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Learning With Street Trees

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Abstract

Learning With Street Trees is an original curriculum for fourth and fifth grade students written by Sigrun Wolff Saphire. The curriculum's eight lessons span the school year from fall to early summer. In each season, fall, winter, spring, and early summer, students work with a number of street trees near their school. They engage in nature observation and drawing, data collection, and interpretation. They practice critical thinking, problem-solving, cooperation, and communication. Throughout the curriculum, the development of science-inquiry skills combines with art making and hands-on tree stewardship. The curriculum culminates in student-initiated community projects.

All student handout materials included in the curriculum were created by the author except for the two-page *Most Common Street Trees*, which is a publication of the City of New York Department of Parks & Recreation. The illustration on the first page of the curriculum (p. 18) was downloaded from oldbookillustrations.com. It is available for use under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

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Rationale

Over the course of the past 100 years or so people all around the globe have been spending consistently more time indoors and less and less time outdoors. Industrialized societies have become increasingly indoor-bound, sedentary, and screen-tethered. A majority of children growing up in the U.S. and other industrialized countries spend little time outdoors, numerous recent national and international studies show (Tandon, Zhou & Christakis, 2012; see also for example Louv, 2008; Starling, 2011). Spending time outside, however, is vital for children's health and development. What's more, research shows that children need to connect with nature before the age of eleven or they may be permanently disconnected. How do we unplug NYC kids and reconnect them with nature? Why does it matter? "If *we* want children to flourish," says educator *David Sobel,* "*we* need to give them time to connect with nature and *love* the Earth before *we* ask them to save it," (1996). For, we don't care for what we don't know. We care for what we love. We love what we know. If we want our children to care for this Earth, we first need to help them experience how amazing it is.

New York City children grow up in a world in which it's easy to ignore that we human animals are part of the ecology of the place. After all, we live in a built-up environment that's all hardscapes and people. Or do we? Nearly one eighth of the Big Apple is forests, marshes, and meadows, more green space than in any other city in North America, and that's counting land features alone. Per capita however, New York appears to be one of the North American cities with the least amount of green. No matter which way you look at it, nature exists in our city. We depend on it, and we ignore it at our peril.

Finding Nature Nearby

The urban forest is essential for our well-being and it is a readily accessible concrete resource perfect for hands- and minds-on exploration, investigation, and experimentation year-round. In other words, the parks, botanic gardens, and street trees that account for a large part of the urban forest make a handy real world teaching tool for children in the elementary grades and beyond that invites children and their teachers outside. Visits to urban parks and botanic gardens commonly require advance planning (and chaperoning) and opportunities for going mano a mano with plants are much more limited. After all, the New York City Department of Parks and Recreation does not look kindly upon spontaneous interventions by tool-toting school groups on parkland. Botanic gardens are largely hands off, with the exception of a few areas dedicated to hands-on exploration. Street trees offer opportunities for year-round science inquiry as well as ongoing hands-on engagement that opens doors to community engagement. Street trees can show children in concrete ways that they are competent human beings and valued members of society. When they learn about trees and care for their charges on a regular basis, children can be physically active outdoors and connect with nature. They can grow into their role as future stewards of the Earth.

Experiences with the trees right outside the school are the first line of inquiry. Field trips to the immersive environments of parks and botanic gardens are the time and place for extension activities that flow out of children's street tree inquiry. Virtual online learning tools can be useful to acquire specific content knowledge and complement real experiences with nearby nature—but not replace them.

Developmental Connections

In the elementary grades, children spend lots of their time acquiring skills. They learn to read, write, and do arithmetic. Rote learning of skills is inherently dull and carries the risk that children get turned off to learning. How do we help our children develop a lifelong love for learning? A compelling approach is to engage with the real world. Object- and place-based learning take advantage of children's curiosity and allow them to follow where their interests may take them. In this case, neighborhood trees engage the whole child, the head, the heart, and the hand in a specific place. Tree care opens the door to intrinsically motivated experiential learning and nature connectedness.

Children in the early elementary grades are ready to learn, but they are not ready to sit still and learn from books alone, or all by themselves. They find it hard to listen for long periods of time. Children in this age group live very much in the here and now. The concepts of past and future are equally hazy. Space that isn't here is vague. They learn best through concrete first-hand experiences that tap into their interests rather than through symbols. Experiences come first, words come second.

In the upper elementary grades, public school students tend to spend quite some time being prepped for rounds of rote multiple-choice testing. Teachers continue to be challenged to move beyond the realm of skill and fact learning and get to a place where they can tap the children's desire to learn. Children's understanding of time, space and numbers is continually deepening. Children continue to be social learners and continue to act in concrete ways. They need to experience themselves as competent.

The street tree curriculum takes advantage of children's desire to communicate with each other and relate to each other as they probe how elements of the real world

hang together and function. The teacher helps children connect new experiences to prior knowledge. It is up to the teacher to create an atmosphere that fosters collaborative learning, a supportive climate of "honest intellectual inquiry" […] "in which mistakes can be made without fear of recrimination", (Cohen, 1972, page 254).

Getting to know trees and developing a relationship with living trees in the community over the course of the school year, or longer can lead to lasting learning experiences and promote nature-connectedness in ways that experiencing trees or other subject matter secondhand through books or other media inside the classroom can never replicate. When they can follow their own curiosity and explore and experiment with real objects and discover connections (with adult guidance), children develop stamina and stick-to-itiveness. They can maintain focus for extended periods of time. They learn to articulate questions and make arguments. They become a community of learners. They are empowered to take action and make visible changes in their neighborhoods.

Engagement with the natural urban environment can provide the integrating context for learning through developmentally appropriate experiences that can foster creativity, ingenuity, and risk-taking. With trees, there's always something to watch. Trees are a stable presence, yet they are always changing. Beyond documenting when they leaf out, flower, produce fruit, and drop their leaves in fall, children can hone observations skills, sketch, write, dramatize, act out, grasp what's going on in a tree, take good care of their tree, relate to members of the community, and appreciate the experience. Trees are one way to bring joy to learning, in the process fostering a deepened understanding of nature and nurturing a lifelong love for nature as well as a sense of stewardship.

Review of Literature

People and Plants: The Human Need for Green

Food, water, shelter: Since our earliest days, humans have depended on nature for survival. Nature sustains life and in so doing nature nurtures the human spirit. Contact with nature is an essential component for human wellbeing. A glance out the window at a nearby tree can improve a person's mood, a stroll through a green space or along a river relieves stress and mental anguish. After playing in a garden or poking around a park children often seem much calmer and happier when they return inside. But why is that exactly? Why do children benefit from being physically active outdoors? Why do I enjoy doing physical labor in a natural setting and derive great satisfaction from the exertion? What happens when we go outside? What happens to a human brain on nature?

The processes that might document the psychological and bodily kinesthetic need for plants and experience of nature have given rise to an array of intriguing hypotheses from researchers and thinkers in disciplines including education, architecture, psychology, evolutionary biology, and environmental psychology. Here's a brief look at some of the thinking. Overload and arousal theories hold that environments that are highly complex visually, noisy, and with lots of movement (think busy city street or classroom, for example) can overwhelm our senses and that settings with low-level stimulation and low intensity (think plants or still or flowing water, for example) require much less effort to process and reduce negative arousal (Ulrich & Parsons, 1992).

Psychologist Rachel Kaplan has proposed that our preference for nature may include aspects of a learned behavior. That theoretical approach holds that people may acquire positive associations with natural environments when they visit rural settings

recreationally and that many people may learn negative associations with urban environments through stressful experiences, such as traffic jams. Kaplan also proposes that viewing nearby nature relieves us from the fatigue associated with sustained directed attention required for activities that demand concentration and focus (Kaplan, 1992).

In 1984, Roger S. Ulrich, a professor of architecture whose research focuses on the relationship between design and health, did a groundbreaking study in which he compared data on hospital patients who were all undergoing the same surgical procedure. One group of patients had a view of a wall from their hospital beds and the other group faced a view that included several trees. The patients who glimpsed nature spent less time in the hospital after the operation, required lower doses of analgesic drugs, got slightly better reports from the nursing staff, and experienced fewer postoperative complications (Ulrich, 1984). In later research, Ulrich documented that views of nature influenced a person's heart rate, brain waves, blood pressure, and muscle tension. Based on their research, Ulrich and others postulate that our immediate reaction to nature is affective (rather than cognitive) and strongly influences subsequent thoughts, memory, meaning, and behavior (Ulrich & Parsons, 1992).

And what happens to the human who takes a nature break? Key findings suggest that nature grabs and holds our attention, blocks out demands and distractions of daily life, and worrisome thoughts, thereby reducing stress and mental fatigue and restoring our sense of well-being (Ulrich & Parsons. 1992).

Two prominent hypotheses have anchored the human affinity for nature in our evolutionary history: Our long connection with the wild has given humankind an (unlearned) preference for environments that resemble the tree-dotted grasslands of the

African savanna where we spent the bulk of our time on Earth so far. People respond especially favorable to settings that show the most promise for survival to pre-modern man, such as places to find food and water (Ulrich & Parsons, 1992). This hypothesis has been put forward to explain, for example, common aesthetic preferences in the design of public and private gathering places and gardens. Likewise, I believe the hypothesis helps explain how I may choose locations when I work with children in the great urban outdoors and how children in turn respond to outdoor spaces. A quiet shady spot offering a child-sized shelter of small trees, for example, may be instantly attractive, promote a calm atmosphere, and invite close attention. A water feature usually draws children like a magnet.

