



# Plants in the Web of Life

Arnold Arboretum Summer Institute 2016



[www.arboretum.harvard.edu](http://www.arboretum.harvard.edu)

# Arnold Arboretum Summer Institute 2016

## Plants in the Web of Life

### Preface

For more than thirty years, the Arnold Arboretum of Harvard University has facilitated coordinated programs for elementary school students from Boston Public Schools to learn about science and nature in the outdoors through guided explorations of the Arboretum landscape. Each season Field Study Experiences are filled to capacity—engaging approximately 2000 students annually—and the Children’s Education staff has explored approaches to expand the reach and impact of the programs with local classrooms. In Fall 2015, through funding from the Henry Meyer Boston School Initiative, the Arnold Arboretum launched an ambitious plan to collaborate more closely with Boston Public Schools, increasing the Arboretum’s visibility and accessibility as a resource for quality life science education. Guided by the selection of a Children’s Education Fellow, Ms. Ana Maria Caballero, the Arboretum created multiple opportunities to bring Boston Public School teachers to the landscape for teacher training programs, as well as supporting field studies through bus transportation and guided programs. Beginning in September 2015, Ms. Caballero designed and hosted monthly gatherings for BPS teachers focused on investigating and understanding seasonal phenomena such as flowering, leafing-out, and fruiting. Ms. Caballero also met with teachers to provide insight into the use of their own outdoor classrooms for nature learning, and visited schools to model the use of science journals to promote careful observation and recording. Collaboration with teachers included the design of customized activities, pre-visit materials, and extensions.

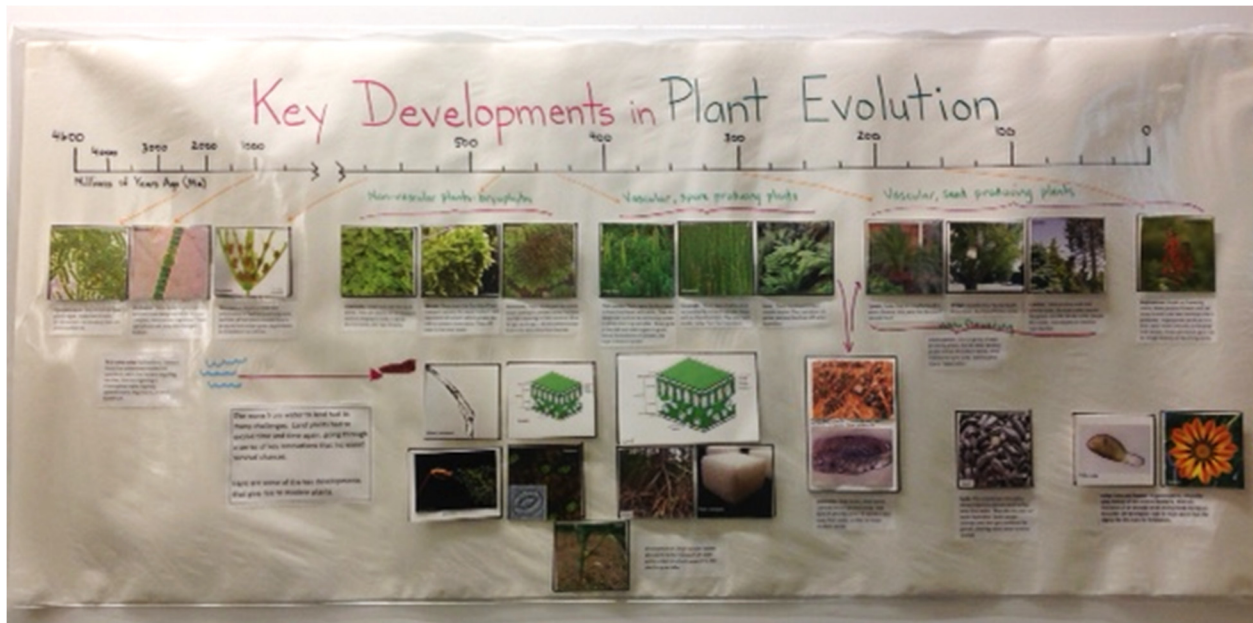


Arboretum for Educators programming for Boston Public School teachers enabled them to experience focused and educational explorations of organisms and phenomena in the Arboretum landscape through the seasons.

The culmination of this pilot year was the organization and implementation of the first Summer Institute at the Arnold Arboretum for BPS teachers. This three-day course, with an optional fourth day, focused on the primacy of the plant kingdom as the center of life. Through daily explorations, lectures, science journaling, and exposure to new technology, teachers learned about plant evolution and adaptation through guided exploration in an exceptional landscape for learning.

