have invited the Urban Agriculture program to share their experiences and its results.
JBMED's education department also participates in the regional work table SAN (Seguridad Alimentaria y Nutricional), collaborates with local networks of knowledge and is member of CINAF (Comité de Impulso Nacional a la Agricultura Familiar).

How Do We Do It?

The program is conducted through theoretical and practical processes, while from an agroecological and educational approach it aims to recover planting traditions and adapting different production techniques to tight spaces. That way it hopes to eventually contribute to the environmental awareness and Food Security of Medellin and the Province of Antioquia.
Through theoretical and practical workshops, and initiating a self-diagnosis with participants the programme supports participiants through a process of participatory planning, overseeing the installation of comprehensive systems such as: seedbeds, production of organic fertilizer (vermiculture), rainwater harvesting, horizontal and vertical crops, native and creole seeds rescue, biological preparations, and post-harvest. Simultaneously, leaders are capacitated and social ties are strengthened in urban, peri-urban, rural communities and educational institutions, where PRAE (Environmental School Project in english) is articulated (Figure 5)

Figure 5. *Systems installed in each one of the processes: seedbed, crop, rainwater harvesting, vermiculture, biologicals preparations, post-harvest.*

The aim of each of the workshops is to introduce participants to a healthier way of eating. Workshops are based upon several key dishes that are all traditional and easily replicable, with a focus upon a low presence of preservatives and packaging and utilizing high nutrient ingredients that are grown in the orchard (figure 6.) The workshop lunch break is a moment to sample the food and discuss which helps reinforce the benefits of consuming healthy, clean and nutritious plants as part of your daily diet. As far as possible, these recipes are scheduled in relation to each workshop.

Figure 6. *Refreshments with orchard plants*

Work Team

At the JBMED we are convinced that developing educational programs in direct contact with nature is the first step in creating an effective impact on the conservation of natural resources. That's why we have a team of professionals trained in education, recreation, arts, social and human sciences, forestry, biology and other related subjects.

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A World-Class Legacy: *Seeds for Change: The Lives and Work of Suri and Edda Sehgal*

Marly Cornell
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I am happy to be in this special place to tell you about Suri and Edda Sehgal, remarkable people who played a part in why we're all here today in this particular place. I'll share a little bit about their connection to the William L. Brown Center here at the Missouri Botanical Garden.

Suri Sehgal is a crop scientist, seedsman, and a pivotal figure in the development of the global hybrid-seed industry for more than fifty years. He and his wife Edda are visionary business leaders, generous philanthropists, and, for last forty-one years, proud Americans.

Each of them experienced life-defining moments at a very early age. Forced to flee from their homes, they became refugees as children, escaping dangerous and difficult circumstances in their respective home countries. *Seeds for Change* is about their lives and work. And their personal story is even more remarkable than their immense business success.

Suri became a refugee during India's bloody partition in 1947. His father was an associate of Mahatma Gandhi, a leader of the Indian National Congress. They worked hard for India's freedom from British rule, and were once even briefly jailed in that effort. The period immediately following India's independence from Britain was a violent time. Suri was only thirteen when he was literally shoved onto a train, and began a terrifying evacuation from what is now Pakistan. He witnessed brutal murders and lived in poverty for a time on the streets of Delhi while searching for his family.

Edda had a similar harsh childhood. When she was only three in 1945, at the end of World War II, her family was forced to evacuate their home in German Silesia ahead of the advancing Soviet Army. Her family lived as refugees in poverty during the post-war years.

Both Suri and Edda came to America as young adults. Suri came to Harvard for his PhD in plant genetics, working with the great Paul Mangelsdorf. Edda, after finishing school and wanting to become fluent in English, answered a newspaper ad in Germany, and came to work as an au pair in the home of a Harvard professor at the time, Henry Kissinger, and his wife Annaliese — both of whom were fluent in German and English.

Suri's first job after Harvard was for a small regional seed company in Des Moines, Iowa. The Pioneer Hi-Bred Corn Company had been founded by Henry A Wallace, the former vice president of the United States, Secretary of Agriculture, and Secretary of Commerce under Franklin D. Roosevelt. For the next twenty-four years at Pioneer, Suri's mentor and greatest influence was his professional collaborator, travel companion, friend, and boss at Pioneer, William Lacy Brown. Under Bill Brown's direction, Suri was made president of Overseas Operations and turned Pioneer into a global leader (the company is now owned by DuPont).

