NYC MASTER COMPOSTER MANUAL

NYC Compost Project

Funded by NYC sanitation

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ACKNOWLEDGEMENTS

The NYC Department of Sanitation (DSNY) thanks the persons and organizations who have contributed to the development of the NYC Master Composter Manual.

This project would not have been possible without the efforts, dedication, creativity, and inspiration provided by the staff and leadership at each of the NYC Compost Project partner organizations, which include Brooklyn Botanic Garden, Big Reuse, Earth Matter NY, Lower East Side Ecology Center, Queens Botanical Garden, Snug Harbor Cultural Center & Botanical Garden, and The New York Botanical Garden. DSNY thanks all those who were part of the NYC Compost Project staff from 2010 to 2015 for contributing to the development of this revised manual and the recent growth of the NYC Compost Project citywide:

Ariana Arancibia
Gina Baldwin
Charlie Bayrer
Chloe Bishop
Chris Bivens
Jennifer Blackwell
Andrew Blancero
David Buckel
Ursula Chanse
Jodie Colon
Renee Crowley
Christine Datz-Romero
Marisa DeDominicis
Erycka deJesus
Emily Bell Dinan
John Douglas
Dara Fedrow
Ryan Green
Luke Halligan
Carol Hooper
Andrew Hoyles
Aleks Jagiello
Ilyse Kazar
Jennifer Kline
Kim Kullmer
Andrea Lieske
Lise Lorimer
Charles Lynch
Marguerite Manela
Erik Martig
Ozzie Martinez
Claudia Navas
Ryan Olds
Carey Pulverman
Cuyler Remick
Junior Schoeten
Bruce Spierer
Sakura Suzuki
Jacob Taylor
Teddy Tedesco
Jeremy Teperman
Kathy Vazquez
Susan Voelker
Natalie Wesson
Rebecca Wolf
Jessica Wu
Tal Zaken

DSNY is grateful to Emily Bell Dinan for creating the illustrations for this manual. Dinan drew on her experiences as community composter and former NYC Compost Project staff member to thoughtfully and beautifully illustrate concepts and practices specific to community composting in New York City.

DSNY would like to thank Melissa Cipollone and Louise Bruce, of the Bureau of Recycling and Sustainability, for creating this updated version of the Master Composter Manual, which strives to provide New York City's composters with the tools and knowledge they need to manage high-performing community compost sites. Cipollone and Bruce are deeply committed to the idea that Master Composters are a critical component of DSNY's organics diversion strategy, and sincerely hope that this manual will support each Master Composter in their pursuit to change the way New Yorkers see their apple cores and egg shells.

DSNY would also like to thank Marni Aaron for her guidance and support in producing this manual, and Robert Lange and Debbie Sheintoch for their leadership of the NYC Compost Project.

Thank you to all of New York City's community composters, whose compost sites, management models, innovations, and passion inspired this updated curriculum.

NYC MASTER COMPOSTER CERTIFICATE PROGRAM:

DESCRIPTION & REQUIREMENTS

DESCRIPTION

The NYC Master Composter Certificate Program is designed to equip you with the knowledge and skills you need to build support for and participation in composting at a home, community, and citywide level. Through classroom instruction, field trips, and practical activities, you will develop a basic understanding of 1) soil and decomposition science; 2) composting; 3) compost systems and tools; 4) compost site design and management; 5) how to use compost, mulch, and cover crops to improve soil; and 6) how to teach others about composting.

Students who successfully complete the program by meeting the course requirements outlined below will receive an "NYC Master Composter" certificate.

REQUIREMENTS

To receive certification, you'll need to:

1. **Meet attendance requirements.** Students may not miss class hours (this includes field trips). Excused absences may be made up at the discretion of the instructor.
2. **Satisfactorily complete homework and activities assigned by instructors.** If you need extra time to complete an assignment, talk to your instructor.
3. **Complete an independent project.** Requirements for the independent project are on the following page.
4. **Complete 30 compost-related service hours.** At least 15 of these hours must be supervised by an NYC Compost Project staff person or other NYC Department of Sanitation staff person. Your instructors will regularly share opportunities for completing service hours. Log all service hours you complete using the form provided in this chapter or according to another method assigned by your instructor. All service hours must be completed within one year of finishing the Master Composter course.

INDEPENDENT PROJECT

The purpose of the independent project is to use the knowledge and skills gained through the NYC Master Composter Certificate Program to support composting in your community. Your project should be related to composting, personally interest you, and provide a service to your community. We encourage you to devote a portion of your service hours to work related to your independent project. If you'd like, you can choose to work with a partner or several classmates on a collaborative project.

There are three requirements for successfully completing your independent project:

1. **Complete the Independent Project Brainstorming Worksheet** on page CD-7.
2. **Decide on a final project and complete the Independent Project Proposal** on page CD-9. Your instructor will provide guidance on developing a suitable project. For your final project, we want you to dream big but also work with your instructors to identify a piece of that dream that can be achieved within a year of completing the Master Composter Course.
3. **Create a short presentation about your independent project for the class.** This will be an opportunity to receive constructive feedback on your project from your classmates. You can present your project in any way you'd like—be creative! Here are some examples:
   - If your final project is to teach a workshop about worm composting to elementary students, you could try teaching five minutes of a half-hour workshop.
   - If your final project is to design a new compost site at a school, you could draw a layout for a site design on graph paper or create a layout using computer software.
   - If your final project is to help a community garden start accepting food scraps for composting, you could present your plan for hosting the first drop-off day—what date/time will the site be open for food waste drop-off, what materials will you need (e.g. a scale to weigh the amount of food scraps people bring, buckets, a tool for chopping); what records you'll be keeping (e.g. how many people drop off food scraps); and so on.
   - If your final project is to create promotional posters for a compost site, you could share promotional campaigns that other groups have produced and share examples of the ones that inspire you, explaining why you think they are effective.
   - If your final project is to apprentice at a compost site in NYC, you could present a photo essay of the site and explain what you're planning to work on while you're there.
   - If your final project is to build a wooden multi-bin composting system for a community compost site, you could present a variety of plans for constructing the system and share woodworking tips with your classmates.

COURSE EXPECTATIONS

Instructors and students should review course expectations together during the course orientation. Instructors and students can contribute other expectations to this agreement as they see fit. Students must submit signed course expectations agreement to instructors by the end of the orientation.

INSTRUCTORS ARE EXPECTED TO:

- Conduct the program in an informal fashion, allowing students to take wild guesses, try new things, and make mistakes as they learn.
- Carefully plan and time out classroom sessions and field trips in order to cover all of the required material.
- Determine how course time is spent and organized, including whether to continue discussions, extend experiments, answer additional questions, or move on to the next topic.
- Encourage the expression of varying viewpoints, but when necessary mediate any disagreements.
- Respond to email or phone requests in a timely manner.
- Respect that students have work, family, and personal responsibilities beyond this course, so required assignments will be kept to less than two hours per week outside of the course.

ADDITIONAL EXPECTATIONS OF INSTRUCTORS:

- _____
- _____
- _____

STUDENTS ARE EXPECTED TO:

- Fulfill all course requirements.
- Take full advantage of this opportunity and challenge themselves to go to the next level.
- Participate in class activities and discussions
- Assist with clean-up tasks after classroom sessions, field trips, and site visits.
- Respect that instructors have work, family, and personal responsibilities beyond the course, so will submit questions to instructors via e-mail or voice message if there is not time to address an inquiry before, during, or after class.
- Notify instructors in advance if they will miss or be late to a class, field trip, or volunteer opportunity.

ADDITIONAL EXPECTATIONS OF STUDENTS:

- _____
- _____
- _____

INSTRUCTORS & STUDENTS AGREE TO:

Conduct ourselves at all times in a manner that is respectful towards the people, organizations, property, and places that are part of this program. This includes:

- Arriving on time and being prepared for all classes, trips, and volunteer opportunities.
- Recognizing that each of us is unique and that all of us have valuable experiences, viewpoints, and observations to share.
- Being open to learning from others in the classroom and in our communities.
- Respecting other people's comfort levels when it comes to handling the materials and living organisms that may be encountered in the field or passed around in classroom settings.
- Showing no discrimination or harassment towards others with regard to, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, citizenship, gender or gender identification, sexual orientation, age, veteran or military status, marital status, disability, or other personal characteristics. Harassment includes making derogatory remarks or jokes about such characteristics and other verbal, physical, and visual behavior.

Signature: _____

Print name: _____

Date: _____

PHOTO/VIDEO CONSENT FORM

Activity Title: _____

Location: _____

I grant NYC Department of Sanitation's Bureau of Recycling and Sustainability (BRS), its employees, and any of its representatives (including but not limited to NYC Compost Project host sites listed below) the right to take photographs or video of me and my property in connection with the above-identified activity.

I authorize BRS, its representatives, and employees to use such photographs and/or video of me with or without my name for any lawful purpose, including for example such purposes as publicity, illustration, social media, and Website content.

I have read and understand the above:

Signature: _____

Printed name: _____

Organization Name (if applicable): _____

Email Address (Optional): _____

Date: _____

Signature of parent or guardian (if under age 18): _____

Please check the relevant NYC Compost Project associated with the subject and location indicated above:

- ☐ NYC Compost Project Hosted by Big Reuse
- ☐ NYC Compost Project Hosted by Brooklyn Botanic Garden
- ☐ NYC Compost Project Hosted by Earth Matter NY
- ☐ NYC Compost Project Hosted by Lower East Side Ecology Center
- ☐ NYC Compost Project Hosted by Queens Botanical Garden
- ☐ NYC Compost Project Hosted by Snug Harbor Cultural Center & Botanical Garden
- ☐ NYC Compost Project Hosted by The New York Botanical Garden

Staff notes:

Photo name(s):

NYC Compost Project
Funded by NYC sanitation

INDEPENDENT PROJECT: BRAINSTORMING WORKSHEET

Name: _____ Date: _____

1. **In a few sentences, describe why you're interested in composting.**

2. **List your connections to particular organizations, gardens, institutions, businesses, or residents where you live, work, or go to school.** Examples: MS 51, Sixth Street Community Center, Castleton Hill Moravian Church, Van Cortlandt Village CSA, etc.

3. **List your hobbies, talents, and skills.**

4. **Check the types of activities/projects that interest you:**

- ☐ Starting a new community compost site
- ☐ Joining an existing community compost site
- ☐ Hosting tours of compost sites
- ☐ Gardening
- ☐ Urban farming
- ☐ Caring for street trees
- ☐ Habitat restoration
- ☐ Hosting information tables at community events
- ☐ Teaching workshops
- ☐ Data collection and analysis
- ☐ Distributing outreach and educational materials
- ☐ Building compost systems
- ☐ Creating promotional materials for a compost site (flyers, signs, etc.)
- ☐ Increasing collaboration among community composters
- ☐ Providing technical assistance to community composters

5. **In addition to the activities above, list any other compost-related activities you're interested in.**

6. **What community compost sites are in your community? What help do they need?** If you don't know, your instructors may be able to identify nearby sites. Consider contacting site managers directly to ask them what help they might need.

7. **What existing opportunities are there for people in your community to learn about or participate in composting?** Examples: Nearby compost site, gardening clubs, indoor composting with worm bins, composting at a community garden, curbside organic waste collection, NYC Compost Project demonstration site/workshops, etc.

8. **List any *assets* (useful or valuable materials, people, properties, etc.) available to you and how they could help you.** Examples: NYC Compost Project staff can answer questions I have about composting and help me build a compost system; My friend Curtis is an artist and could help me create a great sign for a compost site I'm working with; There's a vacant lot on my block that might be a good spot for a new composting site.

9. **Considering your answers to all of the questions above, come up with at least three ideas for an independent project that interests you and supports community composting.**

Idea #1: _____

Idea #2: _____

Idea #3: _____

INDEPENDENT PROJECT: WRITTEN PROPOSAL

Submit a 1-2 page written proposal for your independent project that includes answers to the questions below. Proposal can be typed or hand-written.

Name: _____ Date: _____

WHAT: Describe your idea for an independent project.

WHY: Why does this project interest you? What service(s) will this project provide to people, plants, animals, and/or the environment in your community?

WHERE: Where will this project take place?

(continued on back)

WHO: Who are the people or community groups that will be involved in implementing this project?

WHEN: Create a timeline for completing your project, or a smaller part of a larger project.

HOW: What assets (skills, people, supplies, venues, etc.) do you have available to you to help you with this project? What tasks do you need to do to complete your project? What materials will you need?

SERVICE HOURS LOG

To receive your NYC Master Composter certificate, you must complete **30 compost-related service hours**. At least 15 of these hours must be supervised by an NYC Compost Project staff person or other NYC Department of Sanitation staff person.

Log and submit all service hours using this form, or in another method assigned by your course instructors. All service hours must be completed within one year of finishing the Master Composter course.

Date of Activity	**Description of Activity**	**Activity Location (Street address, City, State, ZIP)**	**Who participated?** *(e.g. general public, community garden members, students at a specific school, etc.)*	**Was activity supervised by NYC Compost Project staff?**	**Number of service hours completed**

Date of Activity	Description of Activity	Activity Location (Street address, City, State, ZIP)	Who participated? *(e.g. general public, community garden members, students at a specific school, etc.)*	Was activity supervised by NYC Compost Project staff?	Number of service hours completed

PROPOSING EDITS TO THE MASTER COMPOSTER MANUAL

The NYC Department of Sanitation works hard to ensure that the content presented in the Master Composter Manual is accurate, helpful, and reflective of all the great work that Master Composters do in New York City.

As you read through the Master Composter Manual, you might catch a typo or find that information that has become outdated. If that happens, the NYC Department of Sanitation and NYC Compost Project want to hear from you!

Please use the form on the following pages to propose edits to the Master Composter Manual. Examples of how you might use this form include:

- To correct a spelling error
- To correct inaccurate or outdated information
- To add important missing information or new information
- To propose that an activity or resource be added to the end of a specific chapter

PLEASE NOTE:

All proposed edits submitted to the NYC Compost Project and NYC Department of Sanitation will be carefully reviewed and incorporated as appropriate into future printings of the Master Compost Manual. However, because of cost, design, and printing constraints, not all edits will be accepted.

