Name That Plant! Overcoming Plant Blindness and Developing a Sense of Place Using Science and Environmental Education

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Introduction: Part of the Problem

> *Carrying her cup of coffee, Donna walked into her daughter's living room. "Oh!" she enthused, "you got a new plant!"*
>
> *Donna leaned close to the plant, inspected the leaves and examined the stems closely, then frowned. "Huh. What's the name of this one?"*
>
> *"Um…" her daughter stalled. "It's…a…" There is a long pause. She smirked and shrugged, "I call it 'Fred'."*
>
> *The mother shook her head in mock dismay. "All those fancy college biology courses, and you still don't know anything…"*

I admit it. I have been part of the problem. When I began teaching high school about 15 years ago, I often sped through the plant unit in my biology classes so that we would have time for "important" topics like animals and ecology. In the years since, however, I have come to admire the importance of plants, their diversity, and the people (like Matt, Gerry, and my mom) who know their names and how they are special. Noticing and understanding the plants around us helps us know the place where we live: the community not only in biological terms but also in sociological terms. Once our students are able to notice and learn about plants, they will have new anchors upon which to build connections that foster ecological awareness, knowledge, and action. The purpose of this chapter is to describe plant blindness (Wandersee and Schussler 1999) and some potential methods of preventing it by helping our students learn science and develop a sense of place.

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Plant Neglect and Plant Blindness

In 1993 and 1996, Hershey wrote about plant neglect: the idea that science teachers spend little time teaching about plants in the classroom. As he explains, plant neglect is not a new problem (e.g., Nichols 1919). In fact, the phenomenon has been around so long that, like many other educational issues, the concept has been revisited and renamed several times: plant neglect, zoochauvinism, zoocentrism. The general cycle seems to be that biology teachers get little training in botany, and as a result, they do not teach much in the way of botany themselves.

Wandersee (1986) gave 136 rural junior-high students a "science interest query" to identify the science topics in which they were most interested. His evidence matched that of previous studies: students had a significant preference for animals over plants as a science topic ($\chi^2 = 10.9$, df =1, $p < .02$). Wandersee suggested that this preference may have been due to students' tendency to anthropomorphize and therefore relate more to animals and to cultural influences, including cartoons, books, and television shows, which tend to focus on animals rather than plants. This study set the stage for Wandersee's later work with plant blindness.

Kinchin (1999) did a "head to head" comparison of plants vs. animals by showing a sample of 162 girls specimens of *Arabidopsis thaliana* (a flowering plant) and *Mellitoba* (an insect). Kinchin then asked open-ended questions including which organism they found most interesting and why. Of the 162 participants, 144 chose *Mellitoba* as more interesting, most frequently citing the fact that *Mellitoba* can move as the reason they found the organism interesting.

Barman et al. (2003) investigated over 2,400 students' ideas about plants. When shown images of different organisms and one nonliving thing (a telephone pole), students were asked which of these items were plants. The data indicated that young students saw plants as green things with stems and leaves that grew in the soil. This conception of plants led students to be unsure about whether trees, grass, and Venus flytraps were plants, since trees have brown wooden trunks, grass has no obvious leaves, and Venus flytraps move and eat insects. The authors suggested that children begin with a narrow definition of the word "plant" and then broaden the definition as they get older, based on examples they gather in school and their daily lives. However, if students do not get the chance to learn about plants from teachers and/or parents, they may continue to hold a fairly narrow definition (Gatt et al. 2007).

Plant blindness, rather than introducing yet another term to describe the same phenomenon, is an attempt to get at the root cause for our tendency to overlook the plant kingdom. We pay little attention to plants because of the way our visual information-processing systems work (Wandersee and Schussler 1999, 2001; Wandersee and Clary 2006). Essentially, human vision is capable of "seeing" a great deal, but what we "attend to" is much more limited; "visual consciousness is like a spotlight, not a floodlight" (Wandersee and Clary 2006, p. 3). Humans do not attend to things unless they hold meaning, survival value, or both. As Mack (2003) explains, this is inattentional blindness, and some studies indicate that our brains process meaningful stimuli while "ignoring" meaningless stimuli.