Biophilia "the innate tendency to focus on life and life-like processes," in the words of biologist Edward O. Wilson, provides an overarching framework for the human propensity to connect with other living things (1984, p. 1). Over the course of our evolutionary history, we humans have lived in close contact with other living beings and natural phenomena and as a result we are hard-wired to respond favorably to those elements of the natural world that are beneficial, such as green plants and water. Over millennia of tool use, an intimate connection between the human hand and the head developed (Wilson, 1984; Kellert &Wilson, 1993). Opportunities to reaffirm and build that connection are much more abundant outside than inside, where the latest electronic gadgets may have given a prominent role to human thumbs, but little else. Viewed through an evolutionary lens, the human need to connect physically, emotionally, and cognitively with the natural elements of our world is hardly surprising, even as the benefits may remain a bit tricky to quantify. Nature sustains and protects us. Our

connection to nature is as much utilitarian as it is spiritual: Degradation of nature will leave us degraded.

Biophilia serves as the springboard for a conservation ethic for this time of rapid climate change and loss of biodiversity. If we accept that it is in our best interest and our responsibility to work in service of the future of the Earth, then it follows that we want to educate our children to grow into their roles as future stewards of the Earth. How do we help our children connect with the Earth, the first step toward stewardship? We need to start when they are young and their attraction to living things is strongest (Wilson, 1984). To state the obvious, we can take our children outdoors where they can experience themselves as part of nature rather than separate from it. As responsible adults, we can nurture our children's fascination with water, animals, trees, and their own special places. We can serve as role model explorers investigating the magic of wild nature side by side with our children, validating their experiences (Duckworth, 1996). How might nature knowledge, connectedness, and caring extend into our schools?

Place-Based Learning

Place-based education, PBE for short, is showing the way. Simply put, place-based education approaches ground student learning in the places where the students live. PBE connects a school to its community through curriculum that is inspired by the social and ecological realities that touch the children's and their neighborhood's daily lives. Schools look to the local community as a resource. The community in turn often benefits from student-led initiatives. School, environment, and community form the basis for authentic learning. Depending on where the students are located and what their ages and interests are, ecologically based projects may revolve around school gardening,

environmental justice issues, and habitat restoration, for example. In an ideal situation, entire schools or school systems move toward a PBE approach (see for example, Altman, n.d.; Smith, 2007; Sobel, 2004, 2008). In circumstances where an immersive PBE program is not in the cards, teachers may take small steps to change their practice in such a way that it moves in the direction of integrating student learning with place, an idea emphasized by David Greenwood (Altman, n.d).

Educators, and I count myself among them, are finding that when environmental education is linked into the local community, ecological thinking synergistically connects with social justice thinking (Altman, n.d.; Orr, 1994; Smith, 2007; Sobel, 2004). In other words, PBE gives environmental education a home base with a purpose. Using a simple street tree-initiative as an example, through student engagement, a neighborhood's previously neglected trees may get care, new trees get planted, freshly planted trees get watered, tree beds get maintained, tree guards get installed. Tree leaves get swept up and composted. Students are a visible presence in the neighborhood, and their work is valued. Students further connect with their community when they raise awareness about the roles of street trees for the wellbeing of the neighborhood or engage in another community outreach project. Before they are ready to share, the students themselves have launched inquiries into tree biology and the ecological roles of trees, using the real-live specimens that dot the neighborhood as their resources. In this way, trees can be the nexus of school, children, and neighbors.

What's compelling is the way in which street-tree projects easily kick off real-life investigations and problem solving, interweaving ecological and social thinking. Student-led projects may skip freely across the curriculum, joining academic subjects from math

to language arts, and everything in between (Sobel, 2004; Smith, 2007). Along the way, student academic achievement and engagement increase, as related research suggests (Smith & Sobel, 2010).

The current curriculum revolves around social studies and science inquiry for several reasons. In the current educational climate, the focus is heavily on language arts and math. Other subject areas can easily get shortchanged in the elementary grades, even though language and math lend themselves to being investigated through the lens of any other subject. Social studies and science, for example, both require language to communicate and both readily extend to provide real-life contexts for grade school arithmetic. Likewise, in my view, it is important to share with students through curriculum that science requires math, but that one does not have to excel at math in order to be a decent scientist. In addition, science inquiry is a gateway into critical thinking and problem solving, provided projects and materials are supportive and the teachers are ready.

One obvious challenge to implementing place-based curricula is that PBE takes an interdisciplinary approach and the NYC school system is centered on neatly separated disciplines. Another challenge is the prevalent climate of high stakes testing. Teachers may find that preparing students for rounds of mandated tests leaves little time for projects that require long-term commitment. Furthermore, PBE makes demands on teachers to research, develop, or adapt materials. In addition, teachers need to trust their students and hand over some of their power to determine curriculum. On top of that, a lack of ready access to a sizable chunk of nature might be perceived as an obstacle to place-based inquiry.

The curriculum revolves around street trees, which are part of the fabric of virtually every city neighborhood. It is an invitation to teachers and students to get out and get involved with their nature neighborhood and make it their own. It's a nudge to take note of the environment through which children travel on their way to and from school every day, and embed it into the work the students do in social studies and science. Where might their inquiries lead the group? Where might they lead each student?

My own affinity for trees certainly got its start with specific individuals, such as an enormous beech tree that I would pass every day on my walk to school and that during one year in grade school became the subject of a fall to summer tree study. The endeavor was a personal one, undertaken separately by each student in the classroom. Who knows what might have ensued if my much loved teacher had embraced a place-based education approach instead?

When they take on the care of trees, children experience their place and connect to it emotionally. They participate in their communities rather than watch from the outside (Sobel, 2004). Students have agency in what they learn and how they learn it (Orr, 1994). By its very nature, such engagement is interdisciplinary and bound up with the dynamics of the real world. Children naturally engage in ecology, the study of the interactions of organisms with their environment (and literally the study of our home). They start to understand and appreciate how people and natural systems relate to each other. In so doing they move toward ecological literacy. They begin to grasp how our actions impact the Earth. With awareness and concern awakened, they may change their behavior and take action down the line (Orr, 1992).

Child Development

A commonly heard lament among concerned adults is that our children spend most of their school days at their desks and the bulk of their out-of-school leisure time indoors "where the electrical outlets are," as Richard Louv quotes one youngster's response to the question where the fourth grader prefers to play (2008, p. 10). Louv diagnoses nature-deficit disorder (2008). Cooped up inside, children miss out on the benefits of unstructured outdoor nature play in diverse age groups, which has been shown to integrate cognitive, social, and emotional behaviors (Kahn & Kellert, 2002). Instead of direct contact, adults and children tend to consume nature vicariously on screen (Sobel, 2008). Virtual contact, for example through nature-based videos, most likely centers on far-away nature rather than what's right outside our doors, creating a disconnect rather than a meaningful connect. A strong bond with nearby nature would be beneficial for the children's wellbeing and development right now as well as improve the prospects for natural areas down the line when those children grow into their adult roles as stewards of the Earth. Research has shown that direct exposure to natural environments before the age of eleven has a profound effect on shaping adult behaviors and attitudes toward nature. Notably, benefits flow from spontaneous child-directed activities in natural landscapes rather than highly structured, adult-developed and supervised activities (Sobel, 2008).

If a curriculum inspired by principles of biophilia, place-based learning, and science inquiry is not a miracle guide to nature-connectedness for children negotiating our sedentary, screen-tethered, industrialized urban world what role might it play? Adult attitudes toward nature and values are communicated when children and adults learn

together out of doors (Duckworth, 2007; Louv, 2008; Sobel, 2008). Direct engagement with nature may prevent ecophobia, described as a fear of or negative attitudes toward the natural world, that can develop when children lack direct contact with nature in the early years or when the premature discussion of global ecological crises leaves elementary-age children feeling disempowered and hopeless, and quite possibly turns them off from nature for good (Sobel, 1996).

Children can develop joy in their own ideas when they ask and pursue their own questions (Duckworth, 2007). This is the joyful place where intrinsic motivation meets developmentally appropriate learning. Nearby nature is part of the here and now that Lucy Sprague Mitchell proposes as a fitting learning environment for children in the early elementary years (children ages six to about nine years old), which comes before engagement with the far away and long ago (1934, 2001). That's because stretching beyond the immediate presence into layers of past and changing locations and different viewpoints requires the full capacity for logical thinking and formal operations that begin to emerge in the middle years of childhood (Minuchin, 1977). In sum, a street tree-based curriculum aims to inspire children to observe carefully what's all around us, participate in it, ask questions, construct meaning, think critically, make connections, develop stamina, become ecoliterate, and take action.

Beyond the classroom and the immediate here and now of developmentally appropriate learning, ecologically based curricula aim to inspire a sense of stewardship for the Earth in students. As responsible adults we help our children experience how amazing this world is. We create opportunities for our children to connect intellectually

and emotionally to the Earth because to paraphrase David Sobel, in order to save the Earth, we have to love it. In order to love the Earth we have to know it (2004).