EDIT PROPOSAL FORM

1. WHERE IS THE CORRECTION NEEDED?

Chapter Title: _____

Section Title: _____

Page Number: _____

2. WHAT TYPE OF CHANGE ARE YOU PROPOSING?

- ☐ Correction to spelling or grammatical error
- ☐ Deletion or revision of inaccurate or outdated information
- ☐ Addition of important missing information or new information
- ☐ Addition of an **activity** that you want other Master Composters to know about
- ☐ Addition of a **resource** that you want other Master Composters to know about
- ☐ Other (please specify):

_____

_____

_____

_____

3. WHY IS THIS CHANGE NEEDED?

4. IF TEXT NEEDS TO BE CHANGED, PLEASE CLEARLY INDICATE THE CURRENT TEXT AND YOUR PROPOSED NEW TEXT.

If you are proposing a new activity, resource, or section, please skip this question and attach the activity or resource to this form.

Current INCORRECT text:

Proposed NEW text:

5 CONTACT INFORMATION FOR PERSON REQUESTING THE CHANGE:

Name: _____

Email: _____

Phone: _____

Please submit completed forms to your Master Composter Certificate Course Instructor.

Orientation

ORIENTATION

LEARNING OBJECTIVES

- Meet your instructors and classmates
- Identify benefits of composting
- Understand the NYC Department of Sanitation's approach to organic waste management
- Identify services and resources available through the NYC Compost Project
- Understand NYC Master Composter program and certification requirements

SUGGESTED ACTIVITIES

- Why Build Support for Composting? (page O-6)
- Why Are We Here? (page O-7)
- Compost Bingo (page O-14)
- Knowledge & Skills Self-Evaluation (page O-15)
- Waste Disposal Quiz (page O-16)
- What's In My Waste? (page O-17)

WELCOME!

The NYC Compost Project is thrilled to have you join us in our effort to rebuild NYC's soils, neighborhood by neighborhood.

To begin our journey, let's take a look at organic waste management in New York City, and how Master Composters fit into the picture.

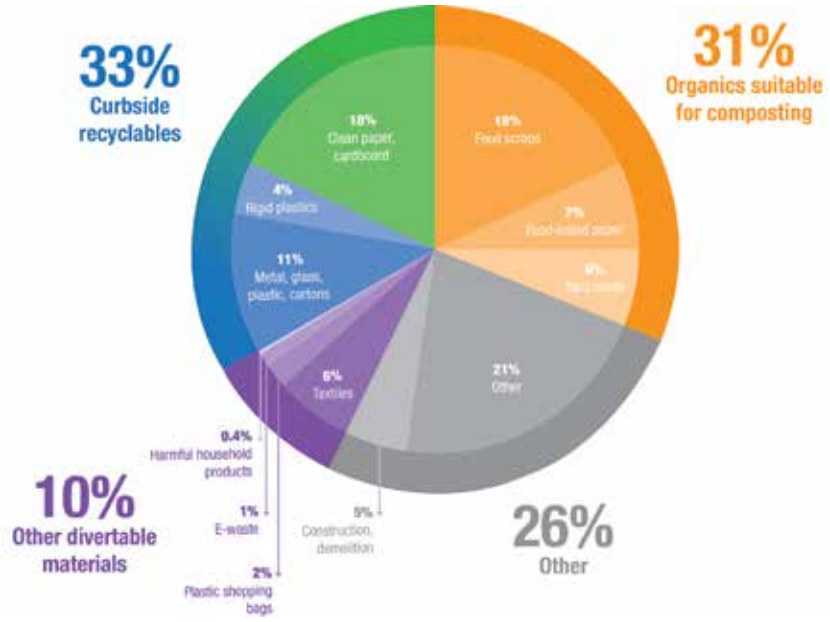
ABOUT THIS MANUAL

You and your instructors have the exact same manual—there is no "teacher edition" or "student edition." This way, you can use it as a model when you educate others about composting.

ACTIVITIES

Hand icons indicate suggested individual, small group, and large group learning activities. Master Composter instructors may choose to alter the activities listed, or conduct entirely different activities, to suit their class needs and teaching preferences.

ORGANIC WASTE IN NYC



Organic waste suitable for composting accounts for nearly a third of NYC's residential waste.

Source: 2013 Waste Characterization Study, NYC Department of Sanitation

As part of its sustainable waste management plan, the NYC Department of Sanitation (DSNY) works to divert organic waste from landfills so it can be used beneficially.

DSNY believes that a strong organic waste diversion strategy for NYC will operate at three scales: 1) at a citywide level, 2) in communities and neighborhoods, and 3) in the home. This tiered approach enables the City to divert the greatest amount of organic waste from landfills; build support for and participation in organic waste recycling; and generate high-quality finished compost in NYC to improve soils and public health. The DSNY programs described in the following pages work to implement this organics diversion strategy.

CITYWIDE LEVEL

At the citywide level, **NYC Organics Collection** began in 2012 as a pilot program to evaluate if citywide curbside organic waste collection is feasible for residents, schools, agencies, and institutions. The program operates much like other curbside recycling collection programs—residents separate organic waste from garbage and other recyclables, then set it out for DSNY collection (in a rodent-resistant bin) on designated days of the week. If scaled up, the program is designed to divert a large percentage of the organic waste NYC generates from landfills to be processed at regional industrial composting facilities. DSNY is also testing the feasibility of recycling some of the organic waste into renewable energy.

Also at the citywide level, DSNY operates a yard waste composting program at the **Staten Island Composting Facility**. Once registered with DSNY, any private landscaper or tree service company can drop off yard waste at the facility to be composted. Finished compost is sold to landscapers in bulk, or donated to parks, community gardens, urban farms, and other local greening projects. This facility also helps manage storm debris by chipping and composting fallen trees and tree limbs.

NYC Organics Collection curbside bins.

The Staten Island Composting Facility composts landscaper waste, and fallen trees and tree limbs from major storms.

HOME AND COMMUNITY LEVEL

Founded in 1993, the **NYC Compost Project** operates at the home and community level. While waste diversion is one part of the NYC Compost Project's mission, it primarily focuses on 1) providing compost outreach and education to build support for and participation in composting, and 2) producing high-quality compost to improve soil health in NYC for greening projects. By making and using compost right here in NYC, home and community composters play an important role in supporting citywide organics waste diversion through NYC Organics Collection. Home and community composting lets New Yorkers see firsthand what compost is and how it can improve urban living.

The NYC Compost Project and community composters in all five boroughs work to rebuild NYC's soils. From left to right: Finished compost made at a community composting site; compost being used to care for a neighborhood tree; and compost used by the New York Restoration Project to care for a peony garden on the Harlem River Speedway.

Small group discussions at the first NYC Community Composting Council meeting in November, 2013.

Recognizing the rapid growth and changing needs of NYC's network of community compost sites, in 2013 DSNY created the **NYC Community Composting Council** to increase the impact of the NYC Compost Project and to help foster greater communication, sharing, and collaboration among compost site operators, educators, advocates, urban farmers, and environmental stewards.

NYC COMPOST PROJECT

Founded in 1993, the NYC Compost Project—us!—works to rebuild NYC's soils by providing New Yorkers with the knowledge, skills, and opportunities they need to make and use compost locally. NYC Compost Project teams operate out of host sites in all five boroughs, including the host site you're in right now!

The NYC Compost Project focuses on the following program areas:

Outreach & Education. We educate New Yorkers of all ages about composting through workshops, site tours, classes, information tables, and speaking opportunities. This includes the Master Composter Certificate program, which trains a core group of ambassadors every year to develop, maintain, and revitalize community composting projects.

Technical assistance. NYC is home to hundreds of community compost sites. We provide technical guidance to these sites by helping construct compost systems, manage volunteers, prevent and resolve neighborhood conflicts, source materials, and more. We also sell low-cost composting equipment.

Food waste drop-off and local composting. We host neighborhood food waste drop-off sites and compost this waste locally at sites managed by our staff. Drop-off sites are located at greenmarkets, subway stations, public libraries, and other convenient locations.

Compost site and urban farm development. By producing, consuming, and recycling food right here in NYC, we create urban models for closed-loop food waste recycling. New Yorkers can visit or volunteer at our composting sites and urban farms to see how a variety of unique systems function.

SMALL GROUP ACTIVITY:

WHY BUILD SUPPORT FOR COMPOSTING?

Students break into small groups and list at least two responses to each of the following questions. Groups will share their answers and instructors will record responses.

- How does composting reduce waste?
- How does composting connect us with nature?
- How does composting connect us with our neighbors?
- How does composting make communities greener and cleaner?

MASTER COMPOSTER CERTIFICATE PROGRAM

The **Master Composter Certificate Program** is the NYC Compost Project's advanced compost education initiative for NYC residents. Certification requirements are listed in the Course Documents section of this manual.

During this program, you will learn about soil and decomposition science; how to manage the process of decomposition (a.k.a. how to compost!); how to build a compost system that suits your and your community's needs; how to design and manage a compost site; how to use finished compost, mulch, and cover crops to improve NYC's depleted soils; and how to teach others about composting.

As a Master Composter, you'll be equipped to support and grow NYC's thriving network of community composters. Instructors will share composting opportunities with students both during and after their participation in the course. No matter when they complete this course, Master Composters can connect with one another to support community composting in NYC.

Graduates of the Master Composter Certificate Program have contributed to NYC community composting in myriad ways: they've started community compost sites in neighborhoods that did not have one; conducted educational workshops about composting for their school, workplace, or faith-based

communities; hosted information tables at public events; conducted tours of compost sites; helped urban farms improve their compost systems; and communicated the importance of composting to NYC at large through writing, photography, and illustration.

The next few pages contain a small sampling of Master Composter projects.

SMALL GROUP ACTIVITY:

WHY ARE WE HERE?

Students who enroll in the NYC Master Composter Certificate Program come from all levels of composting experience. Learn about your classmates by breaking into pairs to interview each other about composting experience and what they hope to learn through the Master Composter course. Students can then share what they learn about their partner with the rest of the class.

LARGE GROUP ACTIVITY:

COMPOST BINGO

Learn about your classmates by playing Compost Bingo. Instructions are on page O-14.

INDIVIDUAL ACTIVITY:

KNOWLEDGE AND SKILLS SELF-EVALUATION

Complete the Master Composter knowledge and skills evaluation on page O-15. This self-evaluation will be completed again on the last day of class to see self-reported progress.

MASTER COMPOSTER PROJECT:

EASTERN QUEENS COMPOSTERS

Floral Park, Queens

Eastern Queens Composters (EQC) began as a project of two Master Composters who shared a love for the Queens County Farm Museum (Queens Farm). It started as a collaboration with the farm to develop a convenient and engaging community food waste drop-off location. The food waste collected through this new project would benefit the farm's existing windrow compost system by diversifying the "greens" added (which primarily consisted of animal manure at the time). This would produce a more balanced and useful compost recipe for farmers to use in their crop production.

EQC used crowd-sourced funding (generated on the IOBY.org platform) to purchase the initial compost tumblers that were used to encourage regular visitors to compost at the farm. In partnership with Queens Farm, EQC has worked to fund and develop an expanded compost education site that will be used to engage students, educators, and other community residents in organic waste management concepts, techniques, and practical use.

Since 2011, other Master Composters have joined ECQ, contributing their skills in education, fundraising, and volunteer organizing. Due to major support, ECQ has been able to initiate a large scale windrow build using kitchen scraps collected by GrowNYC; partner with a high school classroom to research vermicompost harvesting methods; and facilitate field trips for Queens Master Composters.

Master Composters involved in this project include: Aleks Jagiello (graduated 2011), Albert Brucker (graduated 2010), Kitty Azhar (graduated 2011), Elisa Margarita (graduated 2006), and Melissa Young (graduated 2013).

Master Composters Aleks Jagiello and Kitty Azhar pose in front of a windrow at Queens County Farm Museum.

MASTER COMPOSTER PROJECT:

CHENCHITA COMMUNITY GARDEN

East Harlem, Manhattan

Fed up with both the derelict compost system at her community garden and the unwanted contributions to her personal compost bin, Angela Maul took the Master Composter course so she could better implement composting in her community. After the course, Angela taught a series of composting workshops to her fellow garden members, empowering them to begin composting on their own.

Angela Maul

Since then, every plot in Angela's community garden now has its own metal can compost bin. Additionally, the garden built a three-bin system so that all of the woody debris and leaf waste could be composted.

The garden gained certification to become a compost demonstration site through the NYC Compost Project, encouraging other uptown Manhattanites to compost their food scraps, garden trimmings, and fall leaves.

Volunteers pose behind a newly constructed three-bin compost system at Chenchita Community Garden in Manhattan.

MASTER COMPOSTER PROJECT:

JH SCRAPS

Jackson Heights, Queens

JH SCRAPS (Jackson Heights Scrap Composting to Revitalize the Area's Poor Soils) is a community compost site located on a small lot beneath freight railroad tracks in Jackson Heights, Queens. The site was created and supported by Master Composters who lived in the neighborhood and graduated from the course between 2008 and 2010.

Each of the Master Composters who helped create and maintain this site had worked on various other composting efforts in his or her neighborhood—but they came together this time to create a center that would be open to all residents.

Under the umbrella of the Jackson Heights Beautification Group, JH SCRAPS collects food scraps twice a week at the site, accepts fall leaves, takes excess woodchips from a nearby MulchFest site, hosts beautification days and applies their compost to local street tree beds.

The NYC Compost Project Hosted by Queens Botanical Garden and neighborhood volunteers built a three-bin compost system in May, 2013 to increase the site's capacity to accept material. The site is the proud recipient of a 2013 Citizen's Committee neighborhood grant.

Members of JH SCRAPS envision the site as a community center that can take on various functions over time, including a greenhouse that would propagate and advocate for the use of native plant species. The Master Composters also plan to transform a long strip of open soil on 69th street into a Monarch Butterfly way station.

Master Composters involved in this project include: Lenny Olsson (graduated 2009), Melissa Zavala (graduated 2008), Evie McKenna (graduated 2010), Kirsten Magnani (graduated 2010), Julian McNamara (graduated 2009), and Leoncio Romero (graduated 2007).

Master Composter Julian McNamara posing inside a new three-bin system.

Master Composters Lenny Olsson, Evie McKenna, Melissa Zavala, and Julian McNamara in front of their multi-bin compost system.