The observation that biology teachers (and their students) often neglect plants is a symptom of plant blindness (Wandersee and Schussler 2001). People who exhibit plant blindness show "an inability to see or notice the plants in one's own environment" (p. 3) which leads to a lack of awareness and knowledge of plants' role and importance in ecosystems. One common misconception among students, the idea that the bulk of a growing plant's mass comes from the soil, is based on a lack of understanding about plants' role in the cycling of matter and transfer of energy on Earth (Barman et al. 2003; Harvard-Smithsonian Center for Astrophysics 1995; Wood-Robinson 1991). Orr (1994) wrote that "we routinely produce economists who lack the most rudimentary understanding of ecology or thermodynamics" (p. 11) and that may help explain why our natural areas' values are so underestimated. Perhaps instilling understanding of the value (economic, ecological, and aesthetic) of biological communities needs to begin earlier, and continue throughout our education.

Moon's (1921) textbook, *Biology for Beginners*, devoted about 25% of its content to plants, but Glencoe's *Biology: The Dynamics of Life* (Biggs 2004) has less than 10% plant content, though it includes about 20% genetics and biochemistry. Certainly, these branches of science are necessary and important for a broad understanding of the way the world works. However, as textbooks devote more space to emerging fields of biology, plants receive less coverage; this may lead teachers to believe that plants are less important and so devote less time to naturalistic studies outside the classroom. With limited opportunities to encounter and learn about plants, children are not given the opportunity to appreciate "real" nature. In fact, plant blindness may itself be a symptom of what Louv (2005) called "nature-deficit disorder." Children are wired into their worlds, surrounded by technologies that make it unnecessary to venture out and play in nature. Some authors suggest that students know more about rainforest plants and animals than they do the biology in their own back yards (Ashworth et al. 1995; Brewer 2002). Because our students are learning organisms only from their textbooks and the Internet, rather than their local environments, they have become disconnected from the living things actually found in their communities (Bebbington 2005; Brasher 2006; Lock 1995; Paraskevopoulos et al. 1998).

One of the main predictors of students' awareness, knowledge, and appreciation of plants is the presence of a plant mentor, or "someone who help[s] the mentee observe, plant, grow, and tend living plants" (Wandersee and Clary 2006, p. 3; see also Gatt et al. 2007). Teachers need not look far to find plant mentors; ask students' parents if they enjoy gardening, or contact a local master gardeners' association to find enthusiastic helpers. If teachers can learn to "see" plants themselves, they are better equipped to help their students see plants – this is the first step toward a greater understanding, awareness, and appreciation of the community and ecosystem around them.

I'll Sign a Petition, But I'm Not Going In There

An upper-level plant course in a midsized suburban university is full of students who care about the environment. They are biology majors, and they want to change the world. They passionately discuss An Inconvenient Truth and the plight of the polar bears. When their

> *instructor brings up the possibility that part of the university's forest may be cut down to provide more parking, they are irate. The students suggest writing letters, circulating petitions, and a few more extreme solutions. A week later, the instructor walks them out to that same forest. The instructor enters the forest to point out some trees and plants, but the students hover at the periphery of the forest as if there was some invisible fence keeping them out. "Come on in here," shouts the instructor. Many of the students demur. "We can see and hear fine from over here," one student yells back. Another student whispers, "but there are bugs in there!"*

On a positive note, there is increased environmental awareness percolating in schools. Students are ready to save the rainforest, the whales, and the polar bears. Science in schools has focused on those exotic locations and organisms because they are interesting and great exemplars of certain ecological principles.

However, despite having strong emotional attachments to the environment as an abstract concept, our students seem to be deeply disconnected to the concrete environment outside their windows. What should be familiar has become alien. There is a reason that the environmental aphorism asks us to "Think Globally, Act Locally." We must start with where we are.

Teachers tend to consider going on field trips to distant areas when trying to construct lessons that help students learn about ecology and the environment (Simmons 1996). Although a trip to a botanical garden or state park could be a wonderful way to help students explore plants and nature (Bowker 2004), the logistics and costs that are involved can be daunting, particularly for beginning teachers. The schoolyard itself can be just as useful as a field trip for teaching about ecology, while eliminating most costs and logistical concerns.