## Program Goals

Missing from the life science preparation for most elementary teachers is a consideration and understanding of the “Big Picture.” Elementary school teachers frequently have limited knowledge of what defines the six kingdoms of life and how they relate to each other. Equally important, and also often missing, is an appreciation of the evolution of the plant kingdom—from its beginnings in the ocean, through the major evolutionary breakthroughs that represent distinct and evermore complex adaptations to environments, yielding the biodiversity we see today. We consider this underpinning to be foundational to any work that teachers do with students when teaching science as part of the elementary curriculum.



One of the tools used to illuminate the biology of plants was this evolutionary history, condensed and illustrated in poster form.

The four goals set in creating the 2016 Summer Institute at the Arnold Arboretum were:

1. Give teachers requisite knowledge about plants that will enable them to create lessons/units of study aligned with the new standards mandated by the Commonwealth of Massachusetts for science, technology and engineering.
2. Expose teachers to the efficacy of using the outdoors as a means for teaching life science standards.
3. Share resources, teaching strategies, materials, and expertise with teachers to increase their confidence and comfort in leading purposeful life science lessons, both indoors and outdoors.
4. Develop relationships with individual teachers and teacher teams at BPS schools for continued professional development during the school year, including facilitated fieldtrips to the Arboretum.

## Participants and Content/Design

Sixteen teachers from nine BPS schools attended the Summer Institute, as well as a preschool teacher from Brookline and an outdoor educator from Tower Hill Botanic Garden. Teams of teachers participated from the Phineas Bates Elementary School in Roslindale, William Monroe Trotter Innovation School in Dorchester, and the East Boston Early Childhood Center. Six of these teachers serve as science specialists at their schools, seven teach in early elementary classrooms, and three teach in upper elementary classrooms. Most of the participants have more than 10 years of experience.

Arboretum educators designed each day of the Summer Institute to address a specific area of learning. Starting with an overview of the many kingdoms that compose the web of life, the program content zoomed in to consider the structures of land plants that contributed to their evolutionary success. Then the focus returned to the relationship of plants to other life forms in terrestrial ecosystems. The curriculum also provided opportunities for teachers to benefit from self-directed time in the Arboretum landscape and to participate in group explorations of plant diversity in various parts of the Arboretum landscape.

### Day 1: Organizing Life

Teachers worked in small groups to classify photographs of diverse organisms, and then shared their ideas and questions about organizing and categorizing living things. Dr. Elena Kramer, a professor of organismic and evolutionary biology at Harvard University, presented an overview of the Tree of Life and its domains and kingdoms, and introduced teachers to basic concepts of phylogenetics (the evolutionary history and relationships among organisms). This included an examination of the earliest life forms on Earth that eventually gave rise to land plants.

Teachers used the afternoon to explore the Arboretum landscape, looking for organisms and evidence of organisms from each of the six kingdoms. During this phase, teachers were able to review the morning content and its vocabulary, help each other to assimilate and expand on the information presented, and discuss ways to apply what they learned to teaching students in the outdoors.

Twice each day, teachers were asked to spend 15 minutes journaling outside, expanding upon one of three prompts provided by Arboretum educators for written discussion. The prompts were carefully designed to elicit background knowledge and pique interest during the morning session, and to incorporate new knowledge or deepen understanding during the afternoon session. Following each morning journal session, teachers participated in different ways to share their journals and insights with each other.

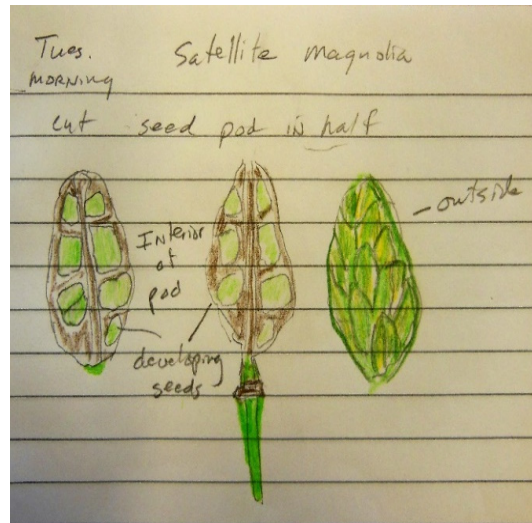


Teachers classify a diverse selection of organisms by cellular structure, reproduction, and energy procurement.

## Day 2: Understanding Land Plants

After morning journaling, teachers returned to the landscape in teams to compare and contrast plants representing a wide range of adaptive features. Using clue cards, teachers were encouraged to search for specific plants and note their distinctive features. Then, using information on the back of the cards, teacher teams attempted to reconstruct the evolutionary timeline of these plants.

In the classroom, Dr. Kramer surveyed the ways plants were forced to adapt as they began to successfully colonize land, focusing specifically on reproductive adaptations that enabled greater successes in diverse terrains.