MASTER COMPOSTER PROJECT:

SHORE ROAD COMMUNITY COMPOST AT NARROWS BOTANIC GARDEN

Bay Ridge, Brooklyn

Kay Wimsatt found a lack of community gardens and places to compost food scraps in Bay Ridge—and was determined to fix that! She partnered with two other Master Composters in the neighborhood and found a perfect site location: the Narrows Botanic Garden, a small nonprofit garden space. Kate and neighborhood volunteers raised money to buy supplies and build a three-bin compost system.

Kate collaborated with the Yellow Hook CSA to make sure the new site had volunteer support and a place to collect food scraps. With the combined forces of Master Composters, CSA members, and neighbors, the first community compost site in Bay Ridge was established. Volunteers collect food scraps during the site's open hours, and the finished compost is used at the Narrows Botanic Garden.

Kate Wimsatt, her son, and NYC District 43 Council Member Vincent J. Gentile pose with the compost system at Shore Road Community Compost at Narrows Botanic Garden.

MASTER COMPOSTER PROJECT:

FRIENDS SEMINARY

Gramercy, Manhattan

Ben Horner, a middle school science teacher, took the Master Composter course in 2009 in hopes of creating more hands-on environmental science lessons for his students. He started by introducing a worm bin into the classroom to teach students how decomposer organisms break down organic matter. He then used a bin to demonstrate how outdoor composting occurs.

His students learn about the importance of moisture, air, and particle size, among other environmental properties in decomposition. Through the example of composting, they also learn about the importance of community service. “Stewardship days” are days when students use finished compost and mulch to take care of street trees in their neighborhood.

Ben Horner

Students adding food waste to a compost bin.

MASTER COMPOSTER PROJECT:

COMPOSTING, A "UNIVERSAL LANGUAGE"

Queens Botanical Garden's Farmer's Market, Queens

The food scrap drop-off site at the Queens Botanical Garden's Farmers Market is part of a collaborative project. Run by both the NYC Compost Project and the Queens Botanical Garden (QBG), it demonstrates composting and urban farming to New Yorkers. As a part of her farm apprenticeship at the QBG Farm located within the botanical garden, Master Composter Sakura Suzuki promoted composting and collected food scraps from farmer's market shoppers. She also helped compost food scraps on the farm using Earth Machines.

Reflecting the multicultural population of Flushing, Sakura communicated with market-goers in English, Mandarin, and Korean to better spread the word about composting. "When I see the twinkle in their eyes when they discover that vegetables at the stand are grown at the botanical garden and that their food scraps are needed to grow more, it makes me feel that composting is a universal language," said Sakura.

In addition to tabling at the farmers market, Sakura is promoting the QBG Farm project through English, Mandarin, and Korean local news media.

Master Composter Sakura Suzuki volunteering at an NYC Compost Project food scrap drop-off site in Forest Hills.

ACTIVITY O-1

COMPOST BINGO

Learn about your classmates by playing Compost Bingo. Try to find people for whom the statements below are true, and write that person's name in the space below the statement. The goal is to fill an entire row of five spaces (up, down, or diagonally) with your classmates' names. Shout "Bingo!" when you've completed a row!

I can name a species of worm that's suitable for vermicomposting	I'm relatively new to New York City.	I've planted or cared for a tree in NYC.	I've composted using a worm bin.	I'm involved with or have volunteered at a community compost site.
I've eaten food that was grown or produced in NYC.	I've been living in New York City for more than twenty years.	I know how to grow food.	I'm new to this whole composting thing.	I'm involved in/used to be involved in a sustainability project of some kind.
I love to cook.	I have experience teaching children about gardening or composting.	I've held a handful of finished compost.	I currently compost leaves, grass clippings, or plant trimmings.	I can fill in the blank: Carbon and _____ are the two elements composters work to balance.
I've used compost to improve soil in my yard or neighborhood.	I currently compost food scraps.	I've been living in New York City for more than ten years.	I'm involved with a school or community garden.	I know a location where I can drop off food scraps to be composted in NYC.
I've helped lead a community project of some kind.	I've eaten food that was grown or produced in NYC.	I can fill in the blank: Soil is made of organic matter, air, water, and _____.	I have carpentry skills.	I've been living in New York City for more than five years.

KNOWLEDGE & SKILLS SELF-EVALUATION

NAME: _____

COMFORT LEVEL:

1: I'm not ready to try this on my own yet.

2: I am unsure about my abilities, but would be willing to try.

3: I have done this before, but would like to improve.

4: I have some experience and feel pretty comfortable doing this.

5: I am very experienced and feel comfortable teaching others to do this.

Master Composter activities	Comfort level at orientation	Comfort level at last class
Identify different types of compost bins and piles (i.e. different types of compost systems)		
Explain the benefits of composting to others		
Determine what type of compost bin works best for a specific site		
Set up a worm bin		
Design a compost site		
Develop a compost lesson plan		
Identify decomposer organisms		
Troubleshoot composting problems, like pests, odor, or slow decomposition		
Use compost for improving soil		
Lead a volunteer compost work day		
Host an information table at an event		
Use basic gardening tools to compost		
Articulate NYC's organic waste management strategy		
Improve soil by using mulch and planting cover crops		
Identify ways the NYC Compost Project provides support to community composters		
Balance the carbon-to-nitrogen ratio in a compost recipe (i.e. balance green and browns)		
Add your own goal here:		
Add your own goal here:		

ACTIVITY O-3

WASTE DISPOSAL QUIZ

Have you ever been unsure about how to dispose of an item properly in NYC? The Department of Sanitation's Bureau of Recycling & Sustainabilty lists all waste disposal information on its website: **nyc.gov/zerowaste**. Complete this quiz using the information provided on the website.

How do I properly dispose of:	
Non-rechargeable batteries	
Rechargeable batteries	
A broken mirror	
Acrylic paint	
Pesticides	
Tires	
Air conditioner	
Refrigerator	
Syringes	
Compact-fluorescent light bulbs	

WHAT'S IN MY WASTE?

Before our next Master Composter class, pick three days to track what you throw away in the log below. Try to be as accurate as possible—and don't change your behavior. During our next class, we'll discuss how we can reduce the amount of waste we are sending to landfills. Note: You will not be required to share your log with the class unless you want to.

Date			
What **paper** items did you discard?			
What **metal** items did you discard?			
What **glass** items did you discard?			
What **plastic** items did you discard?			
What **organics** did you discard?			
What **other** items did you discard?			

CHAPTER 1

SOIL & DECOMPOSITION SCIENCE

LEARNING OBJECTIVES

- Identify the components of soil
- Understand the physical and chemical properties of soil
- Understand the decomposition process
- Identify decomposer organisms
- Distinguish between aerobic and anaerobic decomposition

SUGGESTED ACTIVITIES

- Soil Composition Test (page 1-17)
- Soil Texture Test (page 1-19)
- Decomposer Hide & Seek (page 1-22)
- Compost Critter Quiz (page 1-23)
- Soil & Decomposition Quiz (page 1-24)

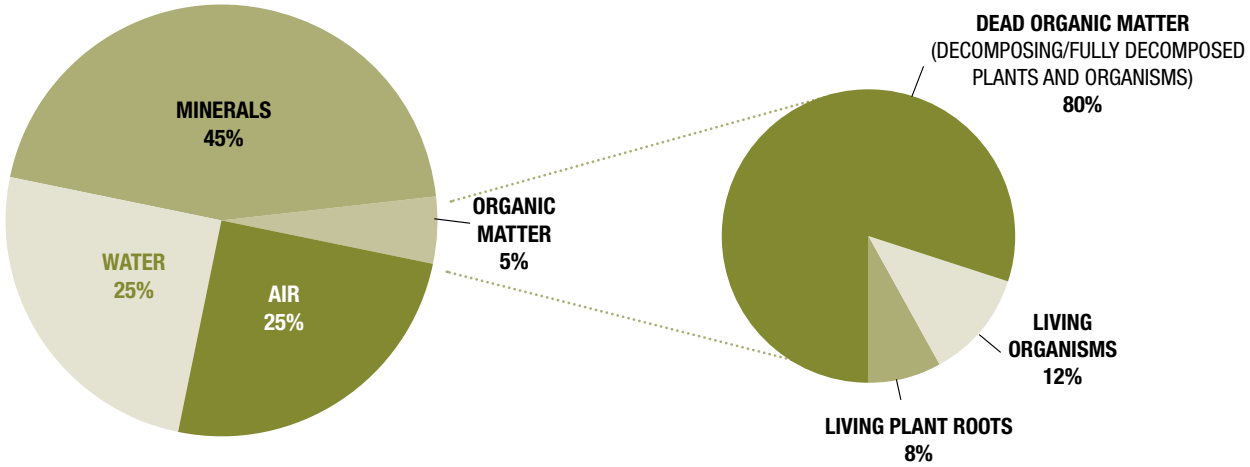
SOIL

When we compost, we're working to produce an important soil amendment. To understand how compost improves soil, we must first understand soil itself. What exactly is soil? What makes it healthy or unhealthy? How do different types of soil affect plants? The more we know about soil, the better we can take care of our backyards, gardens, street trees, parks, urban farms, and other green spaces.

WHAT IS SOIL?

Healthy soil—that is, soil that can support a wide diversity of plant life—is approximately 50 percent solid matter and 50 percent pore, or open, space. That means only about half of the ground we stand on is actually solid!

About 95 percent of soil's solid matter consists of tiny rock particles called ***minerals***. The remaining 5 percent is made of living soil organisms and living plant roots, and dead plants and dead organisms in various stages of decomposition—this is organic matter in the soil. ***Organic matter*** is anything that is living or has once lived.



SOIL COMPOSITION

Healthy soil is made up of approximately 25 percent water, 25 percent air, 45 percent minerals, and 5 percent organic matter.

ORGANIC MATTER

Organic matter is comprised of approximately 80 percent decomposing or fully decomposed material, 12 percent living organisms, and 8 percent living plant roots.

SMALL GROUP ACTIVITY:

SOIL COMPOSITION TEST

Determine the composition of a soil sample by following the instructions on page 1-17.

SOIL PHYSICAL PROPERTIES

Soil texture and structure influence its ability to support plant life, provide a hospitable environment for soil organisms, and prevent erosion.

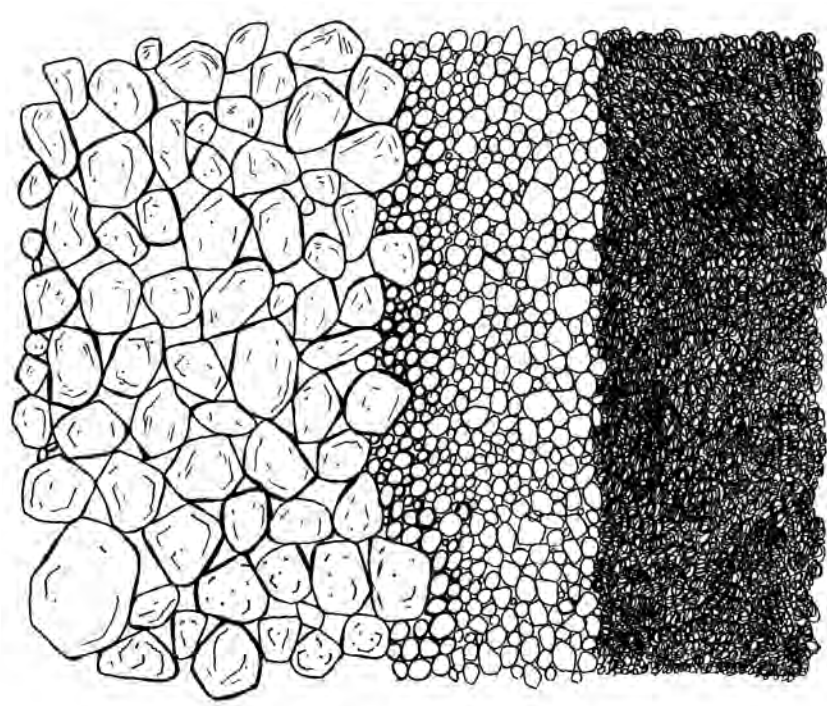
SOIL TEXTURE

If a farmer were to ask you, "What kind of soil do you have in your garden?" she would most likely be referring to the ***texture*** of your soil.

A soil's texture is determined by the different sizes of minerals in it, which are created when wind and water pulverize larger rocks into smaller pieces over long periods of time. Minerals are divided into three categories based on size, from biggest to smallest: ***sand, silt,*** and ***clay***. Sand particles are large enough to see with the naked eye, while clay and silt particles cannot be seen without a microscope.

Soils are comprised of a mixture of sand, silt, and clay. Soil that contains relatively equal weights of all three particle sizes is called ***loam***. If you have loamy soil, you've struck gold! This is an ideal soil texture for most plants. Among other things, roots can penetrate it easily, and it absorbs and drains water well.

SAND, SILT, CLAY



Sand particles range in size from .002 to .08 inches. They're usually large enough to see and feel gritty between your fingers. Anything larger than sand is considered gravel.

Silt particles are larger than clay but smaller than .002 inches and still too small to see without a microscope.

Clay particles are the finest soil particles, at smaller than .0001 inches and too small to see without a microscope.

Pure clay and silt feel mostly smooth between your fingers.

Source: Secrets to Great Soil: A Grower's Guide to Composting, Mulching, and Creating Healthy, Fertile Soil for Your Garden and Lawn. Elizabeth P. Stell. 1998.

"You do not expect a building to last unless it has a decent foundation. The same goes for plants. If the roots are happy, the rest will mostly take care of itself.

...The essence of success lies in the structure of the soil, which should have exactly the right ratio of earth crumbs to air pockets. On heavy clay soils, there is not enough air. The roots keep bumping their noses on the underground equivalent of brick walls. On light sandy soils, there is too much air and the fine, hairy rootlets that absorb essential nutrients find themselves hanging in space, unable to clutch at what they need.

Somewhere in between the two there is a perfect soil, the gardener's nirvana. This is loam, and you can begin the long journey towards it by adding humus to your soil at every possible opportunity. ... Humus opens up heavy soils, adds bulk to light ones. There are not many remedies that work on diametrically opposed problems. This is one of them."

–Anna Pavord
The Curious Gardener:
A Year in the Garden (2010)

If you have soil that has much more sand than it does clay and silt, you'd have sandy soil. High in silt? Silty soil. High in clay? You get the idea.