Brewer (2002) reported that when teachers are asked what they need in order to start including outdoor inquiry in their classes, one thing the teachers ask for is resources that are specific to their region and schoolyards, including "the names and general natural-history traits of common organisms in their schoolyards" (p. 578). Brewer suggested that scientists could work with graduate students to develop field guides for teachers, but another option might be for teachers and students to develop their own schoolyard field guides with the assistance of nearby science and/or education faculty. When the teachers and students are given ownership over the process, it will help them develop or enhance their sense of schoolyard natural areas as a part of their community.

Lindemann-Matthies (2005, 2006) examined the results of a Swiss conservation organization's educational program, "Nature on the Way to School." The program combined structured ecology-related information with more inquiry-oriented activities, and participating teachers reported back on which parts of the program they used, and which parts of the program they found to be most effective. One of the activities in the program that teachers and students rated most highly was one that gave students the chance to investigate different plants and animals that they found on their walk to school. Students were encouraged to observe and identify species that they found to be interesting. These investigations often included what the program called the "Nature Gallery," in which students created picture frames, and then "framed" their favorite plant or animal that they found along their walk. Students could investigate their plant and stand next to their frame and tell passers-by all about their organism. Lindemann-Matthies (2005) used multiple regression analyses to show that the biggest predictors of children's learning gains about common local plants and animals was time spent on investigations on the way to school, and time spent depicting plants and animals. In addition, Lindemann-Matthies (2006) examined how children's appreciation for wild plants and animals changed over the course of the program, and found that the more plant and animal taxa the children noticed in their environment and could identify, the more likely they were to appreciate these organisms.

Sense of Place

> "If you don't know where you are, you don't know who you are." – Wendell Barry in *The Sense of Place*
>
> (Stegner 1992)

The next time you have a meeting that requires an "icebreaker," consider the activity in Project Learning Tree's (2006) *Places We Live*: "Personal Places." The activity asks the group to think back to when they were 10 years old, and draw a map showing their house and features of their neighborhood. Afterwards, individuals can share their drawings in small and/or large groups. Drawings often include nearby creeks or special trees, parks or open areas where children might have converged. More often than not, an animated discussion ensues about how "things were different then." Often, this discussion leads participants to wonder what today's 10-year old would draw.

Sense of place is defined as having ecological knowledge, social knowledge, and attachment to community (human and nonhuman) about and in a particular place (Worster and Abrams 2005). The concept is multifaceted, much like environmental education (EE) itself; in order to have a sense of place, one must have acquired knowledge about it, positive affect toward it, and skills to be a part of it. Worster and Abrams' qualitative examination of farmers and fishermen in New England revealed that these people felt a connection to the land. One farmer commented that, "[t]he ultimate goal has been that you know the place so well, that somehow … you all of a sudden become a part of it" (p. 531). The participants felt closely connected not just to the land and the sea, but also to the people in their place. Worster and Abrams wrote that the fishermen's "perceived relationship with the local social and ecological context led to a heightened ecological knowledge of the ocean" and a desire to learn skills in order to treat that environment responsibly (p. 532).

Giving students the chance to strengthen their sense of place in the classroom also has benefits for multicultural classrooms. As Derr (2002) found, children's sense of place is often deeply influenced by extended family and direct experience. Giving students a chance to share their "place" with others can help them connect the classroom with their real lives. For example, one of the participants in Derr's study was 11-year-old Teresa, a girl who felt deeply connected to a park across from the Boys' and Girls' Club. She found quiet and solace there, and took time to help keep the river that ran through the park clean. Teresa seemed to take great joy in sharing her park with Derr. Other participants, Leo and Marcos, both 10 years old, had deep place attachments to natural areas around their homes, and had plant mentors from their families that allowed them to grow to know and love the land, including plants, in their areas. This kind of place attachment is an important predictor of environmental concern and action (Peterson, 1982; Vorkinn and Riese 2001). If children like Derr's participants are given an opportunity to share their sense of place and their ways of knowing about a place with other children in their classrooms, the classroom itself can start to "feel" more like part of a community. In addition, giving children a chance to share the knowledge of plants and trees that they have gathered from their extended family validates their cultural knowledge.

Not all students will have the kind of place knowledge that is found in Derr's (2002) participants, but they can learn from each other and from their teachers. By allowing students to discover their place, teachers can connect classrooms with communities (Ebersole and Worster 2007). In fact, Ebersole and Worster asserted that "place-based education strives to contextualize curriculum into the local culture and ecology and bridge the gap between schools and communities" (p. 20). Further, they suggest that place is an excellent way to integrate all aspects of a curriculum and meet the standards. They describe two education methods courses (a science/math course and a language arts/social studies course) that were designed to increase teacher candidates' knowledge, skills, and attitudes about facilitating children's exploration of their place. Ebersole and Worster found that teachers who integrated local ecology and culture into their unit planning could target state standards effectively in all of these disciplines.