Learning With Street Trees

An Inquiry-Based Curriculum for Fourth and Fifth Grade

Author: Sigrun Wolff Saphire Mentor: Roberta Altman

Cornouiller à fleurs (Cornus florida).

Learning With Street Trees

Teacher's Guide to the Curriculum

This inquiry-based curriculum for grades four and five was especially designed to draw students' awareness to the street trees in their urban neighborhoods. The eight lesson plans that follow invite students to practice nature observation as well as data collection and interpretation, critical thinking, problem-solving, cooperation, and communication. Throughout, the development of science inquiry skills combines with art making and hands-on tree stewardship, culminating in a student-initiated community project.

After an initial reflection and visit of the trees they will study, students start with observations of leaves, and then fruits and seeds in fall, continue with investigations of leafless trees in winter, and then track the trees from bud break to leaf expansion and flowering and fruit set in spring and early summer. That's to say the inquiry-based lessons two to six span the seasons from fall to early summer. Nature Notebooks are a core component of student inquiry in the curriculum and introduced early. If this is the first time they work with science notebooks, students will benefit from a gradual introduction that includes explicit teaching of strategies. As students become more familiar with observing and recording, they develop their own data collection metrics for the spring lessons. While each lesson can be rolled out independently within nature's cycles, a spring lesson used as a stand-alone may require more guidance than provided in the context of a year-long study.

Students learn from the trees throughout the year and reciprocate by taking care of the needs of street trees throughout the seasons. (For Street Tree Care Basics, see page 62. For Resources see page 65.) They then build on their newfound knowledge and skills to engage with their community around trees.

Individual lessons may take about one or two periods each, with the understanding that the lessons included here are merely a framework and that in-depth study and ongoing tree care will require weekly or more frequent outings. The same is true for the culminating group project. It may take several periods to complete and then much more time when it is rolled out in the community.

Standards

NYS Common Core Standards for Grades 4 and 5

Writing Standards:

> Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Speaking and Listening Standards:

> Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 (5) topics and text, building on others' ideas and expressing their own clearly.

Next Generation Science Standards for Grades 3 to 5

Planning and Carrying Out Investigations

Analyzing and Interpreting Data

NYC Blue Print for the Arts

Benchmark 5th Grade: Making Connections Through Visual Arts

> Students recognize the societal, cultural, and historical significance of art; connect the visual arts to other disciplines; apply the skills and knowledge learned in visual arts to interpreting the world.

Benchmark 5th Grade: Community and Cultural Resources

> By working with a variety of school staff, students access primary resources in the community, the borough, and the city to extend their learning beyond the classroom.

Lesson 1—People and Animals Need Trees

1 Purpose / Aim

Students begin reflecting about trees and start a conversation about the role of trees in our world and articulate questions they have about trees.

2 Materials and Space

Tree Facts and Questions

How Does it Feel to Be a Tree?

(picture book: Flo Morse, author; Clyde Watson illustrator)

Or

Are Trees Alive?

(picture book: Debbie S. Miller, author; Stacey Schuett, illustrator)

Instead of a picture book or in addition to it: a collection of objects that come from trees: twigs, leaves, seedpods, fruits, seeds, small wooden objects such as clothes pins, dice, blocks, pencils, toys. Possibly, bags that can hold a small collection of objects for small group work.

Pencils, sharpeners, erasers, crayons, markers, 3 pieces of 8 ½”x11” card stock; 4”x6” index cards or post-its in different colors; writing paper; colorful cardstock; tissue paper, scissors, glue sticks, 3 pieces of craft paper from a roll, each 5’ to 6’ long;

Binders or folders for Tree Journals

Large tables for group work

Open area along a wall where children can come together in a semi circle

3 Procedure

Tree Story

Gather students in a circle and read the picture book to the group.

- What are your questions for a tree?

And/Or

Object Study

Tree-related objects and things made from wood are displayed on a tray. Students gather in a circle and observe the objects. Alternatively, several sets of objects are set out on tables for small group investigation. Possibly, objects are in a mystery bag from which students remove them one by one.

- What is the job of the object?
- In your opinion, how are the objects connected?

(If starting in small group: Gather ideas in the small group, then share in the large group.)

Tree Posters: Expand the conversation about trees

Students work in three groups at three large tables. Each group collaboratively draw an outline of a tree onto the large piece of craft paper and tape it to a wall. The three groups then take turns working at their work tables on the following three questions.

- What have you touched today that's made from wood?
- What foods do people collect from trees?
- Which animals live in trees or use trees?

In the middle of each table sits a folded piece of cardstock with one of the three questions written on it. Each group write the first question they are addressing on a piece of cardstock and tape it to their tree outline. Then each group brainstorm, and draw/collage/cut-out objects on index cards and label them with the objects' names. When they have finished their first round of artworks, they tape their works around the edges of their tree wall poster. Then the groups move to the next table and switch to the next question and create artworks in response to the second question, and add their artworks to the tree with the relevant question. They use the same procedure for the third question.

Students do a walk of the three tree posters and sit down in a semi circle around the three posters. In the large group, the students say what they noticed. Then they brainstorm two questions in the large group.

- What do trees need to live?

- Trees are forest dwellers, yet there are many trees in the city. What are some challenges trees encounter in the urban environment?

The teacher collect responses/questions for each on a separate sticky pad sheet and tape it near the three trees.

What do I know about trees? What do I want to know about trees?

Students work individually on the **Tree Facts and Questions** worksheet.

Each student fill in the first two columns: What I know about trees. What I want to know about trees. The third column, what I learned about trees, remains blank for now. Tree Facts and Questions is the first item in the Tree Journal.

Tree Journal & Nature Notebook

Throughout the curriculum students will work with Nature Notebooks and Tree Journals. They will use Nature Notebooks to gather raw data in the field (much like an scientist might) and Tree Journals (that stay in the classroom) to synthesize and publish project-related data. Tree Journals can be individual projects or collaborative works developed by pairs or small groups. (Nature Notebooks are introduced in Lesson Two.)

What would you like to know?

Working in pairs, students tell each other one thing they want to know about trees and collect ideas and strategies how they might be able to find or work towards answers. The students then gather in a circle and bring their questions to the large group. Questions that can't be answered in the large group go on a large sticky pad sheet. Students come back to the sheet to add questions, answers, and ideas for finding answers during the entire time they are working around trees.

4 Evaluation

- To what extent do students understand the nature of trees?
- To what extent are students working together in teams and building on each other's ideas and knowledge about trees?
- To what extent do students capture their knowledge and formulate questions using **Tree Facts and Questions**?

5 Follow-up and Extension Activities

- Imagine you are a special business—a tree business. What do you have to offer? What do you need to stay in business? Tell or write a tree story. Develop a skit. Make an ad for your tree business.
- Create a cover design for your Tree Journal.

Tree Facts and Questions

Fill in the first and the second columns now.

Fill in the third column as you are finding out new information.

Feel free to add sketches to illustrate your notes.

What I know about trees	What I want to know	What I found out

Lesson 2—Introduction to Field Study

1 Purpose/Aim

Students make first contact with a number of trees right outside their school. They start recording observations in their Nature Notebooks. They come up with ideas how they might identify the trees.

2 Materials and Space

Before the initial tree walk, teachers familiarize themselves with the area where they will work with their students. Minimum requirement: two different tree species; ideally, one tree for every two to four students.

Tree Journal

Nature Notebooks, one per student
One apple per small table group (or other fruit)
Hand lenses
New York City Most Common Street Trees handouts
Neighborhood map
Outdoor thermometer
Clipboards
Pencils, erasers
Printout of questions from lesson 1, one per student
Possibly, notebooks with blotting paper for collecting leaves (one per student pair or small group)
Cardboard, blotting paper, newsprint, rubber bands (for herbarium collection)
Sticky pad or Smart Board

3 Procedure

Ground Rules for Nature Notebooks

Students will use Nature Notebooks to help them record information. They discuss what kinds of things may be recorded. Ground rules are established in the whole group. For example: Each entry starts on the next available new page. Each Field Note has a title and includes Date, Time, Weather Notes, Location. Detailed drawings are part of Field Notes as well as other Nature Notebook entries as warranted. Notebook organization beyond the ground rules is up to each student. Especially in the beginning, asking volunteers to share what they recorded can help students learn from each other and inspire each other.

Nature Notebook—Technical Drawing of an Apple (or another fruit)

Students sit in small groups and obverse the apple. They use hand lenses, and write down and draw what they find out. They then share their work with a partner. Then students, working with their Nature Notebooks, share their findings in the whole group. Observations are aggregated on the Smart Board or a large Sticky Pad. Student volunteers share with the whole group how they made recordings. (This portion of Lesson 1 may take up one or two periods. At the end, students eat the fruit.)

Tree Walk

Students head outside to the schoolyard or the sidewalk and find the closest tree. They take a moment to notice the tree. Have you taken note of the tree before? What do you notice on the ground? At eye level? In the canopy above? Close your eyes for one minute. What do you hear? What is different when you close your eyes?

Nature Notebook—Recording Observations in the Field

Students fan out in pairs or in small groups to study different trees. Possibly: When they have finished with their first tree, students record observations about a second tree of a different species. This step might also happen during a future outing.

