



FAIRCHILD TROPICAL BOTANIC GARDEN
Exploring, Explaining and Conserving the World of Tropical Plants



CHICAGO BOTANIC GARDEN

Bringing Science to Life

How to create successful education-research collaborations



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MIAMI

CHANGING PERSPECTIVES: PLANTING FOR THE FUTURE

2016 AMERICAN PUBLIC GARDENS ASSOCIATION ANNUAL CONFERENCE



Program

- Goals & Objectives
- *Interactive Part 1: Dreaming*
- Presentation 1: What and Why
 - Science Career Continuum
 - Project BudBurst
 - The Million Orchid Project
 - Growing Beyond Earth
- *Interactive Part 2: Identifying Resources & Challenges*
- Presentation 2: Successes, challenges, and things that didn't go so well
 - Science Career Continuum
 - Project BudBurst
 - The Million Orchid Project
 - Growing Beyond Earth
- *Interactive Part 3: Visioning (groups)*
- *Interactive Part 4: Making it real*
- *Wrap up & report out*



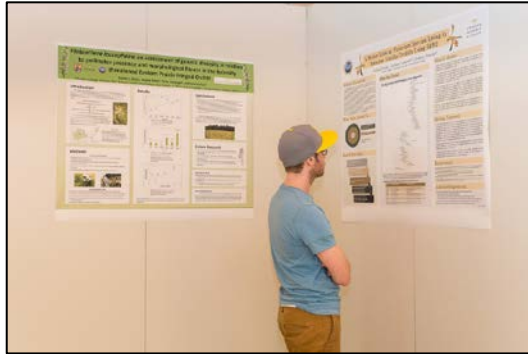
Goals and Objectives

- Offer examples of a variety of successful education-research partnerships
- Identify common challenges to successful partnerships and offer strategies to address those challenges
- Generate ideas and a plan for collaborating across departments to engage the public in botany and horticulture at your organization



Why collaborate?

- Create a more scientifically literate public
- Engage visitors in the “behind the scenes” work of your institution
- Create richer more meaningful programs
- Creating the next generation of plant scientists



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Interactive 1: Dreaming

- Think about successful collaboration between research and education. It can be something you've heard about, experienced, or been part of, at your garden or somewhere else. Write down what you think made it successful?
- Think about the structure and resources in your garden's education and research departments; what are the possibilities for working together? Write down your dream for collaboration.



Case Studies: Programs and Collaborations

- Science Career Continuum
- Project BudBurst
- The Million Orchid Project
- Growing Beyond Earth



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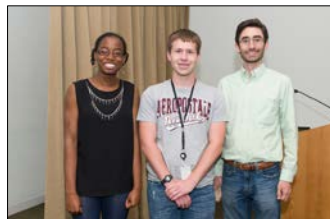
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Science Career Continuum

An education-science collaboration supporting Chicago Public School students in achieving science careers

- Science First (8th-10th grade)
- College First (11th-12th grade)
- Internships (college)
 - Research
 - Recent graduate
- Graduate degree programs



Research – Education Collaboration



- Field and lab based, student driven experiences
 - Teens contribute to ongoing research projects
 - Participate in both field work and laboratory analyses
- Multi-layer mentorship structure
 - High school
 - Undergraduate
 - Graduate and professional research staff
- College and career preparation
 - Learn what schooling and expertise needed for research careers
 - Experience “a day in the life” of a research scientist or horticulturalist



Collaboration Goals

- Participate in the actual, creative work of science.
- Realistic expectations of day to day activities
- Become part of a scientific community of practice
- Introduce students to STEM careers in authentic ways.
- Understanding of what each step in advancing in STEM looks like
- Learn what schooling and expertise needed for research careers



Project BudBurst



- A national citizen science campaign, managed by NEON, to collect phenological data on plants; CBG is a collaborator
- Web based
- No special equipment or instruments needed to participate
- Entry points for all skill levels
- Can report on any plant species



Research-Education Collaboration

- PBB was initially designed as an education/outreach project, but collaboration with scientists was important to insure data are useful and reliable.
- All data are reviewed by scientists and made available freely on website.
- “My BudBurst” allows personal archived data over time.
- Types of comparisons are demonstrated for potential users
 - comparison with existing and historical phenological data sets
 - comparisons with existing climate data.