Texture greatly affects how a soil behaves—meaning, how a soil responds to environmental conditions, like wind and rain. For example, consider sandy soil. Because sandy soil contains larger mineral particles, it also contains many air pockets. Do you think this kind of soil can retain water well? Not very. Water easily drains through it, causing it to dry out quickly. Some plants such as desert succulents have adapted to (and prefer) very dry soil conditions. Most plants, however, need a regular supply of water to thrive, which is difficult to provide in sandy soil.

In comparison, the tiny particles of a soil made predominantly of clay will hold onto moisture tightly. This can also harm plants by drowning them or causing their roots to rot (though some plants, like those found in bogs, prefer waterlogged soil). Also, very wet soil will not be hospitable to important soil organisms that need oxygen to survive. On the other hand, extremely dry high-clay soil can become impenetrable like concrete, causing water to puddle on top of it and cause flooding.

A good way to remember how a soil's texture affects its behavior is to imagine that sand particles are beach balls, silt particles are golf balls, and clay particles are pinheads. A pile of beach balls will leave a lot of space between them, while a pile of pinheads will leave hardly any space between them. A mixture of nearly equal amounts of beach balls, golf balls, and pinheads creates the equivalent of loam.

Knowing what kind of soil you're working with will help you know which plants will grow well in it and how to manage it. You can roughly identify a soil's texture with just your hands and some water (see "Soil Texture Test" on page 1-19). For an exact texture analysis, you'll need to send soil samples to a lab (see "Soil Testing Labs" sidebar on page 1-7).

So what do you do if you don't have loamy soil? If you're working with soil that is high in sand, silt, or clay? Altering soil texture by adding more mineral particles is very difficult. If you wanted to amend a clayey soil, for example, you'd have to haul in and integrate immense quantities of sand and silt. This, more than likely, is an unrealistic solution and prohibitively expensive.

Luckily, this is where compost comes in. Instead of adding more minerals, you can integrate more organic matter to your soil, like ***humus*** (finished compost). No matter what kind of soil texture you have, humus will help it behave more like loam. In sandy soils, absorbent humus binds to the large sand particles,

helping better retain moisture. In high clay and high silt soils, irregularly shaped humus helps better drain moisture by adding pore spaces between tiny mineral particles.

SOIL STRUCTURE

Another physical property of soil is its ***structure***, which refers to how particles are arranged in the soil. Well-structured soil will have loosely grouped particles that are bound together by molecular bonds, organic matter, and excretions from soil organisms. These clumped particles are called ***aggregates***.

AGGREGATES

Dispersed soil particles

Biofilms and glomalins, sticky substances produced by microorganisms and fungi, glue soil particles together

Aggregated soil particles

Source: www.soilandhealth.org

Aggregates prevent soil particles from packing too tightly together, therefore avoiding compacted soil conditions. Small air channels, or pores, are found between the aggregates. These channels allow plant roots and moisture to penetrate the soil easily. The smaller pores loosely hold moisture and nutrients until the plant needs it. The larger pores allow excess water to drain out so air can circulate and warm the soil.

Aggregates are also important for retaining soil nutrients. Nutrients cling to the “sticky” aggregates, helping prevent rain or irrigation waters from washing nutrients into deep sub-soils where roots cannot access them.

Another way aggregates protect soil is by acting as buffers against ***erosion***, the process that displaces topsoil when it is repeatedly beaten by wind and water. It’s more difficult for wind and water to displace well-structured topsoil containing aggregates than it is to displace loose individual soil particles.

Erosion is a major problem: it removes important nutrient-rich topsoil from growing spaces, often sending it to rivers, lakes, and oceans where it's unusable. On top of this, if the topsoil contains pesticides, herbicides, and excess nutrients, it can contaminate these bodies of water.

So how can you help improve a soil's structure by creating more aggregates? You'd improve it the same way you'd improve a soil's properties—by adding organic matter.

LARGE GROUP ACTIVITY:

SOIL TEXTURE TEST

Instructors provide students with soil samples. Students use soil texture flow chart on page 1-19 to determine soil texture of sample.

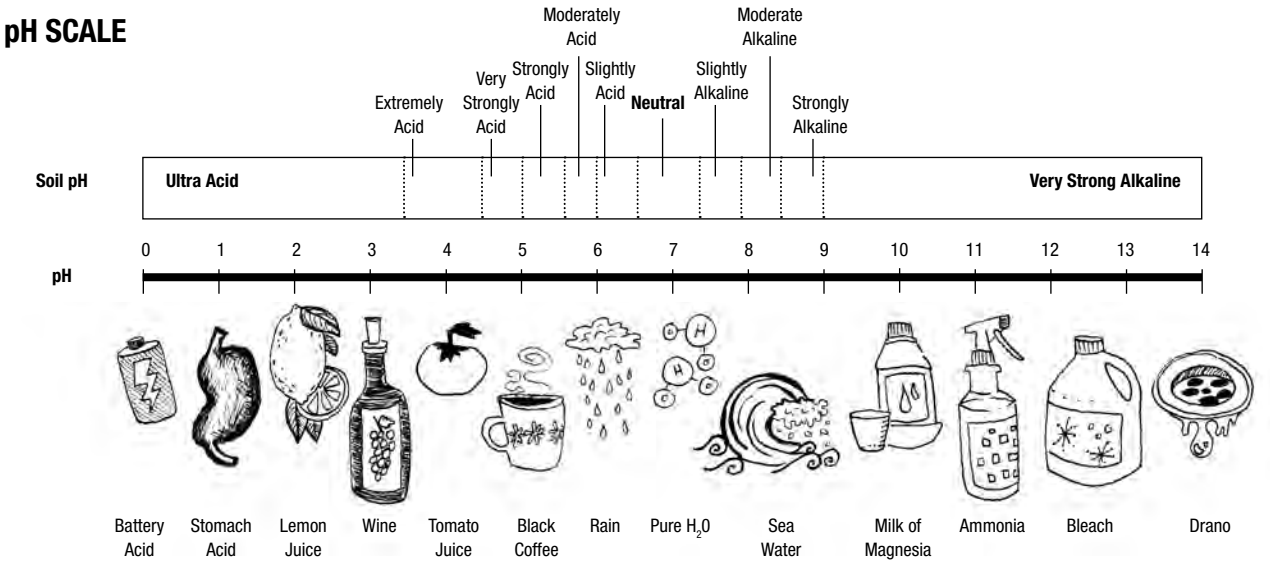
SOIL CHEMICAL PROPERTIES

Soil has many chemical properties. For the purpose of this course, we'll focus on soil acidity and alkalinity levels, measured by the pH scale.

pH LEVEL

pH is measured on a scale from 0-14 that describes how acidic or alkaline a substance is. Substances that have a pH less than seven, like lemon juice, are acidic; substances that have a pH above seven, like an alkaline battery, are alkaline; and substances that have a pH equal to seven, such as water, are neutral.

A soil's pH level affects plants' ability to uptake nutrients. At an acidic or alkaline pH, certain nutrients become less available causing nutrient deficiencies in plants, while other nutrients can be consumed in such high concentrations that they become toxic to plants. At a neutral pH level, plants can consume all of the nutrients they need at a healthy pace. See the chart page 1-8 for a visual representation of this concept.



This diagram shows the pH level of some common items. The bar along the top compares these items to soil pH levels. Ideal soil pH for most plants is close to neutral, between 6 and 7.

It's important to regularly test the soil for heavy metal contaminants, especially if you are growing food or if children are playing in it. To do this, dig up several samples of soil in the area that you are using or plan to use and send them to a soil lab for analysis. The lab should send you back the results within a few weeks. A few soil testing labs are listed in the sidebar on this page. Their websites will explain exactly how the tests should be conducted.

How can you change a soil's pH level? We'll give you one guess. (Hint: It's the same way you'd amend poorly textured or poorly structured soil.) That's right—by adding humus! Adding humus acts as a pH "buffer" by neutralizing both acidic and alkaline soils.

Are you starting to get a clearer understanding of why composting is so important for improving soil health? Compost (humus) is a one-stop fix for almost any problematic soil. That's why gardeners, farmers, and other people who care about soil health love it so much.

SOIL TESTING LABS

Brooklyn College: brooklyn.cuny.edu/web/academics/centers/esac/services/soil.php

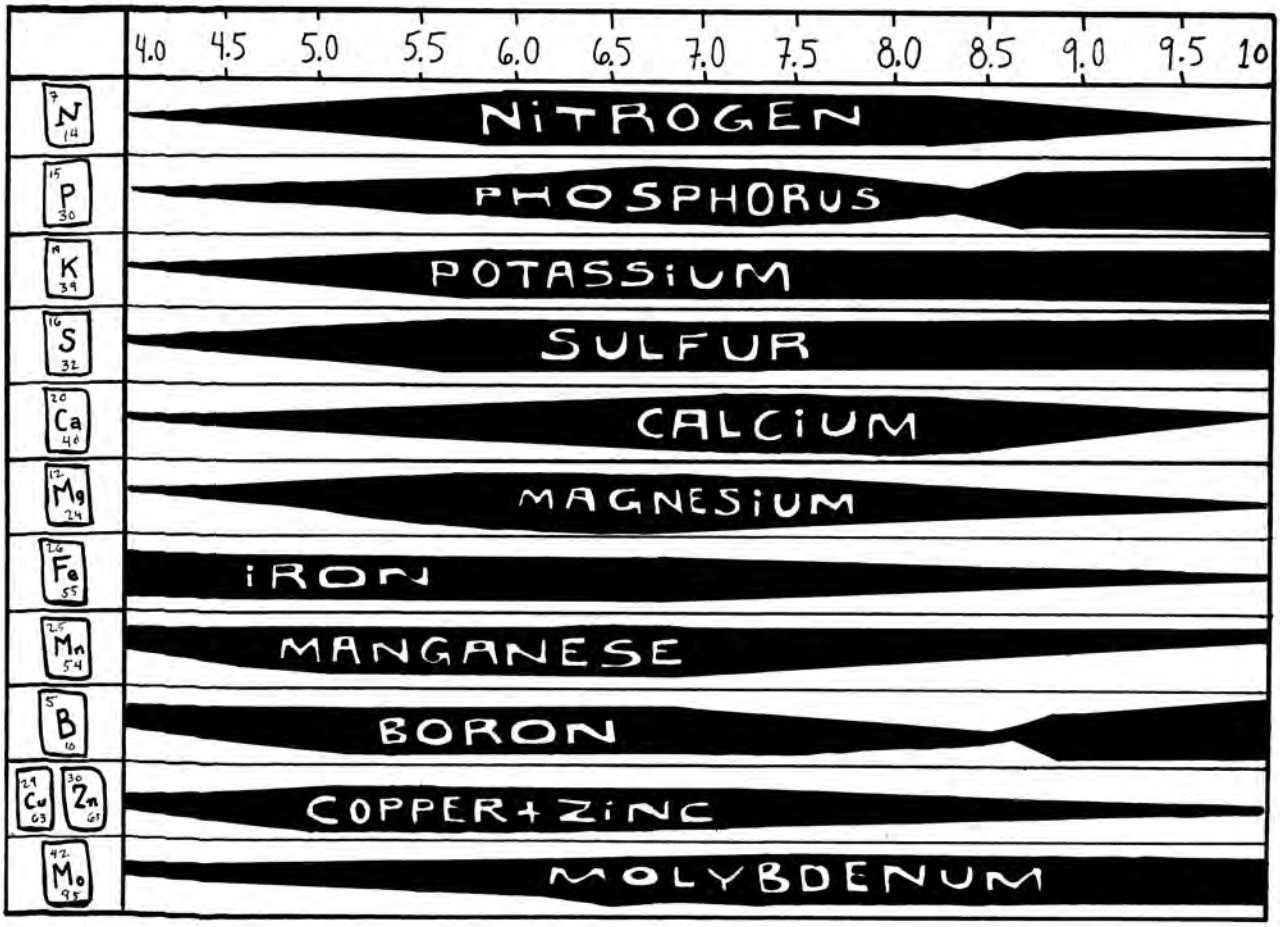
Cornell University College of Agriculture and Life Sciences: soilhealth.cals.cornell.edu

Logan Labs: loganlabs.com

University of Connecticut Soil Nutrient Analysis Laboratory: soiltest.uconn.edu/sampling.php

University of Massachusetts Amherst Soil and Plant Tissue Testing Laboratory: soiltest.umass.edu

SOIL PH LEVEL AND NUTRIENT AVAILABILITY



This diagram shows nutrient availability at different soil pH levels. The thicker the line associated with the nutrient, the higher the availability.

At a soil pH of 7 the macronutrients (nitrogen, phosphorous, potassium, sulfur, calcium, and magnesium) and micronutrients (iron, manganese, boron, copper, zinc, and molybdenum) are all available in sufficient quantities.

At a lower and more acidic pH of 5.5, the macronutrients are available in smaller quantities while the micronutrients are available at higher levels that can be toxic to plants.

Conversely, at an alkaline pH of 8.5, micronutrients become largely unavailable at higher and more alkaline pH levels, causing plant health to suffer from nutrient deficiencies.

DECOMPOSITION

We've talked about how organic matter plays a vital role in improving a soil's texture and structure, and neutralizing its pH level. Let's now explore the process of decomposition, which enables organic matter to be so important to soil health.

HOW DECOMPOSITION WORKS

Decomposition happens when organisms chemically or physically break down organic matter. Simply put, it's nature's way of recycling life. Certain organisms recombine the chemical components of plant and animal cells to create forms of nutrients that can be absorbed by a plant's roots. With these nutrients, plants can grow and perform necessary life functions such as photosynthesis and reproduction. When a plant dies in a natural ecosystem, it is returned to the soil where decomposer organisms can break it down and again release its nutrients back into the soil to be used to generate new plants.

So who are the incredible decomposer organisms that facilitate this entire process? They can be divided into two categories: chemical decomposers and physical decomposers.