Student works on a **Tree Journal** page attached to a clipboard. Alternatively, or for future outings, students work with their **Nature Notebooks**. Either way, they record observations in words and detailed drawings.

Collecting Specimens

Teachers model how to collect a leaf from a tree: Remove the leaf at the stem where it originates. Use your thumb and index finger to pinch or twist the leaf off with its leaf stalk intact. Work with care. Always treat living organisms with respect. Ripping may cause unnecessary harm as well as damage an identifying feature. Put each leaf separately between two pages of your notebook. Write down when and where you collected the leaf. Take note of variation in leaf sizes and shapes.

Collect leaves that represent the differences that you notice on one tree.

Keep leaves from different trees separate.

Student groups collect up to five leaves from the tree(s) they investigated.

Nature Notebook Task—Alternate or Opposite?

Observe a tree branch closely. How are the leaves arranged? Make a drawing in your Nature Notebook that shows how the leaves are arranged along the stem.

Drying Leaves and/or Herbarium Collection

Back in the classroom, leaves are put between sheets of blotting paper for future study. If the leaves will be preserved for a collection: Students work in pairs or individually. They make a small packet for each leaf: Put down a piece of cardboard, add two pieces of newsprint, carefully put down the leaf, cover with two pieces of newsprint, cover with cardboard, fix the packet with a rubber band. Write down collection date, location, name of plant (if known) on the cardboard. Weigh down with heavy objects, such as large books. Once the leaves are fully dry, they are taped into the Tree Journal and labeled with collection date, place, and tree name.

Nature Notebook Share

Back in the classroom, students take a moment to finish work on their **Nature Notebook** or **Tree Journal** page(s) and add them to their journals. Students gather in the large group. Volunteers show their Nature Notebook and/orTree Journal page(s) to the group and describe what they recorded.

Tree Thoughts and Questions

Next students share one thought or one question they have about one tree in particular or trees in general. The teacher records thoughts and questions in separate documents, on the Smart Board or large sticky pad, for example. Students discuss how the questions might be grouped. Which questions are ready to be investigated in the field? Which questions need research? Which are difficult to put into either category? What are next steps? Students then categorize the questions from lesson one. (Mode: think, pair, share)

Which Tree?

Each small group receives a copy of New York City Most Common Street Trees. Working together, students try to determine if the tree(s) they investigated today are listed on the NYC Most Common Street Trees handouts. Are there several possibilities? How might one narrow down the choices?

Adopting Street Trees

Street trees greatly benefit from student care. To get started, check the **Street Tree Care Basics** on page 62 with your students. As you head outside for your first tree care outing, identify applicable tree care tasks. Then make a plan with your students to determine how tasks will be assigned and rotated. Tree care tasks can be carried out each time the group heads outdoors for observations and data collection. Over time students can be in charge of organizing and carrying out routine maintenance tasks such as watering and litter collection.

4 Evaluation

- To what extent do students focus closely on the inquiry task and make and record meaningful observations?
- To what extent do students apply and extend their tree questions to a live tree outside?
- To what extent do students devise and formulate strategies for investigation?
- To what extent do students develop detailed drawings?
- To what extent do students use their field notes to share information?

5 Follow-up and Extension Activities

- Open invitation to students to bring in found objects related to the street trees under investigation and other plants. Teachers establish parameters for responsible collecting procedure and acceptable types and sizes of objects. Possibly, objects can be displayed in a designated area. Leaves, flowers, some seeds and seed heads can be pressed and dried for a herbarium collection.
- Measure and track temperatures underneath specific trees and in full sun over time.
- Set up a rain gauge on the school grounds and check it at least weekly. Record readings over time. (In following years, compare current readings with those from previous years.)

Tree Journal

Journal Entry # _____
Today's Date _____
Temperature _____
Name of Tree _____
Location _____

Draw a part of the tree.

Describe the tree.	Draw the whole tree.

How does the soil around the tree look and feel?

What animals do you notice near the tree?

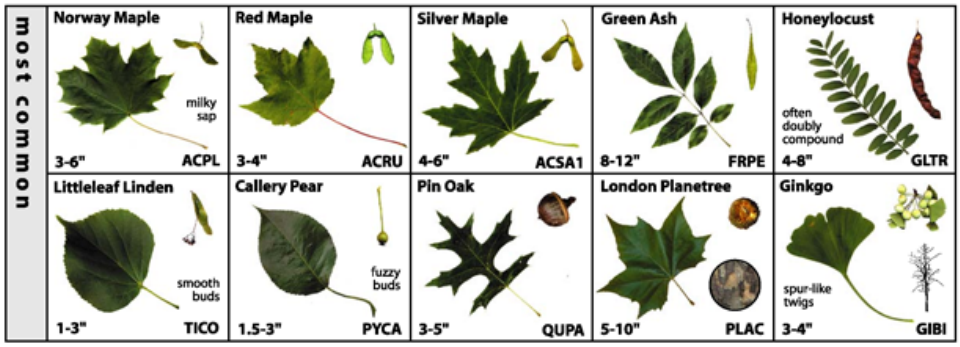
What else would you like to know?
For follow-up visits: What has changed since your last entry?

TREES COUNT!

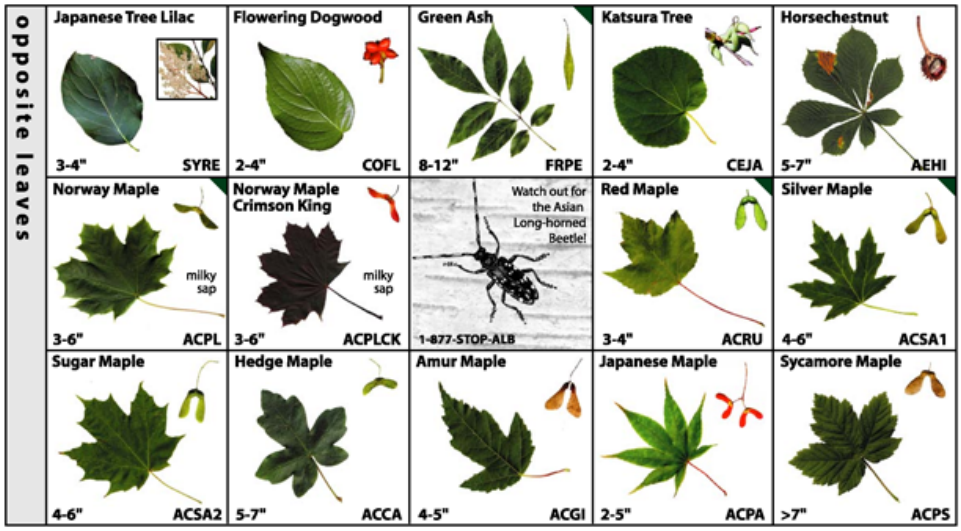
2005 NYC Street Tree Census

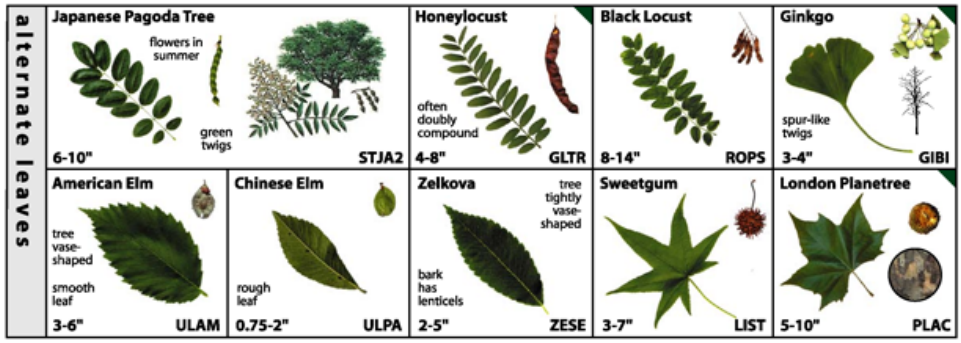
City of New York Parks & Recreation
Michael R. Bloomberg, Mayor
Adrian Benepe, Commissioner