During that same twenty-four years while Suri worked at Pioneer, the Sehgal family lived in a modest three-bedroom home in Urbandale, Iowa. Suri and Edda used their personal resources to offer opportunities for education and a better life in the US or elsewhere to Suri's family, generously helping relatives from India to become educated and get established. Edda shouldered much of the day-to-day work, helping relatives and raising four kids and a nephew, while Suri traveled a great deal all over the world, often in the company of Bill Brown.

I recently asked Suri to describe Bill Brown, the man with whom he shared such mutual respect, affection, and trust. Suri said that Bill Brown was a simple man, who was always learning, a wonderful listener, and full of kindness. "You knew he was your well-wisher." He was "honest to the bone," a man of integrity, a faithful Quaker and truly peaceful gentleman, a man of profound humility who had great passion for his work. Suri smiled as he shared a story about how, early in Bill Brown's career, he traveled thru remote areas of Central America, searching for types of maize. He was far from hotels or restaurants. He ate simply—the bananas he carried, along with coffee. At the end of each day, he merely strung his hammock between two trees. Suri said finally that Bill Brown was interested in using his skills and assets to help those in need around the world and in caring for our planet.

Other than the part about being a Quaker, Suri's description of Bill Brown contained many of the exact same words I'd choose to describe Suri Sehgal—always learning, a wonderful listener, kind, honest to the bone, a man of integrity, a truly peaceful gentleman, profoundly humble, passionate about his work, and interested in using his skills and assets to help those in need around the world and in caring for our planet.

Suri told me that he and Edda basically grew up "under the wings of Bill and Alice Brown." Suri and Edda were both strongly influenced by the warmth and kindness of the Browns—who embraced the Sehgals like family. This is not so different from the way Bill Brown had been warmly embraced by the great Edgar Anderson and his wife when Bill Brown was working on his PhD at Washington University and here at the Missouri Botanical Garden.

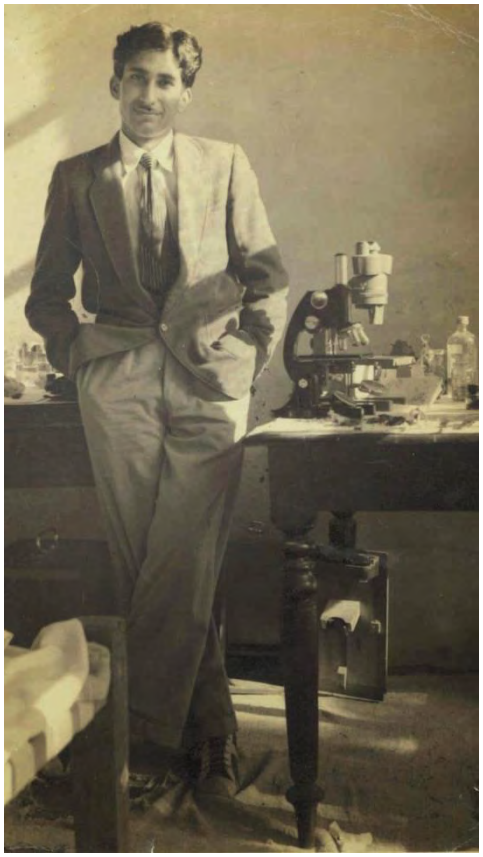


Figure 1: *Suri Seghal in Mussouri, western Himalayas, 1956*.

Figure 2: *Suri and Edda Seghal's wedding at Bill and Alice Brown's home, 1964.*

Figure 3: *Bill Brown, Edda Seghal and Henry A. Wallace in Jamaica, 1985.*

In 1964, Suri and Edda were married in the Brown's home right before they left Iowa to start a corn-breeding program in Jamaica for Pioneer. Here is a brief excerpt from *Seeds for Change* about some visitors to Jamaica that first year.

"In January 1965 Henry A. Wallace, his wife Ilo, and Bill Brown visited Suri's operation in Jamaica for a few days. The Wallaces had just been visiting corn-breeding stations in the Dominican Republic and Guatemala. They stayed at the Mona Hotel, and Brown stayed with Suri and Edda."