Research-Education Collaboration

Use of PBB data to study phenology differences between native and exotic species



Wolkovich and Cleland. 2011.
The phenology of plant
invasions: a community
ecology perspective.
Front Ecol Environ 9: 287-294.

- Wolkovich and Cleland asked if phenological differences contributed to the success of invasive plants.
- They found exotic species leafed out earlier than natives supporting the theory that they benefit from “seasonal priority effects.”
- This supports approach of targeting management early in the season.



Collaboration Goals

Education

- Increase awareness of **phenology** as an area of scientific study.
- Increase awareness of the **impacts of changing climates** on plants and the environment.
- Increase **science understanding and appreciation** by engaging participants in the scientific process.

Research

- Insure data are **useful and reliable** for research purposes.
- Provide **analysis and interpretation** of data collected for viewers.
- Make available contributed data for use in **peer-reviewed research** publications.



Fairchild's Million Orchid Project & Growing Beyond Earth: Goals:

Education

- Provide authentic research experiences that have real-world implications
- Provide opportunities for students to learn to communicate their science
- Inspire and train the next generation of botanists

Research

- Gather and analyze important and necessary data to further plant research





THE MILLION ORCHID PROJECT
CONSERVATION TO INSPIRATION



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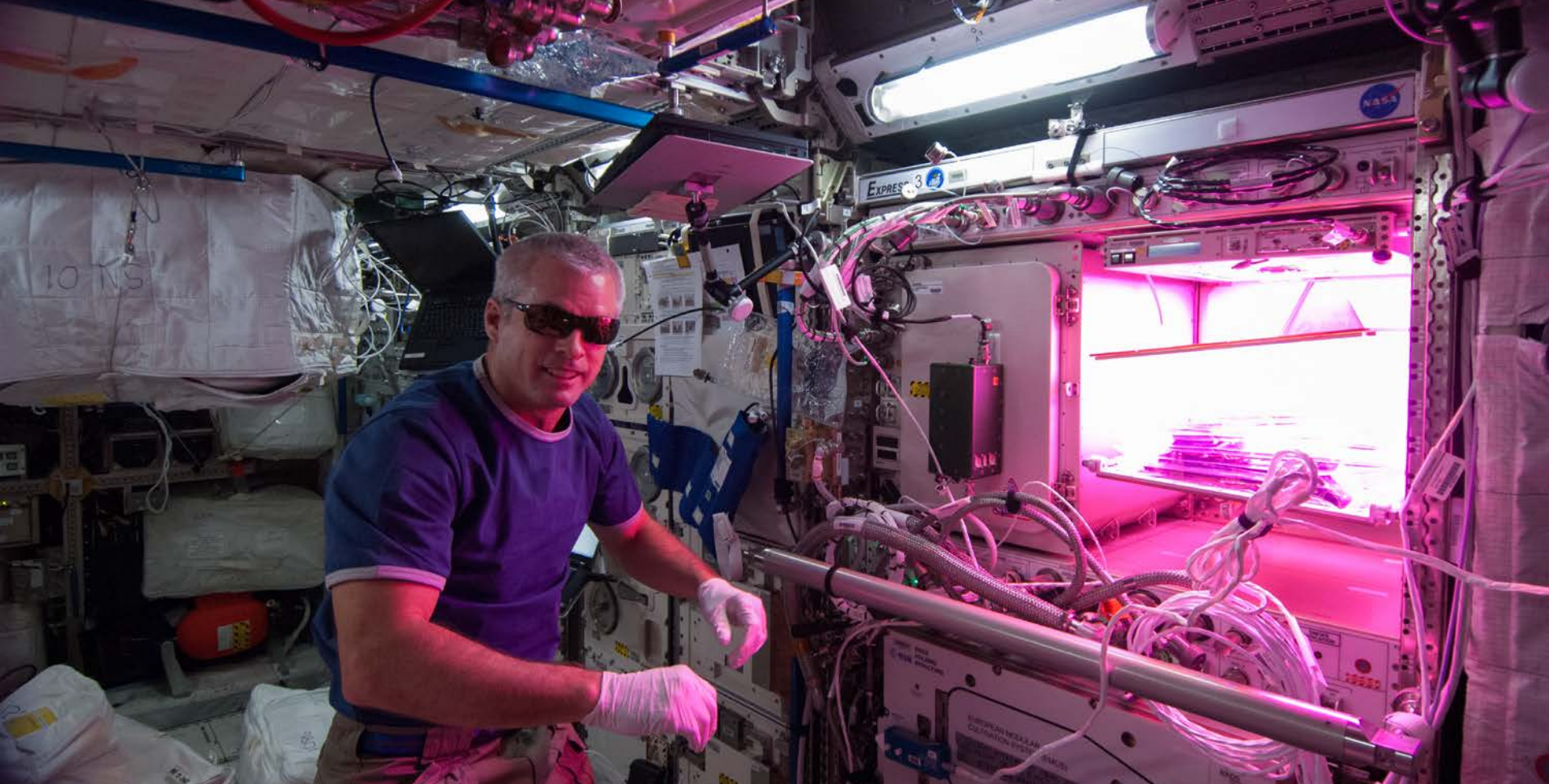