MOST COMMON STREET TREES



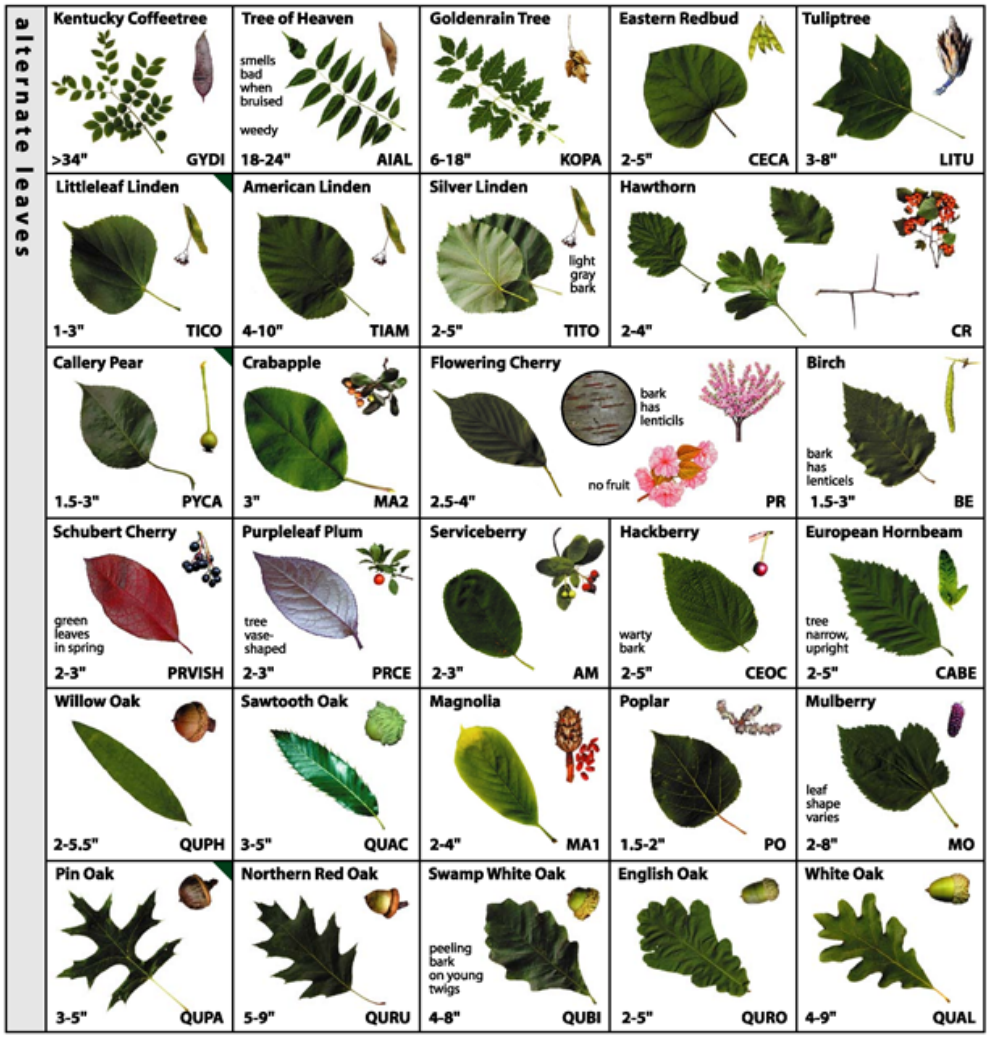
BROADLEAF TREES





BROADLEAF TREES

alternate leaves



CONIFERS

conifers

MORE INFORMATION

Questions
(718) 78-COUNT

Frequently asked questions
Upload data
Contact us
www.nyc.gov/treescount

The ten most common street trees are marked with green triangles.

Helpful Hints:
Measurements given are of leaf length, from bottom to top (not including the petiole or stem). Fruits and flowers shown may not be present or mature at the time of your census. Most broadleaf trees bear flowers in the spring, which turn into the fruit or seed pod during the summer. Be sure you're looking at a whole leaf as illustrated above: don't mistake the leaflet of a compound leaf with a simple leaf. There is always a bud at the base of the leaf (not at the base of the leaflet).

Most leaf pictures taken from *New York City Street Trees*, by Edward Sibley Barnard, Columbia University Press, NY, © 2002

Lesson 3—Leaf ID

1 Purpose/Aim

Students hone their observation skills and familiarize themselves with basic terminology needed to identify trees by their leaves. They then learn to work with a simple dichotomous key to identify four common New York City street trees. They apply their new skills with the dichotomous key *What Tree is That?* to identify their street trees.

2 Materials and Space

Dichotomous Key, one per student

Leaf Features: Leaf Arrangement, Anatomy, Types, Shapes, Margins, one per student. Alternatively: handout texts only combined with collected tree leaves.

What Tree Is That? (Arbor Day Foundation, 2009) or another dichotomous tree key (several copies)

Pile of leaves from different trees

If the leaves collected during the first field outing represent just one or two tree species, more leaves collected by students or teachers from other trees.

3 Procedure

Leaf Arrangement and Leaf Anatomy

Individually, students read clues and label the scans in **Leaf Arrangement** and **Leaf Anatomy.** Students compare their results in pairs or small groups. Remaining questions can be resolved in the whole group. **Leaf Arrangement** and **Leaf Anatomy** are added to the Tree Journal or the Nature Notebook.

Leaf Types, Shapes, Margins

At each step, students read the clues, label the leaf scans, and then work in small groups to organize real leaves.

Step One: Individually, students label **Leaf Types**. Next, working in pairs or small groups, students organize collected leaves and set aside questionable leaves.

Step Two: Individually, students label **Leaf Shapes**. They organize leaves and set aside questionable leaves.

Step Three: Individually, students label **Common Leaf Margins**. Working in pairs or small groups, they describe the leaf margins of the real leaves.

Describing Leaves in Detail

Students each pick two to four different leaves, make detailed sketches and describe them with as much detail as possible in their **Nature Notebooks**. Then they swap their descriptions with another student. Then students add more detail and address questions. Finally, students tape a selection of real leaves onto Herbarium sheets, label them, and add them to the **Tree Journal**. To pursue unresolved questions in the whole group, actual leaves can be projected onto the Smart Board.

Dichotomous Keys

Dichotomous keys are used to correctly identify organisms in the field or in the lab based on distinguishing characteristics. Some characteristics that differentiate leaves include opposite or alternate; simple or compound; palmate or pinnate, palmately or pinnately lobed, entire, leaf margins lobed, entire, or toothed/serrated.

A dichotomous key is made up of a series of questions with two choices. Each choice leads to another question, and finally to the correct identification. A key may be all text-based or it may be all drawings or a combination of the two.

How to Work With a Dichotomous Key

Working with the whole group, pick four random objects found in the classroom.
Come up with questions that lead to the correct identification of each.

Possible Extension

Individually, or in small groups, students create dichotomous keys for four objects, and try them out with each other.

Keying Out Tree Names

In small groups, pairs or individually, students key out the names of the four trees using the **Dichotomous Key**. Individually, students add the names of the trees on the pages of their **Dichotomous Key**.

What Tree Is That?

Individually, students fill in a column in a **Leaf Comparison Chart** for the street tree they want to identify. They draw and write down descriptive words. Students help each other. (In the whole group, the **Leaf Comparison Chart** can be projected on the Smart Board and completed collectively.)

With the help of the collected leaves, **Leaf Comparison Chart,** Nature Notebooks, and Tree Journal students start to key out the names of the street tree(s) they studied in *What Tree Is That?* They may want to revisit the trees to gather more information needed for positive ID. Depending on the tree species, positive identification may involve few steps (e.g. ginkgo) or many (e.g. oak species).

Creating a Dichotomous Key for Four Street Trees

Students gather or receive leaves from four different street trees to be identified (or already identified).

Individually, students work on the **Leaf Comparison Chart** for the four leaves as before. Working individually students come up with (three) questions that lead to identification of the trees. Possibly, they make sketches to help understanding. Students swap keys and help each other. When the keys are final, students can write and draw clean copies for publication. Keys are then swapped and tried out. In addition, students can share their keys with other classrooms.

Reflection

Individually, students gather their thoughts in the **Tree Facts and Questions** chart or in their Nature Notebooks. In the large group, students aggregate what they have found out.

4 Evaluation

- To what extent do students use the new terminology when speaking and writing about leaf anatomy?
- To what extent do students record their new knowledge and formulate questions using the Tree Facts and Questions chart?
- To what extent can students communicate their observations and hypotheses?
- To what extent do students work together in teams and build on each other's ideas and knowledge about tree leaves?

5 Follow-up and Extension Activities

- Create large visuals based on this lesson's ideas for display in the classroom.
- Create a dichotomous key based on tree fruits.
- Brainstorm: How might you identify deciduous trees once they have dropped their leaves in fall?
- Observe and draw leaves and leaves in cross-section under the microscope.
- Review photosynthesis and create visuals that illustrate how a "solar food factory" works.
- Why do leaves change colors in fall? Research chlorophyll, carotenoids, anthocyanins.
- How much light can a leaf collect? Devise techniques for measuring leaf surface, e.g trace leaf outlines on graph paper, count boxes. Compare leaves of different sizes and shapes.
- Visit a nearby park. How are the trees similar to the street trees? What makes their lives different from that of street trees? Are there any trees of the same species as on the street?

Types of Trees

Deciduous tree: a tree that sheds its leaves in fall

Evergreen tree: a tree with leaves that stay on the tree throughout the winter and into the following growing season. Most conifers are evergreen.

Broadleaf tree: a tree with leaves that are flat and thin. Most are deciduous.

Conifer: a tree that bears cones. Most are evergreen trees with needles.

Leaf Arrangement

Leaves are alternate: A single leaf joins the stem at a node.

Leaves are opposite: A pair of leaves joins the stem at a node

Leaf Anatomy

Leaf stalk or petiole: connects the leaf blade to the stem

Leaf blade: the broad part of a leaf

Leaf base: the bottom end of a leaf

Leaf tip: the top of a leaf

Leaf margin: the edges of the leaf

Vein: supports the leaf and transports water and minerals

Node: the point where the petiole connects to a stem

Stem: the main support of the plant

Leaflet: One part of a compound leaf. Leaflets do not have axillary buds.

Axillary buds or leaf buds: Buds located where a leaf joins a stem.