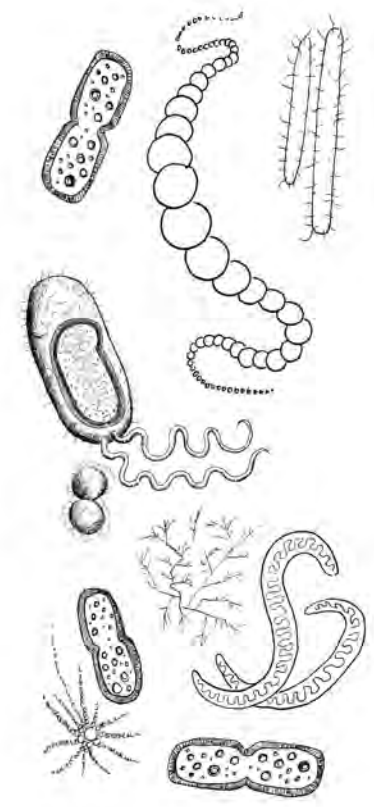
CHEMICAL DECOMPOSERS

Chemical decomposers excrete enzymes or acids to break down the organic matter into simpler forms they can consume. The process is similar to how our saliva and stomach acids help break down the food we eat. Chemical decomposers are mostly ***microorganisms***, which simply means they are invisible to the human eye and can only be seen with a microscope.

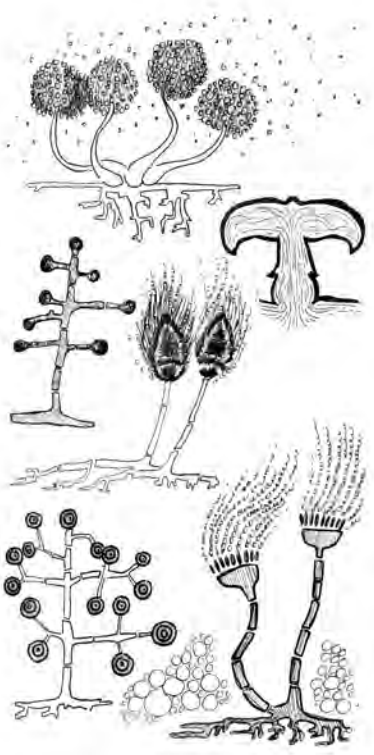
Many chemical decomposers are at work during decomposition. For the purposes of this course, we'll take a closer look at just two of the most important players: bacteria and fungi.

BACTERIA

Bacteria are single-celled microorganisms that break down organic matter chemically. Bacteria are the most abundant microorganisms in compost and perform the majority of the decomposition work. Generating heat while they work, bacteria can heat large piles of decomposing materials to over 100 degrees Fahrenheit. (We'll talk more about how temperature influences the compost process in Chapter 2.)



Bacteria



Fungi

Mesophilic bacteria prefer temperatures less than 104°F. They dominate the initial and final stages of the decomposition process, when temperatures are at their lowest.

Thermophilic bacteria are heat-loving organisms that thrive at temperatures above 104°F. They dominate during the middle stage of the decomposition process, also known as the "hot" or "thermophilic" stage (more on this in Chapter 2). They work fast, drastically speeding up the rate of decomposition. Populations decrease dramatically if temperatures reach above 140°F.

FUNGI

Fungi, which include molds and yeasts, break down tougher, more complex organic matter that is too dry, acidic, or low in nitrogen for bacteria to process, such as woody debris.

Fungi are predominantly mesophilic. When temperatures are high, most are confined to the outer layers of compost. Fungi molds can be microscopic or appear as fuzzy gray or white colonies visible on the compost surface.

Some fungi form visible chains of cells called ***hyphae*** that look like threads weaving through the organic matter. The mushrooms that you might find growing on decomposing matter are the "fruit" of some types of fungi. Each mushroom is connected to an extensive network of hyphae, collectively called ***mycelium***, which aids in decomposition.

While bacteria work by processing organic materials from the outer edges working in, fungi can penetrate materials and work from the inside out.

PHYSICAL DECOMPOSERS

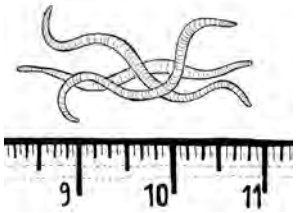
While chemical decomposers carry out most decomposition, physical decomposers play a significant role as well. Physical decomposers are mostly ***macroorganisms***—meaning they can be seen with the naked eye—such as worms, mites, flies, and snails.

Similar to how we use our teeth to break up large pieces of food, physical decomposers chew, grind, and shred organic matter into smaller pieces. They also feed on chemical decomposers. After digestion, they excrete waste products, which are then broken down even further by chemical decomposers.

Physical decomposers are most active in piles below 104°F. If temperatures are too high, they become dormant or move to the periphery of the pile where the temperatures are cooler.

Here's a list of some common physical decomposers:

POTWORMS are small (10-25 mm long) segmented worms, also known as "white worms." Their lack of hemoglobin makes them white in color, thus distinguishing them from newly hatched, pink earthworms.

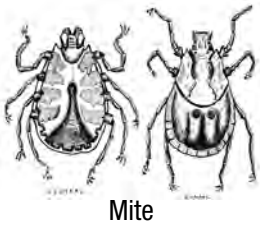


Potworm

EARTHWORMS are key players in ***vermicomposting***, which we'll discuss in the next chapter. There are many species of worms in the world, but in this manual we're only going to focus on one: red wiggler worms, also called *Eisenia fetida*, which thrive in decaying material.

Earthworm

MITES have eight legs like spiders and range in size from microscopic to the size of a pin head. There can be very large populations of mites in piles of decomposing materials.


Mite

PSEUDO-SCORPIONS look like tiny scorpions with large claws relative to their body size that lack tails and stingers. They range from one to several millimeters in size.

Pseudo-Scorpion

SPIDERS feed on insects and other small invertebrates in compost piles.

Spider

SPRINGTAILS are small, wingless insects that are numerous in compost. A tiny, spring-like lever at the base of the abdomen catapults them into the air when they are disturbed. Pulling apart layers of decaying leaves often reveals springtails hopping or scurrying for cover.

Springtail

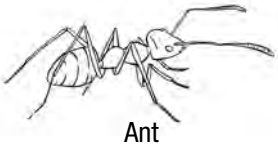
BLACK SOLDIER FLIES do not bite or carry disease. Their larvae out-compete and deter the breeding of houseflies and fruit flies, which can be nuisances in compost piles. Although the adult flies are seldom seen and do not eat, the large off-white larvae (up to 1") often appear by the hundreds and are quite voracious. As they consume food scraps or other organic matter, their powerful chewing and digestive enzymes liquefy the material and convert it into a fraction of the original volume and weight.

Black Soldier Fly

ANTS eat a wide range of foods, including fungi, food scraps, other insects, and seeds. Ants redistribute materials, and help to aerate the compost pile.

Many kinds of **BEETLES** are decomposer organisms. Most common are the rove beetle, ground beetle, and feather-winged beetle.

EARWIGS are distinguished by the jaw-like pincers on their tail end. They are usually 2 to 3 centimeters long.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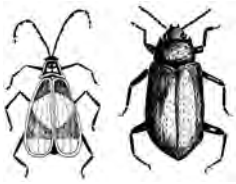
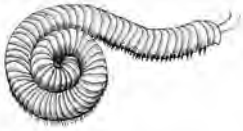
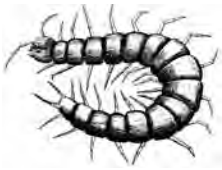

Beetle

Earwig

Sowbug and Pillbug


Millipede


Centipede

Nematode

Snail and Slug

SOWBUGS, also called isopods or wood lice, are terrestrial (land) crustaceans. Because they lack the waxy cuticle common to most insects, they must remain in damp habitats.

PILLBUGS, or roly-polies, are similar to sowbugs, except they roll into a ball when disturbed, while sowbugs remain flat.

MILLIPEDES have long, cylindrical, segmented bodies, with two pairs of legs per segment. They move slowly and are herbivorous.

CENTIPEDES can be distinguished from millipedes by their flattened bodies and single pair of legs per body segment. They are fast-moving carnivorous predators that will attack other insects.

NEMATODES, or roundworms, resemble fine human hair under a magnifying lens. They are cylindrical and often transparent. Nematodes are the most abundant of invertebrate decomposers—a handful of decaying compost probably contains several million. They live in water-filled pores and in the thin films of water surrounding compost particles.

SNAILS AND SLUGS eat living plant material (which is why gardeners consider them to be pests!) or feed on decaying vegetation.

SMALL GROUP ACTIVITY:

DECOMPOSER HIDE & SEEK

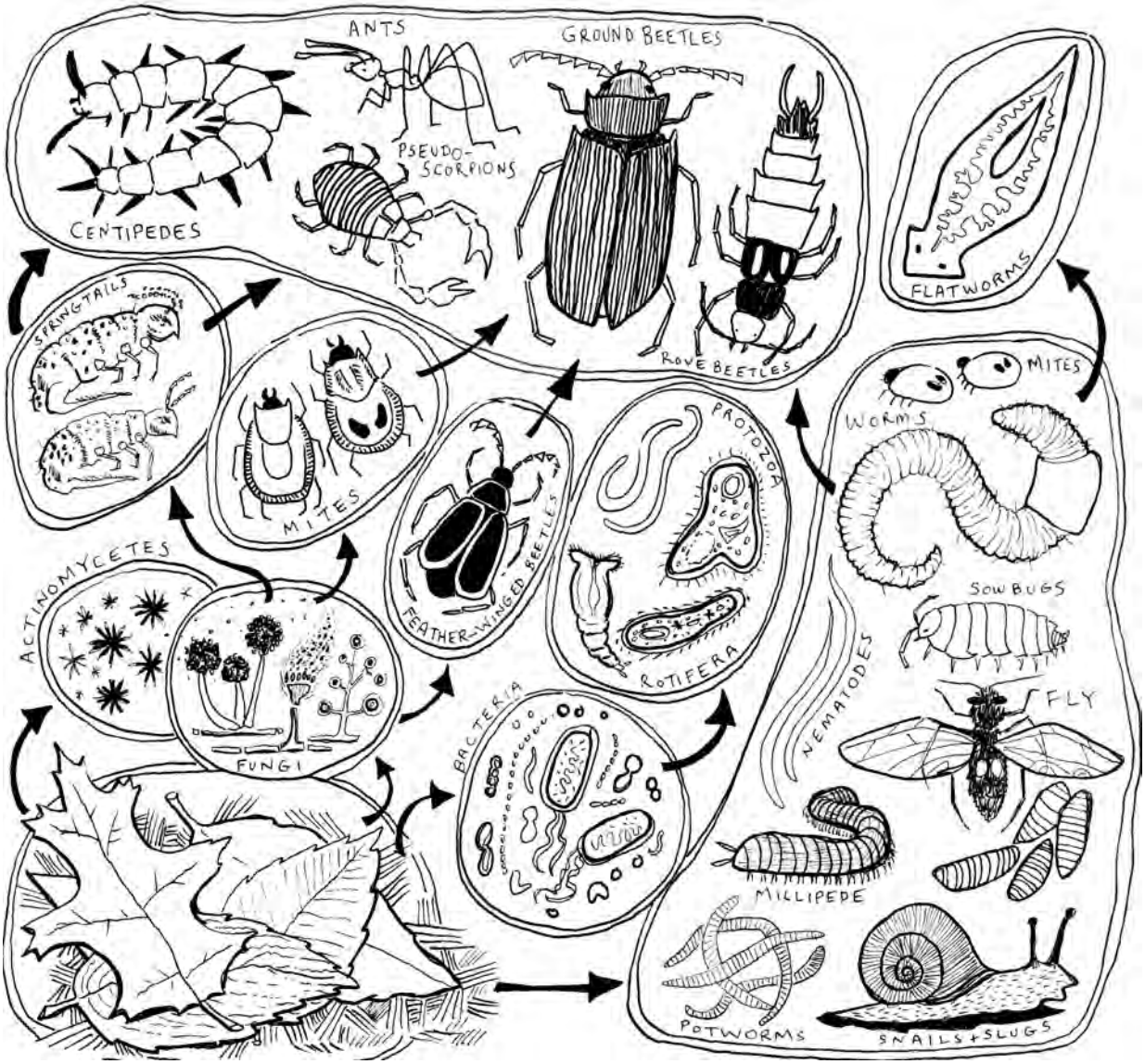
Follow the instructions on page 1-22 to examine decomposer organisms up close.

INDIVIDUAL ACTIVITY:

COMPOST CRITTER QUIZ

Complete the quiz on page 1-23 to test compost critter knowledge.

DECOMPOSER FOOD CHAIN



DECOMPOSING ORGANIC MATTER

Decomposer organisms in a compost pile are an important part of the complex ecosystem that is required to decompose organic waste. Within this ecosystem, decomposer organisms are classified according to what they eat, or consume. There are three levels of consumers in the compost food web: primary, secondary, and tertiary.

Primary (first level) consumers feed directly on dead plant materials as well as other decomposers that have died in the compost pile. This group consists of chemical decomposers such as bacteria and fungi, but also includes larger physical decomposers such as snails, slugs, beetle mites, worms, and flies.

Secondary (second level) consumers feed on primary consumers and their waste products. This group consists of physical decomposers which include springtails, mites, and nematodes.

Tertiary (third level) consumers feed on secondary—and sometimes other tertiary—consumers. This group consists of fast moving organisms which include centipedes, pseudo-scorpions, predatory mites, and rove beetles.

The structure of this food chain keeps different populations under control, maintaining a healthy and balanced compost pile.

TWO KINDS OF DECOMPOSITION

There are two kinds of decomposition: the kind that happens with oxygen (called aerobic decomposition), and the kind that happens without oxygen (called anaerobic decomposition). There are important differences between the two.

AEROBIC DECOMPOSITION

Aerobic decomposition is the breaking down of organic matter by oxygen-breathing decomposer organisms. It's the most common kind of naturally occurring decomposition. It is also the most efficient because the energy generated by organisms can attract heat-loving thermophiles that break down organic matter quickly.

Aerobic decomposition involves a complex web of interacting organisms. Bacteria and fungi convert nutrients into forms that plants can use by secreting enzymes that break down complex organic compounds. Ultimately, an earthy mixture of decomposed organic matter called humus, or organic matter that cannot decompose any further, is generated. Aerobic decomposition also produces water and carbon dioxide.