Meeting such a renowned figure as Henry Wallace was a great honor for Suri. He felt humbled to learn that Wallace already knew who he was when Brown inquired about hiring Suri for the Jamaica station. While at Harvard, Suri had been impressed by reading the "Century of the Common Man" a speech Wallace made in 1942 that so passionately espoused freedom for all people around the world. He thought Wallace was right on target with his revolutionary quote, "We hear a great deal about atomic energy. Yet I am convinced that historians will rank the harnessing of hybrid power as equally significant."

Wallace and Brown spent most of a day with Suri in the nursery and walking the fields together, though Wallace was limping. Both men were enthusiastic and very pleased to see what Suri had done in the nursery, and the crosses he had made. The Wallaces came to Suri and Edda's home in the afternoon. Edda made a delicious apple strudel, which Wallace particularly appreciated as they enjoyed spirited conversation together.

Wallace gave Suri a lot of practical advice involving his operation, but he also wanted to accomplish several other things during his few days in Jamaica. Since he was breeding strawberries and gladioli at his farm in Westchester County, New York, he wanted to meet people who were working on those crops in Jamaica. Though no one in Jamaica was working on gladioli, Suri arranged a meeting with a scientist growing strawberries in the Blue Mountains. At Wallace's request, Suri also set up a meeting with the agricultural attaché at the American embassy and went along on the informative visit. The lively conversation focused on the application of genetics to improve crop plants. They then visited with the American ambassador, who briefed Wallace on the economic and political situation in Jamaica.

Wallace was passionate about plants and full of ideas. Suri found him to be a deep thinker and a genuine visionary who cared about making a difference in the world. Suri recalled something he'd been told by Simon (Si) Casady, a Pioneer associate back in Johnston who had been with the company from the beginning, serving as its first treasurer. In Pioneer's early years, Wallace had said, "Si, the guys running Pioneer think their job is to make profit. I suppose they are partly right. But that isn't our real job. Our real job is to learn how nature operates and to use that knowledge to make more food for the world."

Wallace's whirlwind visit kept Suri totally occupied. Wallace confided to Suri at one point that he didn't have much time left due to ALS, and there were so many things he still wanted to get done. Before leaving Jamaica, Wallace suggested that Suri expand his plant trials to the Dominican Republic, that it was an important agricultural country.

Henry A. Wallace died that fall. Suri had already taken Wallace's good suggestion to conduct plant trials in the Dominican Republic, and it did turn out to be an important agricultural country.

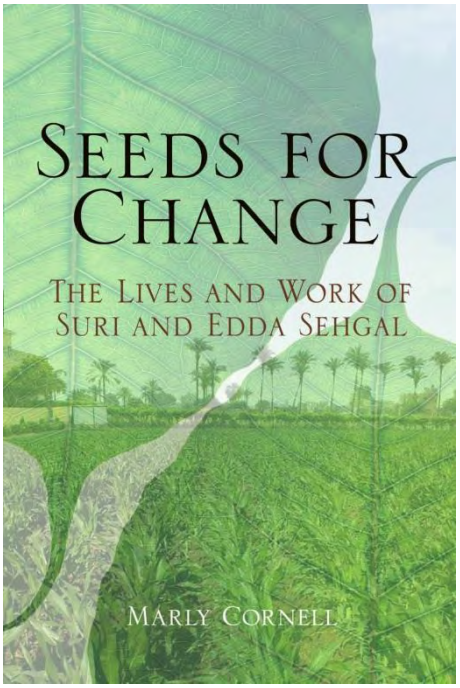
After Suri left Pioneer, he and Edda built a highly profitable seed business in India. When they sold it a decade later, they immediately decided to use the bulk of the proceeds to create a foundation to help the poorest of the poor in rural India.

Sehgal Foundation has been in operation in the US and in Gurgaon, India, for more than fifteen years, with programs that help villagers in the most impoverished communities in Haryana, Rajasthan, and Bihar. The foundation's key focus is on sustainable agriculture; water management (including access, security, and sanitation); and building good rural governance so that the poor will receive the goods and services they are entitled to. In addition, plant research continues in association with ICRISAT (Crops Research Institute for the Semi-Arid Tropics). Many other organizations and individuals have become partners in Sehgal Foundation's efforts to promote conservation and biodiversity—and to make a positive difference in the world.