Leaf Types

Simple leaf: One blade is attached to a leaf stalk.

Compound leaf: More than one blade is attached to a leaf stalk.

Pinnately compound leaf or pinnate leaf: Leaflets are attached along an extension of the petiole called a rachis. (Clue: Looks like a feather.)

Palmately compound leaf or palmate leaf: Leaflets are attached to the tip of the leaf stalk. (Clue: Looks like a hand.)

Leaf Shapes

Heart-shaped **Fan-shaped** **Oval**

Pinnately lobed **Palmately lobed**

Common Leaf Margins

Entire: a leaf that's smooth all around has an entire margin

Crenate: a margin with rounded teeth

Serrated or Toothed: triangular tooth-like margin

Lobed: deep, rounded edges

Dichotomous Key

1. Q: Is the leaf fan-shaped?
If the answer is YES, then your tree is **ginkgo**.
If the answer is NO, go to question 2.

2. Q: Is the leaf pinnately lobed?
If the answer is YES, then your tree is **white oak.**
If the answer is NO, go to question 3.

3. Q: Is the leaf heart-shaped?
If the answer is YES, then your tree is **little-leaf linden**. If the answer is NO, then your tree is sweet gum.

Leaf Comparison Chart

Tree name				
Leaf sketch topside				
Leaf sketch underside				
Simple or compound				
Leaf shape				
Leaf margin				
Alternate or opposite				

Lesson 4—How Plants Spread Their Seeds

1 Purpose/Aim

Students infer how a tree or another plant spreads its seeds by studying fruits and seeds.

2 Materials and Space

Fruit & Seed Investigation

A tree fruit that's familiar to the students and that has seeds, for example apple, pear, mango, papaya

Mixture of seeds dispersed by different means

- Seeds dispersed by wind: dandelion, milkweed, maple (samara).
- Seeds dispersed by water: coconut, cattail, lotus.
- Seeds distributed by animals:
- Hitchhikers: Dry fruits stick to animal's fur.

  Examples are burrs, sweet gum balls.
- Collectors: Some animals, like squirrels and ants, bury and store nuts, acorns, and other fruits. Seeds they don't dig up to eat have a chance to germinate.
- Tasty treats: Many plants that use animals to distribute their seeds wrap them in tasty fruits like berries or stone fruit like cherries and peaches. Animals eat the fruits. The (usually hard) seeds pass through the digestive tract unharmed and come out the other end, with a bit of fertilizer. Some seeds have large seeds that the animals leave behind when they eat the fruits.

Possibly: ***Who Will Plant a Tree?*** Picture book by Jerry Pallotta

3 Procedure

It's not enough for trees and other plants to make seeds. They have to find ways to move the seeds where they have enough space, light, and water to grow. Plants spend their whole lives in one place, so how do they spread—or disperse—their seeds?

What can you infer about the way a plant spreads its seeds by studying the seeds?

The purpose of the object study: It's not enough for trees and other plants to make seeds. They need ways to move the seeds to a place where they have enough space, light, and water to grow. Plants spend their whole lives in one place, so how do they spread—or disperse—their seeds? What can you infer about the way a plant spreads its seeds by studying its fruits and seeds?

Fruit

Start with a group brainstorm around the following questions.

- What part of the plant is the apple? (Use whatever fruit you are using)
- What other fruits do you know?
- What's inside the fruits? What's inside the apple?
- How might you be able to find out if you don't know?
- A plant's fruit holds the seeds inside. A fruit is like a suitcase for seeds. When something has seeds inside, it's a fruit, no matter what it looks like.
- Why do plants make seeds?
- Why might a plant wrap its seeds inside a tasty treat like an apple?
- How do plants move their seeds where they have space to grow?

Extension: Read-Aloud of all or part of the picture book *Who Will Plant a Tree?* Or cover the text and project select images onto the Smart Board for group discussion: What's going on here? What more do you see? What makes you say that?

Seed Mix

Students work in small groups. Each group has a tray with a mixture of fruits/seed heads/ seeds that are spread by different means. The students individually investigate the objects and hand them around the table. In the small group the students discuss how they think the seeds may be distributed and explain their reasoning. Then they each choose one seed and describe it in **Fruit & Seed Investigation**. Do you know the plant to which the seed belongs?

After the fruit and seed investigation, each table explains how they think their seeds are dispersed. The tray of seeds can be projected on the Smart Board.

Seed Dispersal Illustration

Small group, pairs, or individual students create a collage, cartoon/storyboard, chart, or another visual that illustrates the different ways in which plants spread their seeds. Then they do a gallery walk.

Seed Dispersal Charades

Students develop skits that illustrate seed dispersal methods.

4 Evaluation

- To what extent do students make inferences about possible seed dispersal methods?
- To what extent do students make detailed drawings of fruits and seeds?
- To what extent do students synthesize their new knowledge in an illustration that captures seed dispersal methods?
- To what extent do students work together in teams and build on each other's ideas and knowledge about fruits and seeds?

5 Follow-up and Extension Activities

- How has seed dispersal inspired human inventions? Drawings and explanatory texts illustrating and explaining one or more examples.
- In the field: Collect fruits from the street trees under investigation for the in-classroom collection.
- Visit a nearby park. Observe the trees and the landscape. Make comparisons between street trees and park trees.

Fruit & Seed Investigation

Journal Entry # _____ Today's Date _____

Name of Plant _____ Where found _____

Describe the fruit.	Draw the fruit.
Color: Shape: Size: Texture: Scent:	

Describe the seed.	Draw the seed.
Color: Shape: Size: Texture: Scent:	

This is how I think the seeds are spread:

Lesson 5—Trees in Winter

1 Purpose/Aim

Students extend their observation skills as they learn to identify deciduous street trees without leaves. They differentiate twigs and buds from different trees as well as their bark. They get to know different branching patterns and tree shapes. Students chart twig growth.

2 Materials and Space

Twigs from different street trees showing previous year's growth
Hand lenses
Measuring tapes
Rulers
Nature Notebooks
Smart Board

3 Procedure

Trees Without Leaves

Students visit their street trees. They take a brief walk of all the trees. They pick one tree and make a careful technical drawing of it into their Nature Notebook. Then they pick a second tree and make another careful drawing.

- What do all trees have in common?
- What do some trees have in common?
- What are some characteristics that make each tree unique?

In pairs or small groups, students compare their observations. Then observations are shared in the whole group. (Depending on the weather, drawings and discussion may be spread out over several outings.)

Twigs and Buds

If the trees have branches that are low enough for students to observe carefully up close:

Students make detailed drawings of twigs with buds of trees of different species. If students can reach the lower branches, they measure twig growth. How much did the twig grow in a year? Students refine their field sketches in the classroom.

If tree branches are out of reach, collect twigs from the same species as the street trees before class: Students use the specimens to make detailed drawings in their Nature Notebooks inside the classroom. Students hypothesize which twig might belong to which tree. Then students take twigs outside and compare them to the branches that they can see.

Twig Guide

Once twigs and buds have been positively identified and labeled, students may develop a twig and bud guide for the street trees. They think and sketch individually, brainstorm in the whole group, then work in small groups or pairs to develop a twig guide. Once finished, twig guides can be tried out with students and teachers from other classes.

Charting Twig Growth

Students trace the twigs on graph paper and measure how much the twigs have grown in one year.

- How much did each twig grow?
- How much variation is there …
  … among twigs on the same tree?
  … between twigs of the same species?
  … between twigs of different tree species?
- How might you illustrate the differences between twig growth?

(Teachers keep a record of measurements to track growth over the following years.)

Bark Guide

Students make rubbings from tree bark and describe it. Students make a bark guide for the trees.

4 Evaluation

- To what extent do students make detailed drawings?
- To what extent are students improving capacity and stamina for detailed observation and recording?
- To what extent are students able to record observations in their Notebooks in such a way that they are useful resources?
- To what extent are students applying new vocabulary and knowledge?
- To what extent do students work together in teams and build on each other's ideas and knowledge?

5 Follow-up and Extension Activities

- Study the role of bark.
- Create a large visual of tree bark for the classroom.
- Measure tree height (see Lesson 7, Follow-up and Extension Activities)
- Visit a nearby park. Observe the trees and the landscape. Make comparisons between street trees and park trees.

Lesson 6—Buds, Leaves, Flowers, Fruits

1 Purpose/Aim

Students observe buds and bud break to flowering, leaf expansion, and fruit set. They predict events, hypothesize, observe, and record.

2 Materials and Space

Graph paper

Magnifying glasses

Rulers

Outdoor thermometer

Nature Notebooks

Pencils, erasers

3 Procedure

Tracking Bud Break, Leaf Expansion, Flowering, Fruiting

Students visit the trees every other day, or at least twice a week. Each time they draw and describe the expanding buds on one tree. The data collection phase continues through flowering and leaf expansions to fruit set.

After the first outing, students brainstorm how to collect and aggregate data. Students develop a chart model that they will use to track bud break. They also track temperature and weather. (In the following years, collected data of previous years will be available for comparison.)

Memory Game

Each student makes a detailed color drawing, collage, or painting of a bud, leaf, bud, flower, fruit, or twig of one tree species. Then the tree art is put into five separate stacks: buds, leaves, flowers, fruits, and twigs. Each student takes one piece of art and finds the matching parts.