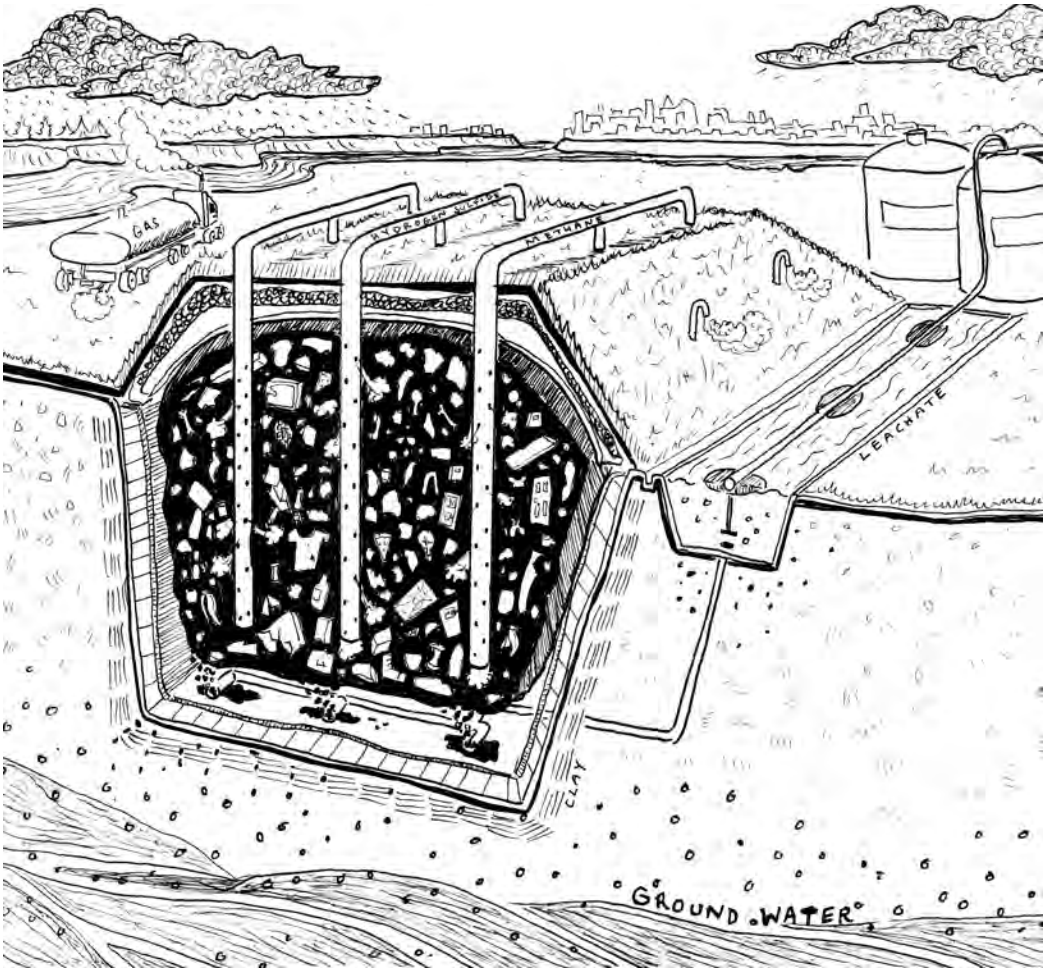
AEROBIC DECOMPOSITION ON A FOREST FLOOR

A forest floor is one of the best places to see aerobic decomposition in action. After leaves, branches, and logs fall to the floor, they are slowly broken down by decomposer organisms (this is true for dead insects and animals too!). The humus produced through this process then feeds living trees and plants. This closed-loop recycling system of breaking down dead plants and animals to create humus that feeds new life never stops in nature.

ANAEROBIC DECOMPOSITION

Anaerobic decomposition involves a group of micro-organisms that do not require oxygen to survive. Like aerobic decomposition, it occurs in nature but is confined to environments that lack oxygen, such as in lakes or oceans. It is also the kind of decomposition that happens in landfills. It is less efficient than aerobic decomposition because it relies predominantly on slow-working bacteria and doesn't support other fungi, microorganisms, and macroorganisms that need oxygen to survive. Because breakdown of organic matter during anaerobic decomposition is slow, less energy is released as heat and temperatures remain low.

ANAEROBIC DECOMPOSITION IN A LANDFILL



In landfills, buried organic matter is cut off from air and decomposes anaerobically. This leads to slow decomposition and creates unwanted by-products such as methane gas, which contributes to climate change, and toxic runoff that could leach into waterways. Additionally, once we put organic waste in a landfill, we can never get it back to use for improving soil and providing essential nutrients to plants—a major missed opportunity!

Like aerobic decomposition, anaerobic decomposition produces humus, water, and carbon dioxide. The process additionally releases small-molecule alcohols, organic acids, ptomaines, amines, and potent greenhouse gases such as methane and hydrogen sulfide—all of which add up to a smelly, toxic environment.

In landfills, buried organic matter is cut off from air and decomposes anaerobically. This can take decades or centuries to break down in dry pockets—newspapers from over forty years ago are often found still intact.

It can be very dangerous when rain or water percolates through landfills. Weak acids produced by decaying organic matter wash through air channels and react with inorganic trash, such as plastics and metals. The mixture of organic and inorganic materials creates toxic runoff that can contaminate groundwater, lakes, and streams. Additionally, methane can accumulate in landfills or migrate underground to nearby buildings, creating a danger of explosions.

Because of these problems, the U.S. Environmental Protection Agency mandates landfill operators to employ systems that collect runoff and capture methane gas. Combined with the cost of shipping garbage, tipping fees for waste haulers at landfills, and other social and environmental justice issues, this makes landfills very expensive and dangerous to build and operate.

Most soil is covered with concrete in a city like New York, so organic matter rarely makes it back into the ground. Instead, food waste, yard trimmings, and leaves are mostly discarded as trash and are sent to landfills.

Through composting, we can work together to prevent NYC's organic matter from being sent to landfills and reclaim it as an important resource for rebuilding our soil.

INDIVIDUAL ACTIVITY:

SOIL & DECOMPOSITION QUIZ

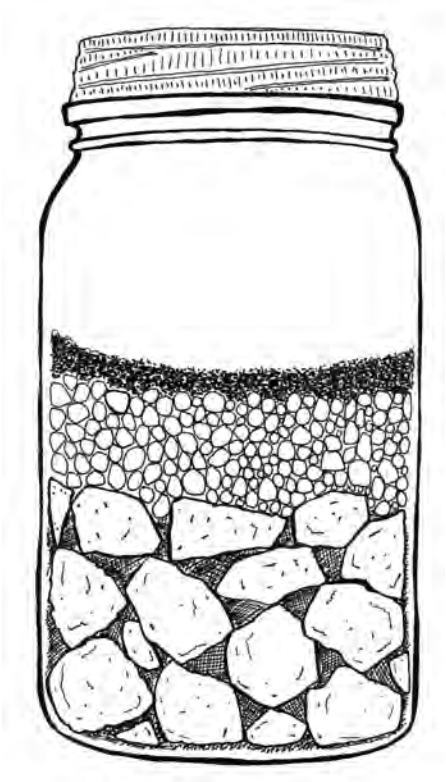
Complete the quiz on page 1-24.

SOIL COMPOSITION TEST

Knowing the composition of the soil that you plan to work with will help you determine how well it can support plant life and biological activity; how it will behave (e.g., drain quickly versus retain moisture); and how much organic matter you need to add to it. This simple test can provide you with a picture of a soil's composition without having to send samples to a testing facility.

MATERIALS

- Glass jar with lid
- Water



INSTRUCTIONS

1. Use jar to scoop up soil from somewhere in the neighborhood where you live. Soil should fill jar about halfway. Cover the jar with a lid.

2. Fill the jar with water to about one inch from the top and shake well.

3. Allow the jar of soil and water to sit for a day or two. The soil will settle into its components, with sand on the bottom, followed by silt, clay, and then the organic matter at the top.

RESULTS

Answer the following questions based on what you see in your jar.

1. What is the approximate percentage of minerals in your soil? Divide by sand, silt, and clay.

2. What is the approximate percentage of organic matter in your soil?

3. How well do you think your soil can retain moisture? In other words, if you were to plant a vegetable in your soil, how often do you think you'd need to water it?

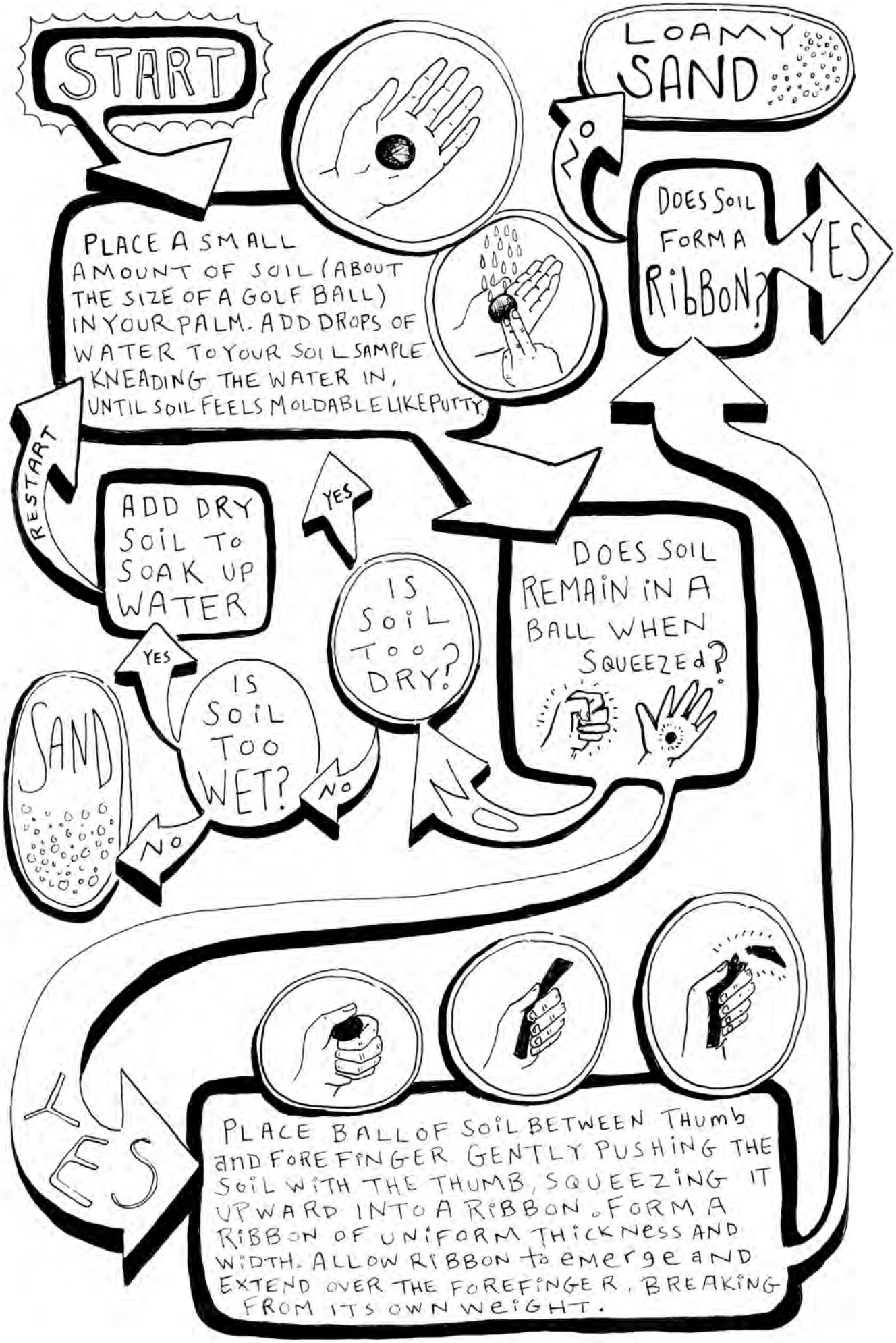
4. How well would your soil support diverse plant life?

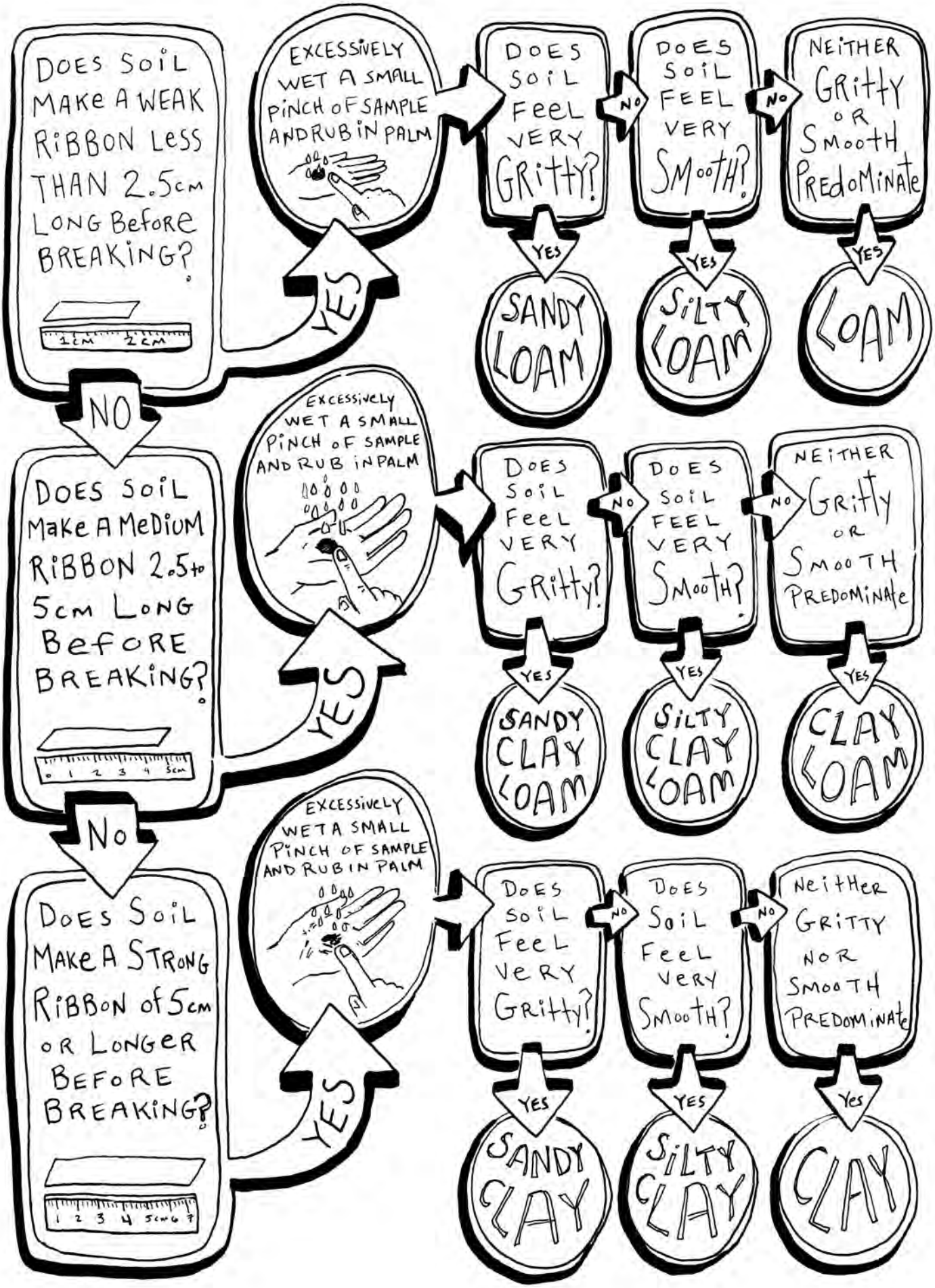
5. What would help your soil better support plant life?