Another choice made by Suri and Edda was to do something significant to honor the legacy of Bill Brown. Suri knew that the Missouri Botanical Garden (MBG) was close to Bill Brown's heart. Suri asked Alice Brown what Bill would most care about, and he spoke with MBG president, Peter Raven. As a result, Suri and the Sehgal Foundation provided an endowment for the William L. Brown Center (serving as a successor to Bill Brown's magazine *Diversity*).

The goal was to create a legacy consistent with the lifelong work of Bill Brown, dedicated to the study of useful plants, the relationships between humans, plants, and the environment; the conservation of plant species; and the preservation of traditional knowledge—all for the benefit of future generations. Suri and Edda also dedicated *Seeds for Change* to future generations, and Peter Raven wrote the afterword.

We can all be grateful that the altruistic legacy of Henry Wallace, Bill Brown, and Suri and Edda Sehgal lives on.



Seeds for Change: The Lives and Work of Suri and Edda Sehgal by Marly Cornell (Sehgal Foundation, 2014) has been recognized in the US with two gold Midwest Book Awards, a first place National Indie Excellence Award, two silver Ben Franklin Awards, and two *Foreword Reviews* magazine Indie Book of the Year Awards. Available from Missouri Botanical Garden Press www.mbgpress.info, www.amazon.com, and www.amazon.in

Evolving a functional education system for the conservation of Mexican Flora in National Botanic Gardens.

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Key Words: *Teaching and Learning, Social Inclusion and Community Engagement*

Mexico has a great biological and cultural diversity and faces many challenges for its conservation; in this context the Mexican botanic gardens (JBM, in Spanish) play a crucial role.

Mexican Botanical Gardens have been grouped for over 40 years in the Mexican Association of Botanical Gardens (AMJB, for its acronym in Spanish); currently having 63 members from 25 states. The AMJB has been working to develop the main actions of, conservation and education in JBM's. However, it was in 2007 when interest was focused on establishing a functional education system for the conservation of Mexican flora. The process for establishing this educational system began by analyzing educational programs in the JBM. The AMJB applied a survey in order to a) Assess the situation of our educational programs b) Propose a national plan of environmental education based on ecological, social and environmental needs of botanic gardens and c) Develop a national environmental education strategy. The questionnaire was answered by 50% of the membership. The results showed that educational activities in JBM are diverse with three main categories identified:

- Educational services such as guided tours (for 96 % of JBM this was the main educational activity) and a wide range of events to increase sensitivity; for example: training courses, workshops and production of educational materials.
- Educational plans: botanic gardens carried out a wide of activities with a diversity of approaches and conceptual limitations. Unfortunately 70% of educators were biologists without training in environmental education, their conceptions of "environmental education" and "sustainable development" was limited.
- Teaching support plan: This category includes gardens with a diverse training for school's teaching staff, but only 25% have a professional background in education or in environmental education.

With this profile of educational activities, the AMJB has realized there is a need to develop a strategic action plan to improve educational programs. Thus, during the annual meeting of the AMJB in 2008 the 'Educational Committee' was created. This committee began the organization of four annual workshops for the collaborative construction of the 'Environmental Education Action Plan'. In this process national and international guideline documents were reviewed in order to use them as a base to formulate the plan. The documents analyzed were: Conservation Strategy for Mexican Botanic Gardens, 2006; Global Strategy for Plant Conservation; Strategy for Environmental Education for Sustainability in Mexico; Mexican Strategy for Plant Conservation and the International Agenda for Conservation in Botanic Gardens. From reviewing the documents it was decided that JBM should:

- Integrate the target 14 (GSPC) across the activities at Mexican botanic gardens.
- Define indicators for measuring and monitoring how this target is integrated.
- Adapt educational goals to national, regional and local reality.
- Develop a conceptual and methodological framework.
- Professionalize the environmental educational work.