After the game, the artworks are arranged by the students into one display or into separate displays for each tree.

Street Tree Care

During each outing, students take care of their street tree stewardship task.

4 Evaluation

- To what extent are students improving capacity and stamina for detailed observation and recording?
- To what extent are students able to record observations in their Notebooks in such a way that they are useful to them as the basis for future study?
- To what extent are students applying new vocabulary and knowledge?
- To what extent do students work together in teams and build on each other's ideas and knowledge?
- To what extent are students able to develop a data collection model?

5 Follow-up and Extension Activities

- Look for tree pollen and hypothesize how the tree might be pollinated. Follow up with research. Create visuals that illustrate the different ways that plants are pollinated.
- Study insect pollinators.
- Dissect flowers. (Lilies work well for macroscopic work because all parts are large. Be sure to use lilies with their anthers intact.)
- Study tree flowers under the microscope. (Deep dish slides work well.)
- Measure and track temperatures underneath specific trees and in full sun over time.
- Visit a nearby park. Observe the trees and the landscape. Make comparisons between street trees and park trees.

Lesson 7—Neighborhood Without Trees?

1 Purpose/Aim

Students reflect on the roles of the trees in their lives and for their neighborhood.

2 Materials and Space

Neighborhood maps

NYC Most Common Street Trees

Previously created dichotomous keys

Smart Phone cameras

Large format sticky notes

Nature Notebooks & pencils

3 Procedure

Mapping Neighborhood Trees

Students take a walk around the neighborhood in small groups paired with an adult. Each group uses the neighborhood map, with an area marked that they are covering. They mark trees on their map and try to identify them with their own dichotomous keys and the NYC Most Common Street Trees handouts. They look closely and determine some challenges for these specific trees in the street. One or several students will be the photographers for the group and take pictures of things that may be harmful to trees as well as things that may be helpful for the trees.

Back in the classroom, students work in their small groups and transfer their map section to a larger sheet of graph paper. They enter the trees they found, marking things that are harmful to trees with sticky notes.

Contemplating the Neighborhood Without Trees

Students do a gallery walk of the maps. Each group introduces their trees.

Following the presentations, the map sections are joined into one complete map.

Then the students sit in a circle. They close their eyes and think about what the neighborhood would feel and look like without the trees. What would it be like in winter? In spring? In summer? In fall? In small groups, students tell each other about their feelings and ideas. They brainstorm and create a skit/tableau that captures their ideas about the differences between a treeless neighborhood and one with trees. They then perform the skits/tableaus for each other.

Tree Facts and Questions

Students review **Tree Facts and Questions** in their journals/notebooks. They write down and draw what they learned about trees and new questions. First individually, then in the small group and large group, students aggregate new questions and discuss which can be answered through investigation and which require research.

4 Evaluation

- In what ways do students deepen their engagement with the physical school neighborhood and make meaningful observations?
- To what extent do students express their observations through skits and tableaus?

5 Follow-up and Extension Activities

- Tree Challenge: Make a board game of the neighborhood streets and trees based on the map and design action cards with good things happening to trees and hazards for trees. Try out the game.
- Create a herbarium with leaves, fruits, and flowers from neighborhood trees and other plants, for example as part of each Tree Journal.
- Create a storyboard telling stories about the neighborhood trees and their place in the community.
- Measuring tree height

—Measuring by thumb, version 1 (demonstrate during field outing): Stand a person whose height you know in front of a tree. Walk away from the tree until you are far enough from the tree to cover the person with your thumb or a pencil. Count the number of thumb (or pencil) heights from the bottom of the tree to the top. For

example, if the person is 4 feet tall and the tree is 4 persons (thumbs) high, then the tree is 16 feet tall.

—Measuring tree height by thumb, version 2: Walk far enough from the tree that the length of your thumb covers the whole tree. Then turn your hand so that your thumb points from the bottom of the tree out along the ground. Notice where the end of your thumb seems to end on the ground. Measure from the base of the tree to the spot where the end of your thumb was. That is the height of the tree.

—Measure tree height by comparing shadows: Measure the length of the tree's shadow. Measure the length of the shadow made by a person whose height you know. Express this as a ratio and solve it for the height of the tree. For example, the tree shadow is 20 feet long, the person is 4 feet tall and has a 5 foot shadow. Call the height of the tree h. h is to 20 as 4 is to 5; h/20 = 4/5; 5h = 4 x 20; 5h = 80; 5h/5 = 80/5; h = 16 feet. Can you figure out other methods?

Measuring tree height has been adapted from Elementary Science Program (schoolsites.schoolworld.com)

Lesson 8—City Trees Need People

1 Purpose / Aim

Working with their Nature Notebook and Tree Journal data, students look for and recognize relationships between living and non-living things around the trees. Students find expression for what trees mean in our daily lives and explore ways to take action and raise awareness for city trees.

2 Materials and Space

"Street Tree," *Old Elm Speaks*, Kristine O'Connell George
Colorful paper and cardstock, tissue paper, pens, pencils, sharpeners, erasers, crayons, markers, scissors, glue sticks.
Large sheets from a roll of craft paper
Photos from neighborhood walks gathered in a slideshow
Large work tables
Smart Board and/or large sticky pad

3 Procedure

Tree Poem

Gather in a circle and read the poem "Street Tree" to the whole group. Students share a few thoughts and then review the materials gathered in their Nature Notebooks and Tree Journals so far.

Collective Drawing of a Neighborhood Tree

Using a sheet of craft paper, students in their mapping groups, make a collective drawing of one or more of the street trees they mapped on their walks. They brainstorm people and animals that come into contact with the tree, and add them to their drawing.

Neighborhood Interviews

First individually, then in the whole group students brainstorm questions to elicit how teachers, other students feel about street trees. Students decide where and when to set up interview stations around the school and around the neighborhood.

What Did We Find Out?

Students aggregate findings first in small groups, then in the large group on the Smart Board or on a large sticky pad.

Neighborhood Tree Skits

Students review interview findings and reflect on their observations. Then they develop a skit that illustrates how people and/or animals interact with trees. The students take a gallery walk of the drawings and perform their skits for each other. After each skit, the participating students share thoughts and feelings the skit inspired in them. Then the observing students do the same.

Gallery of Tree Hazards

Photos of tree hazards from the neighborhood walks are projected in the Smart Board. In the large group students brainstorm ideas of what may have happened to the trees and what the students might do to improve their lot and raise awareness. Project ideas are gathered on the Smart Board or a large sticky pad.

Benefits of Street Trees

Students research benefits of street trees: energy savings, environmental benefits, human health benefits, mental health benefits. Students can start their research with the *MillionTreesNYC Tree Care Guide*. The 15-page booklet is available for download at milliontreesnyc.org/downloads/pdf/treelc_handbook.pdf. Then they work in pairs or small groups to illustrate their findings, for example with posters, storyboards, cartoons, dioramas. Then each small group shares in the whole group,

Tree Awareness Project

Students do two rounds of brainstorming to determine how they might raise awareness for street trees in their community. They first address the question:

- What kinds of venues and events might we use to raise tree awareness?
- The teacher puts each venue and each event on a separate sticky pad sheet. Then the students will divide into small groups, one for each event or venue. In the small group, the students will brainstorm answers to the following question:
- What kinds of projects or media might be effective for the venue or event?
- Once the students have collected their ideas, they will gather in a chair circle and share their ideas in the larger group. Then the larger group will be invited to add thoughts. One person from the group will add them to the sheet.

Students take a moment to think individually how they might strategize what kind of projects they want to do for what kind of venue or event. They then discuss in the larger group and settle on projects, divide into project groups, and start developing their projects.

Venues and events may include store windows; visits to a smaller grade in their school, street tree awareness booth at a school fair.
Ideas for tree awareness projects may include: PSA; cartoons; posters; storyboard; skits; Tree IQ Test with a list of questions (true/false); letter to a city councilmember.

Project Role Play

When the groups have finished their projects, they introduce them to the large group in a role play that illustrates how the project will be introduced in the community. Some students in the group represent the project; some take on the role of community members.

Tellers and Travelers

As an extension, the students present projects to each other in a tellers and travelers format. First one half of the projects are set up, and the creators (or tellers) interact with the community (the travelers). Invite parents to the event.

Project Roll Out

Students decide how to take their projects into the community. See also Follow-up and Extension Activities below.

4 Evaluation

- To what extent do students articulate their awareness and concerns?
- To what extent do students harness their concerns and translate them into positive community action?

5 Follow-up and Extension Activities

- Invite parents to a tree event where the projects are presented. Students share with their parents what they have learned about the importance of trees for the neighborhood and what they are doing to raise awareness.
- Teach other classes in the school about the value of street trees and what they need to survive in the urban environment.
- Interview people in a neighborhood park. What do they like? What might make their experiences richer? Brainstorm ways to address community concerns.
- Individual or small group student projects**:** a year on the street

Street Tree Care Basics

New York City street trees don't have it easy. Shoehorned into tight growing spaces, their root systems have to make do with a meager allotment of mostly infertile, compacted soil that is prone to be bone dry during periods of drought and flooded when it rains (and rains). As if that weren't enough, people toss trash at trees, slam car doors into them, chain bicycles to their trunks, and let their pets abuse their beds as litter boxes.