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GROWING BEYOND EARTH



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Growing Plants in Space

Gioia Massa, Trent Smith
Exploration Research and Technology

Wanda Jones, Lester Morales, Chris Hummel
Communication and Public Engagement

Kennedy Space Center

COMPETITIVE,
MULTIDISCIPLINARY,
ENVIRONMENTAL
EDUCATION

THE FAIRCHILD
CHALLENGE

ORANGE
ORANGE
EXPERIENCE
EXPERIENCE
DAY 1



FAIRCHILD TROPICAL BOTANIC GARDEN



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FAIRCHILD TROPICAL BOTANIC GARDEN



Planting		General observations				Week 2					Week 3					Week 4						
Tray position	GBE number	Species or variety name	Number of seeds planted	Date first germinated	Number of seeds that germinated	Date of first root swelling (for root crops)	Number of leaves	Plant height (cm)	Plant width (cm, left to right)	Plant depth (cm, front to back)	Plant health	Number of leaves	Plant height (cm)	Plant width (cm, left to right)	Plant depth (cm, front to back)	Plant health	Number of leaves	Plant height (cm)	Plant left to			
A1	GBE29	Arugula	2	2015-10-09	2		3	2.8	2.5	2.0	good	5	6.0	9.2	7.4	good	10	13.5				
A2	GBE29	Arugula	2	2015-10-09	2		3	3.0	4.0	2.7	good	6	6.4	15.9	8.3	good	10	16.2				
A3	GBE3	Redleaf amaranth	2	2015-10-13	1		2	2.2	1.3	0.8	fair	4	2.2	2.0	3.0	good	6	9.7				
A4	GBE51	Miner's lettuce	2	2015-10-13	1		1	4.3	6.0	3.0	fair	11	2.5	12.6	8.8	good	25	10.5				
A5	GBE 17	Red Malabar spinach	2	2015-10-14	1		4	1.0	0.1	1.0	fair	4	4.5	9.0	8.7	good	10	6.8				
B1	GBE1	Red Romaine lettuce	2	2015-10-09	2		2	1.5	1.3	2.4	good	6	4.4	8.4	7.5	good	10	9.6				
B2	GBE3	Redleaf amaranth	2	2015-10-13	1		2	1.5	2.5	0.4	fair	5	2.2	5.2	5.7	good	11	5.8				
B3	GBE51	Miner's lettuce	2	2015-10-13	2		4	4.0	4.5	0.4	good	9	5.7	6.8	6.7	fair	11	4.8				
B4	GBE29	Arugula	2	2015-10-09	1		3	2.2	3.0	1.3	good	8	6.8	4.8	12.7	good	8	12.5				
B6	GBE1	Red Romaine lettuce	2	2015-10-09	2		3	1.9	2.7	1.8	good	6	3.6	7.2	8.7	good	7	7.7				
C1	GBE17	Red Malabar spinach	2	2015-10-13	1		stem	0.9	0.7	0.1	fair	2	4.4	6.4	6.5	good	4	6.6				
C2	GBE51	Miner's lettuce	2	2015-10-13	2		2	2.6	5.5	2.0	good	8	5.3	8.5	8.0	good	16	5.8				
C3	GBE17	Red Malabar Spinach	2	2015-10-28	1		stem										2	1.9				
C4	GBE17	Red Malabar spinach	2	10/14/15	1		stem	1.0	0.5	0.2	good	4	4.0	8.5	1.5	fair	6	8.4				
C6	GBE1	Red Romaine lettuce	2	2015-10-09	2		3	2.0	3.2	2.2	good	6	6.0	7.0	11.5	good	10	10.1				
D1	GBE3	Redleaf amaranth	2	2015-10-13	1		2	0.9	1.5	0.4	good	4	2.3	3.6	3.4	good	4	4.5				
D2	GBE51	Miner's lettuce	2	10/14/15	1		3	1.5	0.5	0.3	fair	4	4.8	3.4	1.6	fair	9	29.0				
D3	GBE29	Arugula	2	2015-10-09	3		3	4.1	4.6	2.6	good	6	12.0	5.8	9.8	good	7	9.0				
D4	GBE1	Red romaine lettuce	2	2015-10-09	2		4	1.5	2.3	1.5	good	6	4.5	7.1	6.3	good	9	13.5				
D5	GBE29	Arugula	2	2015-10-09	2		4	3.5	4.0	1.5	good	6	11.3	12.8	12.9	good	8	18.0				
E1	GBE3	Red leaf amaranth	2	2015-10-13	1		2	1.8	1.7	0.2	fair	4	2.6	3.8	4.4	good	6	6.5				
E2	GBE3	Red leaf amaranth	2	2015-10-13	1		2	1.5	2.0	0.5	good	4	3.3	4.3	6.1	good	11	7.9				
E3	GBE17	Red malabar spinach	2	2015-10-13	1		2	2.9	3.0	0.7	good	4	5.5	8.7	4.7	good	9	8.1				
E4	GBE1	Red Romaine lettuce	2	2015-10-09	2		3	0.5	2.3	1.8	fair	6	4.9	9.5	6.1	good	8	8.7				
E6	GBE51	Miner's lettuce	2	2015-10-13	2		2	2.4	6.0	1.0	good	4	2.6	8.7	7.5	good	15	8.5				
Planting date:			2015-10-06	Observation date:			2015-10-13					Observation date:			2015-10-22					Observation date:		
Room temp (avg. °C):			21.9			Room temp (avg. °C):			22					Room temp (avg. °C):			22					
Vol. water added (ml):			825 ml.			Vol. water added (ml):			1650					Vol. water added (ml):								
Notes			Notes			Notes			Notes					Notes								
rodriguez@carrollton.org			C3 has not germinated by October 15. This represents 4% of the pots. 88% of them germinated by October 13.			Plants are small, but healthy. Red Romaine Lettuce appears to be the most successful at this point.			More water needed as plants grow. Temperature is steady. C3 has not sprouted. It is a sample of red-malabar spinach. Arugula has grown considerably and red romaine lettuce is thriving.					All the plants have germinated. Some each other's growth, since their leaves								