Thus, environmental education programs in Mexican botanic gardens should:

- Encourage reflection.
- Motivate significant learning processes.
- Promote nature appreciation.
- Inspire environmental ethics.
- Recognize the intimate relation between biological and cultural diversity.
- Produce knowledge, attitudes, habits and practices of living plant conservation.
- Tackle environmental problems.
- Promote observing capacity, nature understanding including the complex social, political, economic and cultural context.
- Strengthen efforts of Environmental education carried out by other social actors.
- Enrich the school curriculum.

As a result of this analytical process, a typology of environmental education practices in Mexican botanic gardens was proposed. It includes these different standards or perspectives:

- Botanical identification.
- Public dissemination.
- Nature interpretation.
- Plant conservation.
- Relationship between species-ecosystem.
- Knowledge of the territory.

Once the work on environmental education was identified (what, how and where it goes), we made the SWOT analysis to know our strengths and weaknesses. These topics were selected:

- Institutional
- Financing
- Professionalization
- Spreading ideas and communication
- Systematization and assessment

The SWOT analysis helped to define the objectives and lines of action of the education plan;
The objectives were:

- Define the course and actions that are crucial to strengthening educational tasks.
- Share a reference framework.
- Provide greater institutional visibility and social pertinence to botanic gardens and the Mexican Association of Botanic Gardens.
- Contribute to the Mexican Strategy for Plant Conservation: “promote education and awareness about plant diversity”.
- Influence public politics of sustainable environmental education.

According to the objectives, the following were identified as lines of action:

- Institutional Rules
- Financing
- Formalization and professionalization
- Institutional strengthening
- Interagency links

- Systematization and assessment
- Knowledge generation
- Spreading ideas and communication

For each line of action there was several factors defined: crucial actions, identified advances, implementation period and responsible staff. For example the crucial actions are:

- Institutional rules, a general diagnosis is needed.
- Financing, It should provide a list of products and services
- Professionalization, a strategic plan should be developed
- Teaching services, improve knowledge of garden visitors
- Foster interagency links for a greater visibility
- Design a systematization and assessment System.
- Generate knowledge Defining educational research lines
- Spreading and communication through printed Materials, social networks and media.

The Action Plan for Environmental Education in Mexican botanic gardens was presented in 2011 and published in 2012. Although we have delayed the implementation of many crucial activities, mainly due to complex situations in each botanic garden, we believe that it has had significant progress as:

- Modification of the Statutes of the Mexican Association of Botanic Gardens to include the Minister of Education in the board of directors.
- We organized the Workshop: "Preparing educational materials for JBM"
- Design an on line Certificate of Environmental Education for JBM

In this process we learned about:

- Reflecting on our practices:
- Dialogue between theory and practice. Define collective routes with actions and crucial operational coordination through willingness, technical ability and tolerance.
- Assessment in the field of Environmental Education.
- Recognition as environmental educators, integrating environmental know how, contents and methods towards an environmental ethic – committed citizens to sustainability.
- Empowerment.
- Participation in public politics of plant conservation (Mexican Strategy of Plant Conservation).

We know that much remains to be done, however the educational situation in Mexican botanical gardens is easier now because we know what to do, how to do it and where we go in the educational work. We have established a common dialogue that allows us to move cautiously towards the consolidation of this action plan.

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Nature Play: Nature Conservation

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Key Words: *Teaching and Learning, Professional Development*

There is increasing evidence to show how outdoor play, especially within green environments, benefits the social, behavioural and physical development of children. Botanic gardens, which have traditionally been popular with family audiences, can provide direct interaction with nature and provide diverse opportunities for child-led outdoor play.

For the site manager it is a question of how to ensure a safe and rewarding play experience while still maintaining the integrity of the site including plants and habitats. We have been exploring different approaches to nature play such as how far to go in prescribing the type of play through the provision of designed structure or materials and how much to rely on 'found objects', natural features and plants and the children's own creative imaginations.

Nature play as a form of outdoor, early childhood education has a long history and the benefits of spending time with nature are now widely accepted. However, an understanding within situated agendas and locales is limited and there is a paucity of empirical research into this genre of play in botanic gardens to inform management policy. By closely investigating nature play by adult and child participants within an area of semi-natural vegetation, the Project hoped to develop a better understanding not only of what participants do, but also determine user needs and wishes. The findings of this research provide a basis from which to prepare a series of Guidelines for nature play both at RBGE and beyond, so that lessons learnt in this study can be shared worldwide with the management of other botanic gardens and urban nature reserves.