This state of affairs is quite surprising when you take a moment to consider just a few of the ways in which trees improve our daily lives. They clean the air we breathe, they provide much needed shade in summer, trap dust and pollutants, muffle ambient noise, and give city dwellers a taste of the natural world. To return the favor residents can improve the lot of street trees with a few simple acts of care. Keeping tree beds litter free, improving the soil, and supplemental watering during times of drought do wonders for the health and longevity of street trees and help make city blocks more appealing. Taking up the cause of street trees and educating neighbors is equally important.

Keep the tree bed clean. Removing trash and animal waste from the tree bed tells passers-by "Someone cares!" Picking up trash may not be glamorous, but your tree will love you for it. Consider posting a small sign in the tree bed that asks people to curb their dogs and avoid littering.

Improve the soil. With a hand cultivator (a tool that looks like a three-pronged claw), loosen the soil gently 1 to 2 inches deep. Most of a tree's delicate feeder roots grow in the top 18 inches of soil, so be very gentle. Apply a thin layer of well-rotted compost (no more than ½ inch) every year and work it lightly into the soil.

Mulch the tree bed. Add a 2- to 3-inch layer of organic mulch such as wood chips, being careful to keep the mulch well away from the tree trunk. Mulch smothers weeds, helps retain moisture, and makes good compost as it decomposes. In early spring, remove the mulch and flush the tree bed with lots of water to help remove salt deposits in the soil. Then apply a fresh layer of mulch.

Never raise the soil level. Moist soil or mulch mounded up against the base of the tree can cause the bark to rot, provide an entry point for pests and diseases, or create a

cozy spot for rodents to hang out and eat away at the tree base. Rotten or damaged bark at the base of the trunk can "girdle" a tree, or strangle it to death. When a girdled tree dies, it can topple over from the base, which can cause a lot of damage. A raised soil level also chokes roots. Roots need oxygen, which they get from air bubbles in the living soil. When too much soil is piled up, the extra weight squeezes the air out of the soil. Without oxygen, roots die, and without a strong, healthy root system, the tree will die.

Water the tree. Even without a drought, tree beds are so small that not enough rain falls onto their soil to adequately irrigate the trees. You can help by watering new trees with about 15 to 20 gallons of water a week. A mature tree needs 8 to 10 gallons a week when it's hot. The key is to water slowly: Set up a hose and let it trickle water into the bed for an hour; or prick a few holes near the bottom of a clean garbage can, set it next to the tree bed, fill it with water, and let it seep into the tree bed. **Water every newly planted tree.** It needs about 15 to 20 gallons of water a week.

Plant flowers in the tree bed—responsibly. Annuals, perennials and small bulbs can be beautiful additions to a tree bed. Just remember that the tree's health comes first: Use small plants and bulbs to minimize disturbance to tree roots. Select drought-tolerant plants that can take abuse. A tree bed is a harsh environment. Avoid shrubs and other plants that grow large root systems that may compete with the tree for water and nutrients. Flowers let passers-by know you are taking care of your street tree. Wilting flowers in the tree bed are also a good reminder to water. As you water the flowers, the tree will also get a drink. If you're not careful, though, planting in tree beds can do more harm than good! Over-cultivating the soil to plant flowers damages the tree's roots, as does raising the level of the soil. It may take years until the damage becomes apparent, but it may shorten the life of your tree.

How to plant without harming your street tree. With a hand cultivator gently loosen the soil to a depth of 1 to 2 inches. Mix in a ½ inch layer of compost. Overall, don't raise the soil level by more than ½ inch. To minimize disturbance, choose small bulbs or plugs of annual flowers (such as those available in four and six packs in spring) or perennial groundcovers with small root systems. Never plant ivy: It is a preferred habitat for rats and may climb up the trunk and damage the tree. Do not install shrubs in the tree bed and avoid any water-guzzling plants.

Take care of newly planted trees. Immediately after planting, remove any burlap wrapped around the trunk and any tape or wire used to hold it in place. The burlap could keep the trunk wet and cause rot, and tape or wire could girdle the tree. Also remove any burlap or wire that may be peaking out of the ground in the tree bed. After a year, remove the guy wires and stakes so that the tree can move freely and grow a strong root system and trunk. The guy wires have to stay in place for a year, the time the tree is under warranty from the nursery. Then they have to come off or they will start strangling the tree.

Avoid rock salt in winter. Try to use sand instead of salt to keep icy sidewalks navigable. If that's not an option, choose an "animal and tree-friendly" de-icing product for the job, for example one that contains calcium magnesium acetate (CMA). Though usually a bit pricey, these products are worth the extra expense because they are much more benign than rock salt (usually sodium chloride), which can severely damage trees, is harmful to pets, and contaminates groundwater.

Install a tree guard. Guards help protect your tree from animals, foot traffic, and car and bicycle abuse. Even the simplest guard creates a psychological space around the tree that tells passers-by the tree is important to the block.

Adapted from Brooklyn Botanic Garden's *Brooklyn Urban Gardener Resource Guide*, Sigrun Wolff Saphire, 2010.

Resources

Tree Identification

Dichotomous Twig Key and Dichotomous Leaf Key

Virginia Tech Dendrology Tools

dendro.cnre.vt.edu/dendrology/idit.htm

Online leaf and twig keys illustrated with photos

Leaf Snap

Columbia University, University of Maryland, Smithsonian Institution

leafsnap.com

Electronic field guide available as a free app for Iphone. It uses visual recognition software to help identify tree species from photographs of their leaves. The website features high-resolution images of leaves, flowers, and fruits of each species included in Leafsnap.

New York City Trees: A Field Guide for the Metropolitan Area

Edward Sibley Barnard

Columbia University Press, 2002

Tree ID Guide for Common Urban Trees in New York State and the Northeast

Lily Herrera and Nina Bassuk

Urban Horticulture Institute

Cornell University, 2003

What Tree Is That?

Arbor Day Foundation

arborday.org

Dichotomous tree key with print and electronic versions (desktop and mobile app), illustrated with drawings

Street Tree Stewardship

MillionTreesNYC Tree Care Guide

milliontreesnyc.org

A15-page booklet that covers the basics of street tree stewardship, from tree identification, benefits of trees and tree adoption to street tree care dos and don'ts. It is available for download at milliontreesnyc.org/downloads/pdf/treelc_handbook.pdf

Trees New York

treesny.com

Through training programs, volunteer courses, educational workshops and publications, Trees New York promotes active community volunteerism and stewardship. It organizes the Citizen Pruner program and is the NYC clearinghouse for Asian Longhorned Beetle outreach. The website provides useful information all around NYC street trees. The organization's array of educational materials for adults and children is available at no or minimal cost (depending on the size of the order). Publications include the 20-page booklets *Urban Leaf & Tree Handbook* and the *Urban Bud & Bark Handbook* for winter tree identification.

Journal References

Keeping a Nature Journal

Clare Walker Leslie & Charles E. Roth

Storey Publishing, 2000

Science Notebooks: Writing About Inquiry

Brian Campbell & Lori Fulton

Heinemann, 2003

Picture Books

Are Trees Alive?

Debbie S. Miller (author), Stacey Schuett (illustrator)

Walker & Company, 2003

(Suggested reading for lesson 1)

A Seed Is Sleepy

Diana Aston (author), Sylvia Long (illustrator)

Chronicle Books, 2007

(Suggested reading for lesson 4)

Autumn Leaves

Ken Robbins (author and photographer)

Scholastic Press, 1998

(Suggested reading for lesson 3)

Fip, Float, Fly: Seeds on the Move

JoAnn Early Macken (author), Pam Paparone (illustrator)

Holiday House, 2008

(Suggested reading for lesson 4)

How Does it Feel to Be a Tree?

Flo Morse (author), Clyde Watson (illustrator)

Parents' Magazine Press, 1976

(Suggested reading for lesson 1)

Old Elm Speaks

Kristine O'Connell George (author), Kate Kiesler (illustrator)

Clarion Books, 2007

(The poem "Street Tree" in lesson 8 is in this book.)

Planting the Wild Garden

Kathryn O. Galbraith (author), Wendy Anderson Halperin (illustrator)

Peachtree Publishers, 2011

(Suggested reading for lesson 4)

Seeds

Ken Robbins (author and photographer)

Atheneum Books for Young Readers, 2005

Who Will Plant a Tree?

Jerry Pallotta (author), Tom Leonhard (illustrator)

Sleeping Bear Press, 2010

(Suggested reading for lesson 4)

Applications

The curriculum Learning With Street Trees was conceived with upper elementary classrooms as well as afterschool programs in mind. It is aligned with Common Core Standards, Next Generation Science Standards, and Blue Print for the Arts as outlined on page 21. Ideally, the eight lessons of the curriculum unfold over the course of a school year. All lessons revolve around nearby street trees that are accessible to students and teachers on a daily basis. The trees, chosen by educators and students, are the subject of a fall-to-early-summer study that requires regular observations. Through weekly or twice weekly contact students become familiar with the trees and attuned to seasonal changes as they themselves become a familiar presence in the neighborhood. Students conduct science inquiry throughout the seasons and they also carry out routine tree care tasks. The ongoing engagement becomes the springboard for a student-led community project.

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