SOIL TEXTURE TEST

If a gardener or farmer asks you what kind of soil you have, they are likely referring to its texture. How does your soil break down into sand, silt, and clay? Is your soil loamy, containing a relatively equal proportion of all three of these particle sizes?

Use the flowchart on the following pages as a guide to help you determine a soil's texture.


START
PLACE A SMALL AMOUNT OF SOIL (ABOUT THE SIZE OF A GOLF BALL) IN YOUR PALM. ADD DROPS OF WATER TO YOUR SOIL SAMPLE KNEADING THE WATER IN, UNTIL SOIL FEELS MOLDABLE LIKE PUTTY.
DOES SOIL FORM A RIBBON?
NO
LOAMY SAND
YES
DOES SOIL REMAIN IN A BALL WHEN SQUEEZED?
NO
IS SOIL TOO DRY?
YES
ADD DRY SOIL TO SOAK UP WATER
RESTART
IS SOIL TOO WET?
YES
SAND
NO
NO
YES
PLACE BALL OF SOIL BETWEEN THUMB AND FOREFINGER GENTLY PUSHING THE SOIL WITH THE THUMB, SQUEEZING IT UPWARD INTO A RIBBON. FORM A RIBBON OF UNIFORM THICKNESS AND WIDTH. ALLOW RIBBON to emerge AND EXTEND OVER THE FOREFINGER, BREAKING FROM ITS OWN WEIGHT.


DOES SOIL MAKE A WEAK RIBBON LESS THAN 2.5cm LONG BEFORE BREAKING?
1cm 2cm
YES
EXCESSIVELY WET A SMALL PINCH OF SAMPLE AND RUB IN PALM
DOES SOIL FEEL VERY GRITTY?
YES
SANDY LOAM
NO
DOES SOIL FEEL VERY SMOOTH?
YES
SILTY LOAM
NO
NEITHER GRITTY OR SMOOTH PREDOMINATE
YES
LOAM
NO
DOES SOIL MAKE A MEDIUM RIBBON 2.5 to 5cm LONG BEFORE BREAKING?
0 1 2 3 4 5cm
YES
EXCESSIVELY WET A SMALL PINCH OF SAMPLE AND RUB IN PALM
DOES SOIL FEEL VERY GRITTY?
YES
SANDY CLAY LOAM
NO
DOES SOIL FEEL VERY SMOOTH?
YES
SILTY CLAY LOAM
NO
NEITHER GRITTY OR SMOOTH PREDOMINATE
YES
CLAY LOAM
No
DOES SOIL MAKE A STRONG RIBBON of 5cm OR LONGER BEFORE BREAKING?
1 2 3 4 5cm 6 7
YES
EXCESSIVELY WET A SMALL PINCH OF SAMPLE AND RUB IN PALM
DOES SOIL FEEL VERY GRITTY?
YES
SANDY CLAY
NO
DOES SOIL FEEL VERY SMOOTH?
YES
SILTY CLAY
NO
NEITHER GRITTY NOR SMOOTH PREDOMINATE
YES
CLAY

ACTIVITY 1-3

DECOMPOSER HIDE & SEEK

This activity helps bring decomposer organisms out of hiding so you can examine them more closely.

MATERIALS

- Glass jar (or bottom of a plastic drink bottle cut in half)
- Funnel (or top of a plastic drink bottle cut in half, turned upside-down)
- Bright light (such as a flashlight)
- Wire mesh or netting
- 1-2 cups fresh compost

INSTRUCTIONS

1. Place a piece of wire mesh inside the funnel to keep the compost from falling out.
2. Place the funnel inside the glass jar.
3. Fill the funnel with compost.
4. Shine a light into the funnel—organisms will move away from the light, making their way down the funnel into the glass jar. Leave the light over the compost for an hour, or until you've extracted several decomposer organisms.
5. Try to identify the organisms by referencing pages 1-10—1-12 in the manual. Record the names of the compost critters you see here:

Organism #1: _____ Organism #4: _____

Organism #2: _____ Organism #5: _____

Organism #3: _____ Organism #6: _____

6. What are some critters you did not see?

Organism #1: _____ Organism #4: _____

Organism #2: _____ Organism #5: _____

Organism #3: _____ Organism #6: _____

COMPOST CRITTER QUIZ

Test your compost critter knowledge! Review the following list of decomposer organisms, and then follow the instructions below.

Fungi

Black Soldier Flies

Thermophilic Bacteria

Mites

Centipede

Worms

Millipede

Ants

Sowbugs

Mesophilic Bacteria

1. Circle all chemical decomposers.
2. Draw a box around all physical decomposers.
3. Draw a star next to a terrestrial (land) crustacean.
4. Draw a spiral next to the organism that deters the breeding of houseflies and fruit flies.
5. Draw a tree next to organisms that excel at breaking down complex organic matter, like wood.
6. Draw a sun next to organisms that thrive in temperatures about 104°F.
7. Draw a web next to the organism that forms mycelium networks.
8. Underline the most important player in vermicomposting.
9. Draw an “X” next to a fast-moving, carnivorous organism.

ACTIVITY 1-5

SOIL & DECOMPOSITION QUIZ

1. What is soil composed of?

2. What are three mineral particle sizes in soil and why do they matter?

3. What is loamy soil?

4. What are aggregates and why are they important for soil health?

5. What can you do to improve a poorly textured, poorly structured soil?

6. Why is a soil's pH level important? What is the ideal pH level for soil, and what can you do to neutralize acidic or alkaline soils?

7. What is the difference between chemical and physical decomposers? Give some examples of each.

8. What is the difference between aerobic and anaerobic decomposition?

CHAPTER 2

COMPOSTING

LEARNING OBJECTIVES

- Use the “Five Factors of Composting” to manage decomposition
- Understand thermophilic composting and its benefits
- Troubleshoot composting issues

SUGGESTED ACTIVITIES

- Calculate Carbon-to-Nitrogen Ratio (C:N ratio) (page 2-25)
- Moisture Test (page 2-26)
- Bulk Density & Free Air Space Test (page 2-27)
- Fix It! Troubleshoot Composting Issues (page 2-30)
- Temperature Curves (page 2-31)

COMPOST RECIPE

Let's step away from compost for a bit and think about baking an apple pie. First, you gather all the ingredients you need. Then, you chop up any large ingredients (like whole apples) to a smaller, more manageable size. Next, you mix the ingredients together in specific proportions, and place it in the oven so that it bakes at the right temperature. Soon, you'll have a tasty treat—though make sure you let it cool before you eat it!

Okay, back to compost. Making compost is similar to baking an apple pie. In fact, composters refer to the instructions for making compost as a "recipe." Different composters might have different recipes (just as there are different recipes for apple pies), though they all follow a basic set of guidelines: gather the ingredients (chopping up any large ingredients), mix them up, let them cook, then let them cool.

COMPOSTING

Decomposition happens in nature without any human intervention. When humans work to manage the decomposition process, we call it ***composting***.

When we compost, we work to create and maintain an environment in which decomposer organisms can survive, thrive, and multiply. Think of a compost pile as a farm where you raise decomposer organisms to produce humus. The aerobic decomposers we want to favor will need food, water, and oxygen. Some decomposers prefer lower temperatures, while others—the fastest, most effective ones—prefer higher temperatures. In this chapter, we'll explain how to create the ideal conditions for raising millions and billions of happy decomposers.

In addition to building a hospitable home for decomposers, when we compost we also strive to create and maintain a favorable environment for ourselves and our neighbors by preventing odor and pests.

So, how can we manage the process of decomposition in a way that meets both the needs of compost critters and our own needs?

THE FIVE FACTORS

There are five important parts of the decomposition process that we humans can control. Learning how to control each of these factors well is the key to composting organic materials quickly and with minimal problems.

The five factors of composting are:

1. Ingredients
2. Moisture
3. Oxygen
4. Size of ingredients
5. Size & shape of bin or pile

Let's review each of these factors in detail.

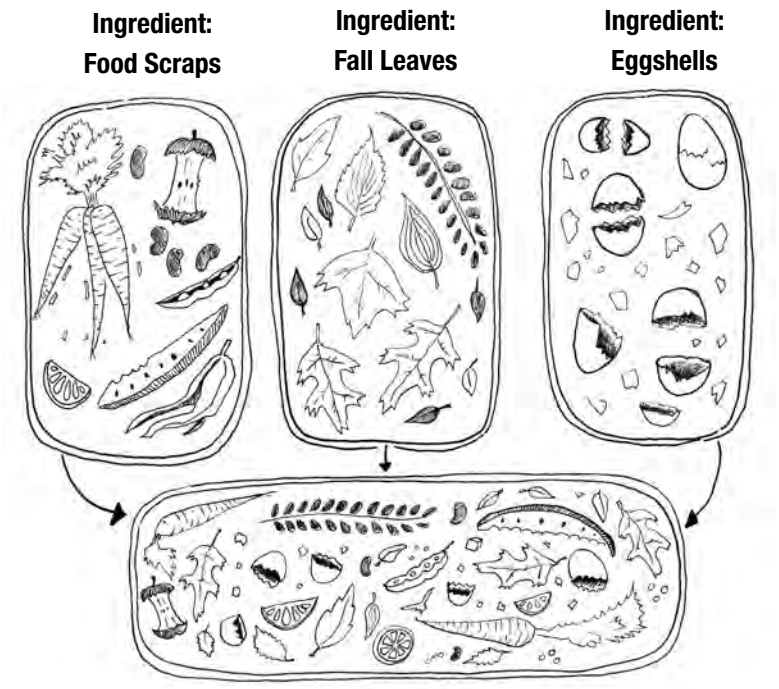
1. INGREDIENTS

All decomposers need food, and they like to eat dead organic matter. As we mentioned in Chapter 1, organic matter is anything that is living or has once lived.

Composters call the types of organic materials they feed decomposers ***ingredients***, or feedstocks, and the total mix of these materials their ***recipe***. For example, coffee grounds would be considered an ingredient; the combination of everything you put into your compost system—coffee grounds, fruits, vegetables, eggshells, leaves, etc.—would be considered your compost recipe.

You must balance ingredients in a specific way to create the ideal food for a variety of decomposer organisms. To do this, you'll need to balance the amount of carbon and nitrogen in the recipe, or create an ideal ***carbon-to-nitrogen (C:N) ratio***. This might sound intimidating, but after we explain the concept in detail and you get some practice, you'll get the hang of it in no time!

INGREDIENTS AND RECIPE



Food scraps, fall leaves, and eggshells are separate types of ingredients, or "feedstocks," because they have significantly different carbon-to-nitrogen ratios. Food waste is high in nitrogen, while fall leaves are high in carbon. A compost "recipe" is the combination all the ingredients mixed into your compost system.

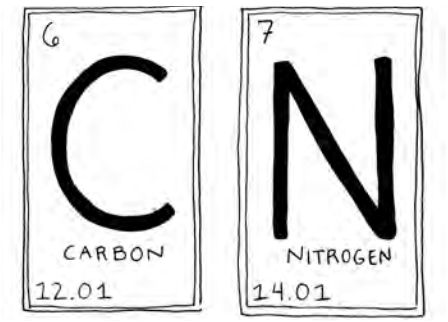
ORGANIC FOOD VS. ORGANIC WASTE

On food labels at grocery stores, the term "organic" means food grown without the use of synthetic pesticides and herbicides. This is not the definition of "organic" we are referring to in this manual.

Here, we define "organic" as anything living or that has once lived. Decomposer organisms will eat all dead organic materials—including organically grown and conventionally grown apples—but they will not eat inorganic materials such as rocks and plastics.

Over time, most inorganic materials will physically break into smaller and smaller pieces, as only very few organisms in our current environment have the ability to digest inorganic materials.

CARBON AND NITROGEN



All organic matter contains ***carbon*** and ***nitrogen***, the chemical elements responsible for essential life functions such as cellular respiration and metabolic activity.

The amount of carbon and nitrogen in organic matter varies depending on the material. Some organic materials such as leaves and wood contain high levels of carbon, while others like fruit and vegetables contain high levels of nitrogen.

To balance the amounts of carbon and nitrogen in your compost recipe, you'll need to know which organic materials are carbon-rich and which are nitrogen-rich. Luckily, these are easy to distinguish from one another: Carbon-rich materials are typically very dry, like leaves, paper, or woodchips. Nitrogen-rich materials are typically fresh and moist, such as fruit, vegetables, and garden trimmings. Some organic materials have about equal amounts of carbon and nitrogen, like bean pods, but most materials are rich in either one or the other element.