Six themed 'Intervention' days were devised, one per month between April and September 2014: 'Wood', 'Listen', 'Stone', 'Meadow', 'Earth' and 'Water'. The research design recorded how pre-school children and their adult carers engaged in nature play within an area designated by a map. Data collection comprised observations and assessment of the impact of play. Participants were encouraged to feedback through annotation of their maps, in conversation with the researchers and via questionnaires emailed to adult participants following their visit. Data were analyzed interpretively and reflexively by the research team.

Findings indicate that nature play was enjoyed and suited to the context of a botanic garden. Visitors valued the freedom and time to investigate, explore and be creative with natural and non-natural resources. There was evidence of meaningful human-nature interactions and in particular, participants liked the continuity of experience and the opportunity to return to the same site under different conditions. There are families, however, within the local community for whom nature play is not routine and while informed about the opportunity, were reluctant to attend. The results from this study are transferable and relevant to comparable sites and ten Guidelines are presented to help management enhance their provision.

KEY FINDINGS AND GUIDELINES

Nature Play is Popular and Readily Accommodated
There are regular visitors to RBGE with young children, both boys and girls, who are eager to participate in

nature play. Indeed, a community was seen to be developing that comprised participants who attended more than one Intervention who shared comparable attitudes and values towards nature play. Nature play opportunities can be readily accommodated and even a small area of semi-natural vegetation is a sufficiently rich source.

Guideline:

Recognise how minor adjustments are often all that is necessary to adopt nature play. Giving regular users of RBGE permission to take part in nature play is attractive and liberating to them when in a space where such behaviours were previously 'not allowed'.

Locally, There Are Harder To Reach Groups

While there is a community of adults who actively seek and want their children to spend time playing with nature, families remain within the local community who do not routinely choose to participate in nature play at RBGE. The Project had limited success in attracting these non-users and demonstrated how nature play attracts visitors with similar dispositions. Word of mouth is significant in communicating about opportunities between participants.

Guideline:

Build upon enthusiasm of existing advocates of nature play to attract others to such initiatives. Establish the concept with existing audiences and staff before seeking ways to extend nature play.

Nature Play is Spontaneous and Unpredictable

Nature play is difficult to plan for and control. It will rain, high winds will impact on safety, children will get stung, there will be chance occurrences and interactions will vary (see 5, below). These characteristics are inherent both to nature and the play conducted within it. Resources that are fluid and generic can better accommodate spontaneity and visitor choice. Loose parts and tools can be added to increased opportunities or play; however, finite resources may be the source of conflict behaviours.

Guideline:

Be flexible, both in the use of the setting and its resources. Suggest subtle traps in favour of planned, compartmentalized activities that limit freedom. While both natural and non-natural tools and resources are popular, there is value in open-ended, generic resources (eg. stones, fallen tree trunk) versus more prescriptive items (eg. buckets, magnifying lenses).

Taking Time Pays Dividend

Nature play participants can be encouraged to slow their pace to help them to engage in meaningful human-nature interactions. Seating helps adults to increase the duration of their visit. Less journeying increases the likelihood of child-led exploration. Likewise, when children are on foot, human-nature interaction increases.

Guideline:

Provide appropriate spaces and means to sit. Ideally, seating is durable, washable and weatherproof as well as portable to allow choice in where to sit. Offer adults the opportunity to leave buggies and prams to better afford children direct contact with nature.

Guidance Is Prudent

Demarcation of a nature play area is vital for all stakeholders. Visitors were aware that some nature play behaviours were less appropriate beyond the boundaries of the designated site. In the context of RBGE, some visitors looked for guidance until comfortable with permitted activities (see 10, below). This project has shown maps help to guide and suggest rather than prescribe and direct activities

Guideline:

For visitors, a map is a fundamental source of information and we advise maps are offered. For management, the maintenance of a site in unison with tolerance and understanding of the characteristics of nature play are important and will help different agendas to co-exist.

Creativity and Fantasy Play Are Common Features

Observed child behaviours were routinely creative and make-believe was a pervading facet. Children's imaginations can be reliably effective and simple resources (for example, sticks and fallen leaves) can hold a child's interest for sustained periods. There is a fine line between mess or disorder (for example, scattered pebbles, muddy hands) and creativity.