Left, teachers enjoy daily opportunities to develop their journals in the Arboretum landscape. Right, journaling activities included drawings of organisms encountered, like this magnolia fruit.

In the afternoon teachers examined various plant parts and structures presented in seven learning stations. Teachers were directed to use clippers to dissect material and worked with lenses, dissecting microscopes, and a digital microscope to explore specimens in depth. At each station, selected visuals enabled teachers to gain more information about the structures, and insights or questions were captured and shared. As in Day 1, teachers enjoyed journal time in the landscape.

## Day 3: Ecosystems: Putting it All Together

Following the morning's journaling exercise, teachers shared their questions and insights as they integrated a deeper understanding of plant evolution. Small groups, led by Children's Education staff and the guest speaker, went outside to observe ferns and mosses, the more primitive plants. Teachers considered growth habits, frond shapes, and location to compare different species of ferns and elicit questions. They then collected specimens to share with the larger group.

Dr. Elizabeth Farnsworth, Senior Research Ecologist at the New England Wild Flower Society, provided an overview of ferns and fern allies, sharing tips on identification and illustrating the role ferns play in a larger ecosystem. Teachers also learned how to use the web-based plant identification resource, [Go Botany](#), developed by Dr. Farnsworth and her team.

The entire group walked to the Hemlock Hill section of the Arboretum for journaling and an exploration of an urban forest. Once again in teams, this time based on grade levels, teachers were challenged to use the specific Massachusetts Science, Technology and Engineering Life Science standards for their grade levels as a framework for understanding an urban forest ecosystem. Teachers looked for evidence in the landscape and discussed ways to use this outdoor space with children.



Teachers investigate the uses of a digital microscope on Hemlock Hill.

#### Day 4: Lesson Planning

This optional day in the program was designed for teachers and staff to develop lessons/units of study based on specific grade level MA life science standards. In the morning, teachers explored the Conifer Collection and focused on the leaves and reproductive structures of the conifers. An opportunity to journal in this new landscape also allowed teachers to consider a new environment to use with students, and generated various ideas for how to incorporate more outdoor experiences in their teaching.

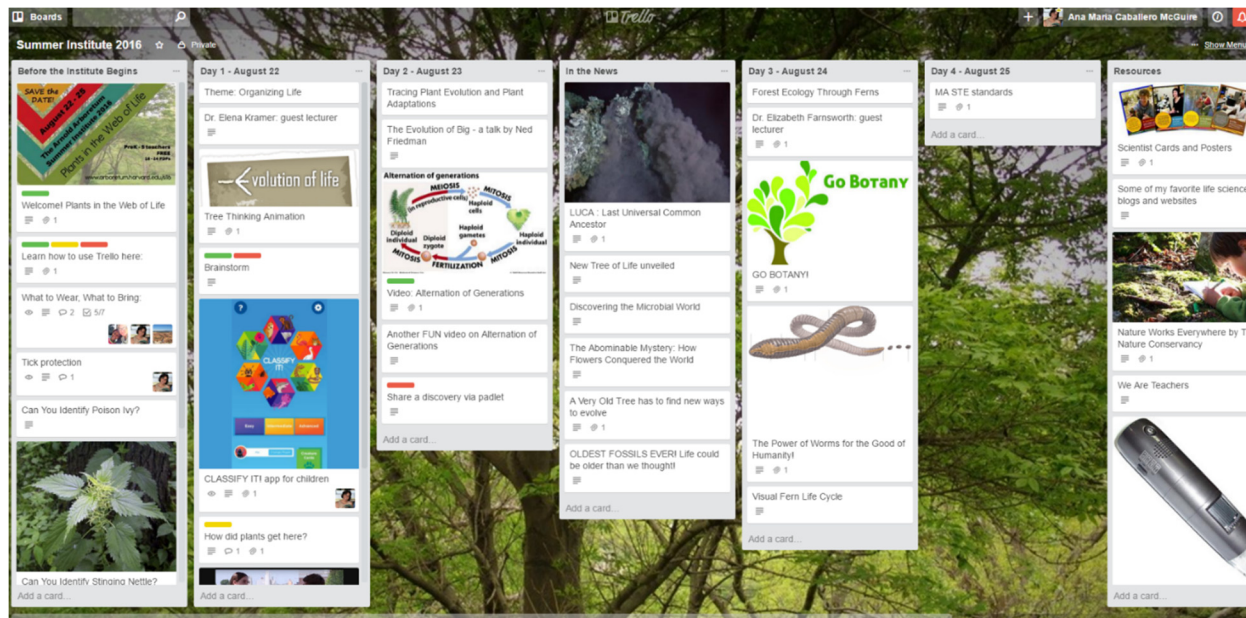
When they returned to the classroom, teachers discussed how to incorporate microscopes, lenses, and the digital field scope along with children's books into their science teaching. Another discussion centered on ways to enhance literacy skills with science materials, and ways to integrate more life science teaching throughout the day and with teachers of other disciplines.