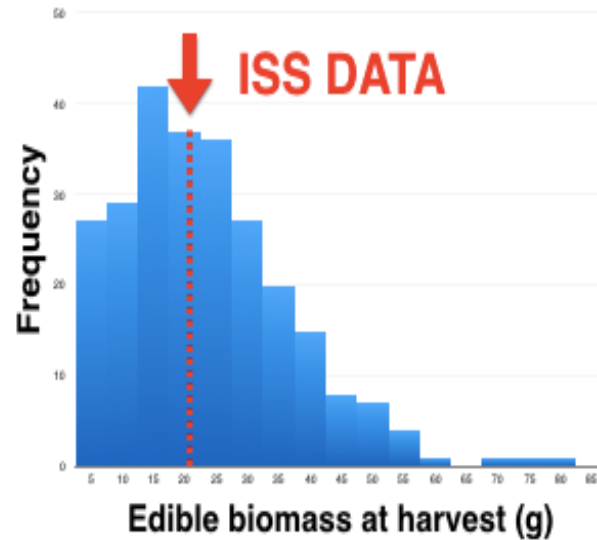
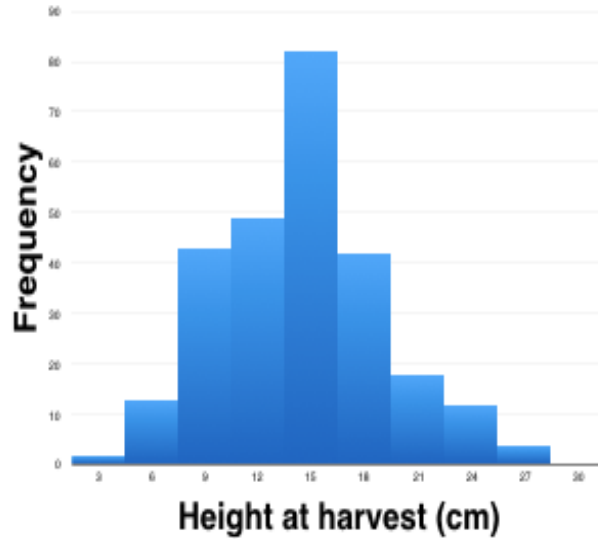
30 Day Trial 1