Knowing about the natural history of one's local environment, including the local flora and fauna, can contribute to a place-conscious education (Gruenewald 2003), which may boost student achievement (Lieberman and Hoody 1998; Theobald and Curtiss 2000). In learning about place, students can discover connections between ecology, social science, and the arts.

What's in a Name?

By encouraging teachers (and thus, their future students) to use taxonomic keys and learn the names of common trees and plants in their area, we are teaching them to combat their own plant blindness (Wandersee and Clary 2006). When students learn a name and the associated characteristics for something, they are attending to it. The process of comparing and contrasting flower and leaf structures is a higher-level skill (Bloom 1956, revised in Anderson et al. 2001), and allows students to form schema and connections between schema that will help them better understand both the nature of science and nature itself.

However, the external constraints on teachers can make it difficult to convince them about the importance of teaching about plants. Time and space constraints may prevent teachers from growing plants in the classroom, and budget constraints or liability concerns may keep teachers from taking students outside. While trying to gauge interest in a teacher workshop on plant taxonomy and nature-deficit disorder, we came into close contact with these constraints. One district science coordinator scolded that our objective of having teachers learn the names of twenty common local plants was unreasonable, because "we're trying to get away from memorizing now." She went on to suggest we develop a workshop on molecular genetics or something else teachers "needed."

While memorization is part of the process of learning about the land around us, it is hardly the main learning outcome. When we learn the names of plants, we are learning part of their history. Every plant has a story, and their names, both common and scientific, can help tell that story. For example, the genus name *Dracaena* comes from the Ancient Greek δράκαινα, meaning female dragon. Plants in this genus include the so-called Dragon Trees, which, according to legend, sprouted from the blood of Landon, the hundred-headed dragon slain by Hercules. The genus includes the Canary Island Dragon Tree, *Dracaena draco*, which produces a red resin known as dragon's blood, often used for ancient Roman magic and alchemy. If this story inspires students to want to get a look at a dragon tree, they might have a relative in their home. Relatives of the dragon trees include shrubby plants often sold in the USA as ornamental plants, like the *Dracaena fragrans*. *D. fragrans* is commonly called a "corn plant" because its leaves resemble the leaves of a corn plant, but the common name is deceptive since it is not closely related to corn plants. Instead, *D. fragrans* is a shrubby dracaena, or sort of a domesticated dragon tree, with honeysuckle–lilac scented, fragrant flowers that led to the specific epithet "fragrans."

Like us, plants have names that show their relationships with each other and their own unique characteristics. Learning and sharing plants' names help make the plants themselves more visible, more real, and more important. However, learning names alone may not eliminate plant blindness. Schussler and Olzak (2008) found that college students shown a slideshow including both plant and animal images recalled significantly more of the animals than plants shown, even if the students had taken a botany course. However, we suggest that giving students the opportunity to learn not only local plants' names but also their stories will be a good strategy to combat plant blindness; even though teachers and students may still have a preference for animals, their appreciation and knowledge of plants will increase. The goal is not rote memorization, it is appreciation and understanding, and a good plant mentor (which can be any teacher that helps students learn about plants) is important to achieving that goal.

There is a great deal of science content for teachers to "cover" in a short amount of time, and "learn the names of the plants in your area" is not stated explicitly in any state's standards. However, giving students the opportunity to learn the names, structures, and functions of the plants in their own communities can fit well into any science curriculum. Thoughtful design and some of the ideas included here and elsewhere can allow teachers to use plants to teach about evolution, ecology, and classification.

Teaching Plants and Meeting Standards

In elementary classrooms, science is often overlooked, in part because of schools' and standardized tests' emphasis on mathematics and reading. However, place-based teaching is one way to thoughtfully integrate reading and science. In middle and secondary science classrooms, reading and writing across the curriculum is at least encouraged, if not mandated, and activities that help students develop and investigate the ecological community around them can often help meet these goals.