Guideline:

Promote nature play in as broad a frame as feasible and allow scope for contect driven interpretations. Disarray may not sit comfortably with orderliness of a botanic garden. Familiarity of and tolerance for the charateristics of nature play are key.

There Is Longevity and Continuity In Nature Play

Nature play spans time frames imposed by humans. Relationships with nature can take time to establish and may do so via continuity of experience and opportunities for repeated behaviours, given that the same locations may be visited on multiple occasions during different seasons. Den building and make-believe scenarios are examples from this project where participants looked for and made reference to previous experiences and artifacts.

Guideline:

Recognise that visitors may expect constancy. Carefully consider the potential impacts of the introduction and removal of resources and artifacts.

Work with What Each Setting Affords

A relatively small area of semi-natural vegetation will have a diversity of natural resources to facilitate nature play. Even in an urban setting, nature play can exist side-by-side with traffic noise or construction work. Each site will afford different stimulation and experiences to different visitors on different days.

Guideline:

Work and become familiar with what each setting affords ahead of investment in equipment, permanent features and other resources.

Monitoring Impact and Diversity

Overall, the physical impact upon the site was minimal. With the exception of the meadow, disturbance was less than expected and the vegetation proved resilient so that where damage did occur it was short-term and not significant. Inherently diverse areas, like the flowery meadow, were appealing to families but also represent high conservation status and potentially vulnerable spaces. Even when not closely supervised, participants tended to keep to pathways and other open spaces.

Guideline:

Signs or barriers restricting activity to the paths are to be avoided. A site should be professionally assessed both ahead of designation and regularly re-assessed to monitor impact. Building the level of activity slowly will avoid detrimental impact.

Adults Have An Impact Too

Parents and carers showed a preference for morning sessions and their actions had both positive and negative effects on their playing children. The facets of nature play alleviate the need overt supervision by staff.

Realistically, sessions are going to involve both adult-led and child-led activity, but an objective of nature play is to increase the behaviours that are stimulated by the child's own curiosity and imagination with adults encouraged to hold back. The presence of a trained specialist may add to the nature play experience, however, adult intervention may mediate child behaviours and diverge from individual discovery.
Guideline:
Be aware of adult mediation. Train staff to understand the concept of nature play and to know how to subtly support an unstructured discourse and to handle contingencies.

CONCLUSIONS
Nature play is a new role for botanic gardens. There has always been a culture of keeping people and the plant collections separate: a look but do not touch policy, which has not encouraged free play or interaction with nature. This study has shown that within the context of a diverse, semi-natural or naturalistic landscape, containing a variety of native trees, shrubs and herbs, nature play involving intimate contact with plants, bark-chip and mown paths, stones, soil, water and small creatures can have a benign effect on the plants and landscapes. Regular, interactions of relatively short duration but high intensity have had no lasting impact on the habitat.

Manipulating the resources for play, for example, adding stones, leaving a tap dripping, cutting back nettles, supplying mats or blankets, rather than providing specific play equipment, was all that was required to facilitate play sessions that could last, in many cases, for an hour or more. The way in which the children used these resources and natural found items was unpredictable so risk assessment had to be generic rather than specific. Generally, children and parents explored and experimented with the resource in a cautious way, no particular hazards were identified and no accidents occurred. A culture of trust, respect and responsibility appeared to become established among participants who felt comfortable with the offer and returned regularly.

The overall conclusion has been that enabling and encouraging nature play within a designated area can create an overwhelmingly positive experience for the participants without posing a serious risk to either the plants or annoying other garden-users. The recommendation is that botanic gardens consider, as part of their social role, creating or designating an area of semi-natural vegetation for nature play and encourage its use in partnership with the local community.

Copies of the full report are available as follows:

Nugent, C., Edwards, I., MacDonald, J. and Hutcheon, S. (2014) *Nature Play: Nature Conservation.* Project Reported on behalf of Royal Botanic Gardens Edinburgh. Funded by Calouste Gulbenkian Foundation.

There is also a short film about the Project available for free view at
https://www.youtube.com/watch?v=HrXQOq12mrw