30 Day Trial 2

Evaluation Sheet



GBE1 Red Romaine Lettuce Trial 1



Interactive 2: Identifying Resources & Challenges

- Make a list of the resources in the education and research departments respectively. Resources can include existing programs or collaborations (internal or external), staff, materials, funds, shared goals, or anything else that can contribute to making a collaboration work.
- Think about the structure and culture in your garden's education and research departments. Write down what challenges might there be in making your dream a reality?



Science Career Continuum: Challenges

Education

- Preparing mentors to work with teens
- Preparing teens to work in a professional environment
- Ensuring successful placement of teens with mentors
- Creating an effective support and management structure to address mentor concerns

Research

- Developing appropriate and meaningful research projects from ongoing work
- Providing guidance, direction & support for teens
- Fitting in with other professional commitments



Science Career Continuum: Strategies for Success

Education

- Mentor training & appreciation
- Ongoing communication with mentors
- Setting & enforcing professional behavioral expectations for teens
- Ongoing review of program structure

Research

- Multi-tiered mentoring system
- Ongoing, close communication with education staff
- Creation of a culture and expectation of mentoring for newly hired research staff



Project BudBurst: Challenges & Strategies for Success

Challenges

- Keeping volunteers engaged
- Ensuring data quality

Strategies

- Reduce barriers (allow any plant, any phenophase); No cost; Special campaigns; Use data and acknowledge participants!
- Online plant and phenophase guides with pictures; Cell phone entry; Scientific review with FRC data for verification

www.budburst.org

Participating in *Project BudBurst* can provide you and your family with an engaging outdoor experience and provide data that are useful to scientists studying climate change impacts on plants.



Fairchild's Million Orchid Project & Growing Beyond Earth: Challenges

Education

- How do we fit this into those darn “Pacing Guides”
- What, no equipment/resources at the schools?
- Who's going to fund this?
- What do you mean teachers don't know how to do research?
- How do we collect the data? AND how do we share the data back?
- How the heck do provide immediate feedback to teachers?

Research

- What do you mean we promised one million orchids but have space for a thousand? (Fairchild's internal space constraints)
- We can't hire more staff or graduate students ? (limited staffing)
- How do we develop research protocols that provides clear direction & contributes useful data to an existing project?
- 125 schools? How do we prepare enough materials for all schools?
- Yes, this is real research! How do you convince the research community that that this is real and useful data collection method?



Fairchild's Million Orchid Project & Growing Beyond Earth: Strategies for Success

Education

- Ensure project is mission driven & establish common goals
- Integrate into already successful programs
- Communicate!
- Gain support from School District & Funders
- Provide throughout teacher training
- Provide ALL necessary equipment and materials
- Link project goals & objectives to the district pacing guides.
- Set clear expectations and guidelines
- **Have a compelling story**
- ***Create a project that provides authentic research opportunities with real-world implications!***

Research

- Ensure project is mission driven & establish common goals
- Integrate into already success research programs
- Communicate!
- Be the trainers of all scientific content
- Provide consistent & regular feedback to schools(to ensure protocols are being followed and data is consistent).
- Commit to ongoing data analysis & sharing of results
- ***Publish the results!***



Interactive 3: Visioning (in groups)

- Discuss the opportunities for cross-department collaboration. Write down any common elements -- themes, audiences – and highlight differences.
- As a group, discuss the challenges you have identified. Are there common themes? Discuss and propose some solutions to shared challenges.



Interactive 4: Making it Real

- Choose one of the ideas in your group and build it out together to create a plan for a successful education/research collaboration.



Report out

- Share your ideas



Thank you

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