Wandersee et al. (2006) developed "a writing template for probing students' botanical sense of place (BSP)." The template found in this article is designed to be used with students in phases: the first phase allows students to access their memories of plants from their childhood; the second phase allows them to choose two of the memories and write mini-essays based on them. The third phase is designed for use at the end of a plant-based unit, and helps the student to connect plant biology concepts they have learned with the memories they have described. Wandersee et al. (2006) report that their BSP helped students reconnect to their sense of wonder toward plants, motivated students to learn plant biology, inspired new botanical awareness and appreciation, and helped establish a "plant-centered community of learners" (p. 421). The article includes detailed instructions for using the template in the classroom.

Sanger (1997) described how storytelling is an important way that students may connect to their places. He wrote: "[I]ndividuals have stories that represent their personal histories, just as the land has a story of its own that includes people and their stories" (p. 5). Teachers can take students to a natural area, encourage them to tell stories about this or similar natural areas, and then guide them in an exploration of a new question related to the area. Through this guided inquiry activity, the teacher is reaffirming the students' lives and stories, while encouraging them to add to their knowledge by uncovering some of the stories the land has to tell.

As an example of this storied–guided inquiry approach, let us use the Ginkgo tree. Students in an urban forest might be curious about how an exotic ornamental tree like *Ginkgo biloba* came to be found in the urban area. The history of the tree reveals numerous interesting tidbits, including the fact that *Ginkgo* is considered the oldest genus of living trees, and was around at the time of the dinosaurs. Global learning objectives could be met by showing students where *Ginkgo* came from in China, and how it was cultivated on temple grounds for many years. A group of students might then discover the natural history of the tree, its unique taxonomic position, when it became introduced to the USA, and the properties that make it tolerant to pollutants. Another group of students might decide to design an experiment to investigate how *Ginkgo* seedlings react to various other environmental conditions. As a culmination of this activity, students could do expressive writing activities about the stories the tree might tell if it could. A unit such as this incorporates reading and writing across the curriculum, global learning, science inquiry, and life science standards.

For elementary- and middle-school students, the "go-to" EE curricula, Project Learning Tree, and Project WET, include useful activities that teach about plants and place. Project Learning Tree includes several activities ("To Be a Tree," for example) that allow younger students to examine, compare, and contrast different types of leaves, seeds, and flowers, and begin to learn the names of the trees to which they belong. “Adopt a Tree” from PLT can extend students’ understanding by giving them a chance to study and get to know a tree over time. Students can even do a phenology of their tree, improving their science process skills by measuring and recording the tree’s bud and leaf growth or senescence over a semester or a year. Students might even compare the dates for “first flowers” or “first leaf” on their tree with data from other places. Project WET, for its part, includes an international supplement, River of Words, which encourages young children to develop and explore their senses of place, and express their place in poetry or artwork. These products can be evaluated statewide and internationally (http://www.riverofwords.org/about/index.html).

Teaching about plant taxonomy aligns well with classification standards; for example, National Science Education Standard (NRC 1996) middle-school life science standard C: diversity and adaptations of organisms includes facilitating students’ understanding of the multitude of different species of living things and how their similarities and differences are analyzed, how evolution accounts for the diversity of species, and extinction of species. Although teachers tend to spend a great deal of curricular time teaching the animal kingdom, these principles can be illustrated just as effectively with plants (Uno 1994), and students’ tendency to be less interested in plants can be overcome with enthusiasm and interest of a teacher (Strgar 2007). It could be particularly effective to teach about names of local plants while helping students learn about these plants and their place. Later, the local plants studied could be placed in the broader context of known plant taxonomy, in order to show the breadth of the kingdom. Students could be taught the skills to use field guides, not just for plants but also for many other organisms. Taxonomy could lead into lessons in ecology, to demonstrate the importance of plants and other producers in the energy dynamics of an ecosystem.

Evolution is a major standard in high school, as well. One tool that biologists use to illustrate and model evolutionary relationships is a phylogenetic tree. Interestingly, the lay public’s misconceptions about how to interpret phylogenetic trees can contribute to general misunderstanding of evolution in general and human evolution in particular. Baum et al. (2005) article describes how and why phylogenetic trees are often misread, and includes some suggestions for how scientists and science educators can help people read them correctly. The article also includes a Web link to quizzes that can be used to assess students’ developing understanding of phylogenetic trees. To integrate the understanding of local plants’ classification and evolution, we suggest that a lesson on taxonomy be followed by examination of a phylogenetic tree that includes the plants just discussed (such as the sample tree in Fig. 1). Students could then study the phylogenetic tree and discuss how it illustrates similarities and differences between the trees studied.