Drawing practice by teachers reveals the complexity of familiar structures.

## Technology Focus: Use of Trello and Padlet

All participants joined an online collaborative platform called Trello. This was designed as a way to share readings, videos, homework assignments, and resources with the group. The material chosen for the boards was curated specifically as a way to pre-view or re-view the content of the guest lecturers, and provide more information for further learning. Teachers were encouraged to add their own links and resources to share with the group.



The Trello board facilitated information sharing before and during the Summer Institute.

Another web-based tool, Padlet, was also used as a way for teachers to collaboratively brainstorm answers to a prompt, and to individually share a page from their journal or photo taken throughout the institute. The tool operates, essentially, as a giant whiteboard on which participants post “sticky notes” that contain text, images, video, or links. Teachers enjoyed learning about these two free, easy to use tools; many teachers plan to incorporate them into their teaching.

## Teacher Evaluations

Overall, the Summer Institute received high marks from the participating teachers. Of the 16 respondents to the final survey, 15 teachers said they would enthusiastically recommend the program to a colleague. Their comments included:

- The Summer Institute was a great way to experience numerous fieldwork ideas.
- The program offered the expertise of fun and knowledgeable guest speakers.
- Sessions proved a source of useful information, tools, and resources that can be directly applied to science in the classroom.
- There is a need for all teachers to understand life science content so they can better teach it.

- The Arboretum is a great resource and adults don't always have the opportunity to engage in this type of learning.
- The group experiences were valuable learning opportunities.
- The Institute was well organized, with excellent material, good group size, and broad range of activities.



A teacher uses a magnifying glass to observe and draw aspects of wood anatomy.

Teachers also strongly agreed that they achieved a deeper understanding of plants in the web of life; their responses illustrate a range of experiences that were valuable to them:

- “I think I have a better understanding of the evolution of algae to land plants, and have begun thinking of ways to look at plants in more ways.”
- “The materials provided allow me to go out in the field and really understand plants more.”
- “I especially enjoyed learning about plant evolution and the haploid-diploid life cycle stages.”
- “I wanted to be outside a good deal during the Institute and the prompts we were given for getting out there were fantastic and thoughtful.”
- “The info on plant evolution opened a new area for me.”
- “I went home after each session talking about all the info I learned, and I want to learn more!”

Finally, the teachers also strongly expressed that they could use what they had learned in their teaching:

- “The journaling and chances to observe/make choices are both things I'd like to bring back, especially in trying to incorporate more science content into literacy.”
- “Provide independent and small group field work observations.”
- “I know much more real science, the proper vocabulary, and how to recognize and think about plant life.”
- “While evolution and reproduction will not be taught explicitly, what I learned will help me guide students through different kinds of plant adaptations.”
- “The journaling might be a bit out of reach for the little ones but I think I will still attempt it—getting children out there, touching, noticing, etc. I would love to incorporate some of the technology (field microscope with iPad—fantastic!)”



## Next Steps

While the Summer Institute was well-received, we are also conscious of the potential to revisit some of the design and content for the following year to further impact teacher learning. Specifically, some teachers felt that some of the academic presentations were too complex to readily grasp. Other teachers wanted more time for journaling in the landscape. At least one teacher suggested more content around the interactions of plants and fungi.



Stations with angiosperm and conifer reproductive structures illustrate for teachers the evolutionary advancements of seed-bearing plants.

All participants can take advantage of free bus transportation for their class to the Arnold Arboretum during the 2016-2017 school year. This field trip is designed to be self-guided; that is, teachers will plan the activities in the field that best support their curriculum needs and goals. Education staff is available to work with the teachers to plan the trip, provide pre-visit and post-visit activities in the classroom, and help facilitate the experience in the field on the day of the trip. We hope that teachers will draw upon their Summer Institute experiences and learning to convey deeper content around life science to their students. In this manner, we will continue to collaborate with BPS teachers, and share their lesson plans and activity sheets with the larger education community.

We are pleased to have accomplished our major goals for this first Summer Institute for BPS teachers, and see clear avenues for improvement and expansion for next year. We have achieved a firm foundation for deepening our work with teachers in Boston Schools, and we look forward to the second year of focused support—both to the teachers with whom we are now acquainted as well as those who are just becoming aware of the resources available to them and to their students here at the Arnold Arboretum of Harvard University.

*The Arnold Arboretum of Harvard University extends thanks to Henry Meyer and the Henry Meyer Boston School Initiative for making this programming possible through generous annual funding.*