With resources that are available, why not consider creating a children’s garden? Children can be allowed to make choices about the types of plants that will be kept, and they can be given responsibilities commensurate with their ages that will allow them to feel more connected to their place. Wake (2007) describes a case study of a children’s garden in New Zealand, including how it can serve as a model for other

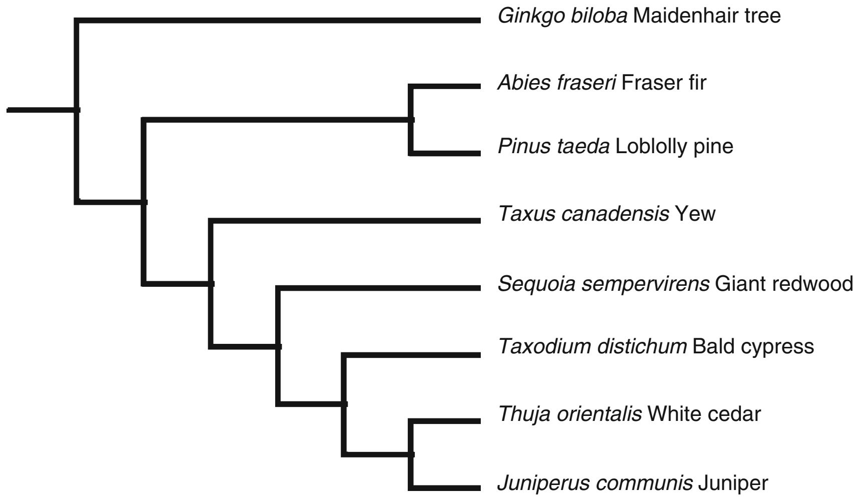

Fig. 1 Sample phylogenetic tree showing relationships of *Ginkgo biloba* to other gymnosperm trees and shrubs based on molecular data

learning gardens. If properly maintained, gardens can be versatile teaching tools. Vegetable gardens are an excellent project for students. In fact, Learning Gate Community School in Florida has structured much of its interdisciplinary curriculum around an organic garden, with impressive gains in both students' knowledge and their sense of place (Howes et al. 2007).

Environmental Education, Sense of Place, and Finally Seeing Plants

One of the foundational documents of environmental education, the Tbilisi Declaration (UNESCO 1977), asserts five goals of EE: awareness, knowledge, attitudes, skills, and action. By teaching our students (and the teachers of our students) to see their environment, including the essential details of plants, we begin at the awareness level. From there, we can begin to address the knowledge of our students by introducing them to ecology and evolution through plants. As students and teachers become aware of and more deeply connected to their own senses of place, attitudes toward their environment cannot help but change. We also seek to give our students the skills to continue developing that sense, by teaching them how to use field guides and how to take care of the land.

If we want students to finally "see" plants, *our* action piece is the most important part. Science teacher educators can (and should) act as a bridge between the research on plant blindness and sense of place, and the practice of science teachers in the classroom. We know that science teachers are faced with constraints that keep them from teaching about plants, and if we expect them to overcome these constraints we need to overcome them ourselves when we teach methods courses. We can all enhance our plant skills. Take a methods class on a walk, pointing out the distinguishing features of the trees on your campus. Have your students transfer their plant understanding to their neighborhoods or the school where they student-teach, by asking them to draw a map that includes trees they can identify. Include plant curricula in life science methods courses whenever feasible; there are well-designed curricula (including PLT and FOSS kits) that preservice teachers may not be exposed to once they are teaching, so give them a chance to explore them when you teach methods courses. A list of other potential lesson sources is included in Appendix 1. We can solve this problem, now that our eyes have been opened.

Appendix 1: Botanical Lessons and Lesson Source Ideas

Hopefully, we have convinced you to start teaching about and with plants. In order to capitalize on your enthusiasm, here are some lessons and resources. The resources meet some or all of the objectives described in the chapter. Our intention is to provide teachers and teacher educators with many ideas and options; however, this is by no means an all-inclusive list. The Botanical Society of America (http://www.botany.org) maintains a list of web links and resources, and that is another great place to look.

Plant Curricula (Aligns to National Science Education Standards)

- American Museum of Natural History (AMNH) "Biodiversity Counts" http://www.amnh.org/education/resources/biocounts/ Has plant identification lessons at http://www.amnh.org/education/resources/biocounts/plant_id.php Plant ecology curriculum materials for grades 6–12 online at: http://www.amnh.org/education/resources/biocounts/ecology.php
- Botanical Society of America's PlantingScience http://www.plantingscience.org This project connects teachers, students, and plant scientists with a venue to connect and develop relationships. Includes inquiry units ("The wonder of seeds" and "The Power of Sunlight") for middle- and high-school classrooms where students can follow the science process by engaging in real research.
- C-Fern®: Using *Ceratopteris richardii* to teach about plants. http://c-fern.org Lessons and ordering information.
- FOSS modules http://www.delta-education.com/science/foss/scopesequence.shtml "Tree" (K); "New Plants" (Grades 1–2); "Plants and Animals" (1–2); "Insects and Plants" (1–2)
- Literature in the Garden http://www.jmgkids.us/index.k2?did=11882&sectionID=2013 Elementary curriculum that incorporates children's literature with garden activities designed by Junior Master Gardener program
- Project Learning Tree ® http://www.plt.org *Pre K-8 Environmental Education Activity Guide*.

- The Private Eye http://www.the-private-eye.com Activities use loupes, observation, and “thinking by analogy” to help students get out, increase their sense of wonder, and explore nature.
- Wisconsin Fast Plants ® http://www.fastplants.org *Brassica rapa* plants that are especially fast cycling, for use in the classroom. Lessons and ordering information.

Plant Classification Guides and Phylogeny Resources

- Tree World http://www.domtar.com/ARBRE/english/index.asp (Designed for 4–6 grade students. Includes a simple online tree identification dichotomous key, and quizzes to test your students’ tree ID skill.
- The Missouri Botanical Garden (MBG): The Unseen Garden. http://www.mobot.org/MOBOT/Research/unseengarden/unseengarden1.shtml Includes information on systematics and how scientists study plants.
- Missouri Botanical Garden and University of Missouri’s Angiosperm phylogeny Web site. http://www.mobot.org/MOBOT/research/APweb/welcome.html Very extensive taxonomy resource.
- Tree of Life web project http://www.tolweb.org/tree/ Phylogeny and phylogenetic trees.

Latin and Legends: Plant Names and How They Got Them

- Barnette, M. (2005). *A Garden of Words.* Lincoln, NE: ASJA Press.
- Virginia Tech (dendrology): The meanings of Latin names http://www.cnr.vt.edu/dendro/dendrology/syllabus/meanings.cfm
- Wells, D. & Patterson, I. (1997). *100 Flowers and how they got their names.* New York, NY: Algonquin.
- Wildflower name origins http://www.wildflowerinformation.org/WildflowerNames.asp Includes information on common names, botanical names, and brief description of systematics.

Other Good Resources for Teaching Outside and About Plants

- Photographic Atlas of Plant Anatomy http://botweb.uwsp.edu/anatomy/
- Exploratorium: Science of Gardening. http://www.exploratorium.edu/gardening/feed/index.html Interactive videos and information on composting, carnivorous plants, garden vegetables, and soil science.
- Grissino-Mayer, H. D. (University of TN-Knoxville) “Ultimate Tree-Ring Web Pages” http://web.utk.edu/~grissino/ Information on dendrochronology.
- Plants in Motion http://plantsinmotion.bio.indiana.edu/plantmotion/starthere.html Indiana University-based web site includes many good time-lapse photography movies (QuickTime) so that your students can see that plants really do move.
- Avoid misconceptions when teaching about plants with this D.R. Hershey (2004) article available online at: http://www.actionbioscience.org/education/hershey.html

- More misconceptions to avoid when teaching about with this D.R. Hershey (2005) article available online at: http://www.actionbioscience.org/education/hershey3.html Junior
- Master Gardener Program http://www.jmgkids.us/ Part of 4-H, information, lessons, and instructions on starting your own JMG group (includes ordering information for several curricula, including Wildlife gardener, literature in the garden, health and nutrition from the garden).

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