To put it in simpler terms for the public to understand, composters refer to materials that are high in carbon as ***browns***, and materials that are high in nitrogen as ***greens***. Note that the actual color of a material does not in itself indicate whether it is a brown or a green—many carbon-rich materials are indeed brown (such as woodchips) and many nitrogen-rich materials are green (such as spinach), though not all materials fit neatly into these simplified categories according to their color. One common example is coffee grounds, which are brown in color but are considered a "green" because they are high in nitrogen.

SAMPLE CARBON-TO-NITROGEN (C:N) RATIOS FOR INGREDIENTS

Humus	10:1
Food scraps	15:1
Grass clippings	19:1
Vegetable trimmings	25:1
Various leaves	35:1 to 85:1
Corn stalks	60:1
Pine needles	60:1 to 110:1
Straw	80:1
Newspaper	170:1
Douglas fir bark	491:1

Source: Washington State University (whatcom.wsu.edu/ag/compost/fundamentals/needs_carbon_nitrogen.htm)

IDEAL C:N RATIO RANGE

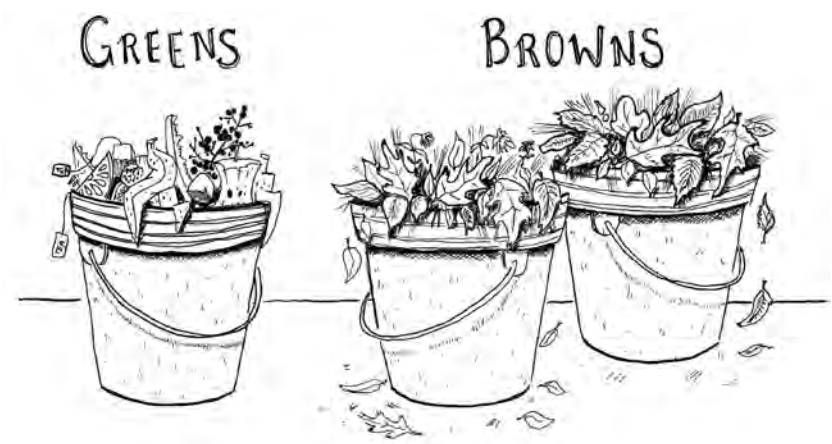
The C:N ratio shows the number of parts carbon for every 1 part nitrogen by weight. Decomposers thrive at a C:N ratio of between 25:1 and 40:1. Keeping within this range will speed up a compost recipe's decomposition rate and help prevent anaerobic conditions.

So how do we get our compost recipe to fall into this ideal range? As a general rule of thumb, you should add two parts browns (carbon-rich materials) and one part greens (nitrogen-rich materials) to your compost recipe. Here, a part is a certain quantity of material, such as a certain weight or a certain volume.

For example, for every one bucket full of food waste you add into your compost pile, you should add two buckets full of leaves or woodchips. After observing how long it takes your materials to decompose and the conditions in your compost pile, you can alter the amount of browns and greens depending on your compost system's needs.

BROWNS
CARBON-RICH MATERIALS

GREENS
NITROGEN-RICH MATERIALS



When you're starting out composting, a simple way to achieve a suitable C:N ratio is to add two buckets of browns for every one bucket of greens you add to your compost system. As you observe the conditions in your compost system over a few weeks or months, you might decide to alter these proportions.

Composters who want to increase the decomposition rate of their organic materials need to achieve a more precise C:N ratio. Experienced composters will often use online compost recipe calculators, which are tools that help calculate a recipe's C:N ratio based on the types of ingredients in it. There are many available—an internet search will yield many options. The most precise calculations for the C:N ratio of a compost recipe account for the weight, the percent carbon and percent nitrogen, moisture content, and bulk density of each ingredient.

Another way to calculate the C:N ratio of your compost pile is to (1) add the amount of carbon in all of your materials; (2) add the amount of nitrogen in all your materials; and (3) divide the total amount of carbon by the total amount of nitrogen. Here's the formula:

$$\textbf{Carbon-to-Nitrogen Ratio} = \frac{\text{[Carbon in material A] + [Carbon in material B] + [Carbon in material C] + [...]}}{\text{[Nitrogen in material A] + [Nitrogen in material B] + [Nitrogen in material C] + [...]}}$$

For example, using C:N ratios taken from the "Sample Carbon-to-Nitrogen (C:N) Ratios for Ingredients" table on page 2-25:

1 part newspaper = **170:1**

3 parts grass clippings = 3 x (19:1) = **57:3**

3 parts vegetable trimmings = 3 x (25:1) = **75:3**

2 parts food scraps = 2 x (15:1) = **30:2**

$$\frac{170 + 57 + 75 + 30 = 332 = 37}{1 + 3 + 3 + 2 = 9 = 1} = 37:1$$

Problems arise when the C:N ratio is unbalanced. A compost pile that contains too much nitrogen leaches ammonia into the air, causing the pile to smell bad. Additionally, the oxygen in the compost pile will be rapidly consumed by aerobic bacteria and displaced by the moisture from the greens. Without oxygen, your compost will be very wet and quickly become anaerobic—in other words, stinky and slimy.

Conversely, a pile that is too high in carbon causes decomposer organisms to slow down and temperatures in the compost pile to remain low, therefore causing materials to break down at a much slower rate. A compost recipe that's high in carbon may even appear stagnant since the fast-working bacteria that drive the composting process thrive on moisture and nitrogen.

When in doubt, it's better to err on the side of adding too much carbon. The problems associated with adding too much nitrogen-rich material (odor and pests) are comparatively worse than those associated with adding too much carbon-rich material (slow decomposition rate).

MANAGING YOUR INGREDIENTS

To keep your ingredients balanced and minimize potential problems:

- **Secure your supply.** You'll need a steady and consistent supply of browns and greens to maintain the ideal carbon-to-nitrogen ratio. If you're composting food waste, make sure to secure a supply of browns before you begin to prevent anaerobic conditions and pests. Securing a supply of browns beforehand is not necessary if you are only composting yard trimmings. We'll talk more about managing your supplies of browns and greens in Chapter Four.

  Greens are easily obtained and will primarily come from yard and/or food waste. The best place to store food waste for composting is in your freezer or refrigerator to prevent odor and avoid attracting pests. If this isn't possible, you can store food waste in a closed container anywhere that is convenient but always line the container with paper and cover food waste with a layer of browns to prevent odor.

Storing food scraps in a freezer prevents odor and pests.

AVOID GLOSSY PAPER

Don't compost glossy magazine paper, receipts, or paper dyed bright colors. Heavy metals and other toxins are used in many glosses and dyes, which you don't want in your finished compost. Instead, recycle these kinds of paper.

Outside of cities, browns can be obtained easily during the fall when trees shed their leaves. In cities, however, browns can be difficult to secure. Shredded newspaper might suffice for a smaller composting system, such as a worm bin, but larger systems require a steady supply of sawdust, woodchips, and/or leaves to balance greens. (Ideally, you'll want a mix of different kinds of browns.) If you can, hang on to a bag of fall leaves throughout the year to use as needed.

Some greens such as grasses, plant stems, and flower heads act as greens when they are fresh, but as browns when they dry out.

- **Mix it together.** Thoroughly mix browns and greens before you add them to your compost system so they are equally distributed (think baking: you would mix cake ingredients before setting the mixture to bake). This way, decomposers have access to a balanced diet of both browns and greens, ensuring a quicker decomposition rate. Well-mixed materials also prevent your compost from becoming compacted and soggy. Avoid mixing in worm bins, however—those little guys prefer to do the mixing themselves, without the intervention of human techniques.

MIXING

If you don't mix browns and greens together before adding them to your compost system, you'll create distinct layers that prevent tiny decomposers from easily accessing the balanced diet they need to work quickly. Furthermore, not mixing materials will result in odorous pockets of greens if you dig into the compost pile.

Mixing browns and greens together before you add them into your compost system helps evenly distribute materials, ensuring that decomposer organisms have steady access to a balanced diet, which in turn speeds up the decomposition rate.

- **Turn it.** Continue regularly mixing your recipe after you've added it into your compost system. Composters refer to this as ***turning***. The idea is to flip your pile over, kind of like flipping a pancake. You can turn your compost in many ways, like by rotating a tumbler or using a pitchfork to move your recipe from one location to another (e.g., from one bin or pile location to another). If you are only working with one bin, use a tool such as a long stick or compost crank to redistribute materials inside the bin and create new air channels.

  For the best results, piles should be turned at least once every one to three weeks. The most efficient way to turn your compost is to mix only the part of the pile that still has recognizable pieces of organic materials in it. Leave the finer compost where it is at the bottom of the pile.

Volunteers turn a newly built windrow at Red Hook Community Farm to ensure that all browns and greens are thoroughly mixed together (more on windrows in Chapter 3).

"MIXING" VERSUS "TURNING"

You might hear the terms "mixing" and "turning" used interchangeably among composters. In this manual, we're making a distinction between these terms.

When we refer to mixing, we mean mixing your organic materials *before* they are added to your compost bin or pile. You should try to always mix materials.

By turning, we mean flipping over organic materials *after* they are already in your compost bin or pile. This typically involves moving the compost from one location to another (usually directly next to the original pile or bin). You should turn your compost regularly, ideally once every one to three weeks.

Volunteers at a community compost site in Brooklyn flip an actively composting pile from one bin into another to turn it.

- **Cap your pile.** If you are composting food waste, you should always cover your pile with a substantial layer of browns after you add new materials to your system. This is called ***capping*** your pile.

  Capping helps buffer potential odors produced by food waste, and it helps the pile avoid pests such as flies and rodents. It also insulates your pile and ensures that temperature and moisture are equally distributed throughout, leading to fast, even decomposition.

Every time you add materials to your system, cap your compost with a layer of browns or finished compost to prevent odor and pests. In the photo above, Jeremy Teperman covers newly added food waste with a thick layer of wood chips and dried leaves at the NYC Compost Project's Compost Demonstration Site at Queens Botanical Garden.

Volunteers layer a newly built compost pile with six inches of finished compost at the NYC Compost Project Hosted by Big Reuse's compost site in Queensbridge Park. Capping is critical to the system used at that site, which is called an aerated static pile (we'll learn more about these systems in Chapter 3). As this site is located near residences, capping is also important because it ensures that the piles look neat and do not emit any unpleasant odors.

SMALL GROUP ACTIVITY:
CALCULATE C:N RATIO

Instructors provide sample compost ingredients. Students calculate C:N ratio based on ingredients provided by following the instructions on page 2-25.

2. MOISTURE

Like humans, in addition to food, decomposers need a certain amount of water to survive and thrive. If there's too much or too little moisture in your compost, many decomposers will either die or pack their bags and search for another home. Also, compost that's too moist also runs the risk of becoming anaerobic.

You'll need to manage the moisture level in your compost to make sure it's hospitable to aerobic decomposers, who prefer a moisture content between 45 and 65 percent—about as moist as a wrung out sponge.

If you're composting food waste, fruit and vegetable scraps will provide all or most of the moisture your compost needs. Browns will soak up some of this moisture, helping distribute it evenly throughout your bin or pile.

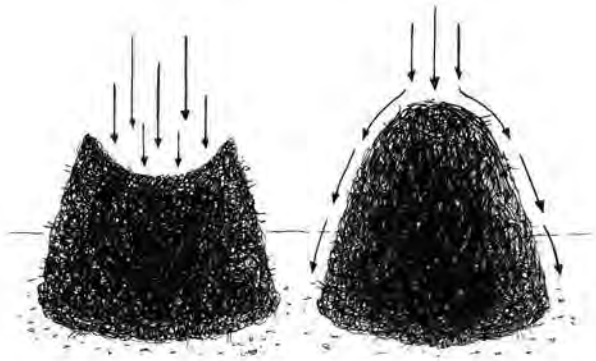
If you are mainly composting leaves and garden trimmings, you can speed decomposition by shredding or chipping them into smaller pieces and keeping the pile moist. You can moisten materials before you add them to your compost bin or pile, and afterward as needed, with a spray bottle, watering can, or hose (depending on the size of your pile). If possible, use non-chlorinated water, as chlorine can harm decomposer organisms.

MANAGING MOISTURE

If your compost is too dry:

- **Add more greens.** Nitrogen-rich materials also tend to be rich in moisture. Therefore, by adding more greens to your recipe, you can add more moisture. Be careful not to add too many greens without thoroughly mixing them into your pile—a pile of wet food scraps on top of a pile of very dry leaves won't result in an evenly moist recipe.
- **Add water.** Use a watering can, hose, sprinkler, or misting system. If the forecast calls for rain, leave the lid of an enclosed bin open until the compost is sufficiently moist. Make sure to mix the compost so water is distributed evenly.
- **Adjust the size of your compost pile.** Piling up your materials will have the same effect as piling up wet laundry—it will keep the compost moist. Piles that are three or four feet wide or high are both large enough to retain moisture and small enough to be penetrated by air at its middle.

- **Adjust the shape of your pile.** If you're composting using an open pile, you can encourage a dry pile to catch more rain water or a wet pile to shed rainwater by changing the shape of the top of your pile to be convex or concave, as shown in the illustration below.



Capture water Shed water

SMALL GROUP ACTIVITY:
MOISTURE TEST

Instructors provide a single sample of compost, or multiple samples of compost with different moisture levels. Use the "Moisture Test" worksheet on page 2-26 to determine the moisture content in the samples of compost.

3. OXYGEN

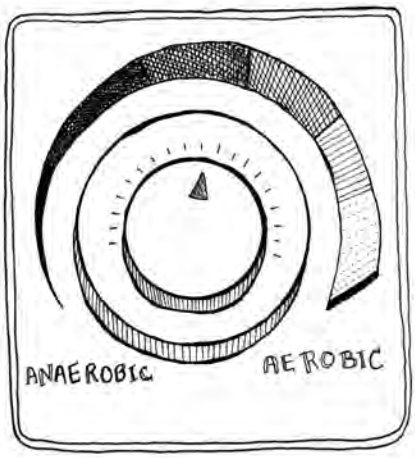
Since you want to attract aerobic decomposers to speed decomposition and minimize odors, you must make sure your compost pile maintains enough oxygen to support them.

Ideally, your compost pile should be at least 10 percent oxygen. (The air we breathe contains approximately 21 percent oxygen.) If oxygen levels drop below 5 percent, your pile will become highly anaerobic.

Oxygen levels fluctuate when it enters a compost pile as materials are added to it, and sometimes as a result of the temperature difference between the inside and outside of the pile.

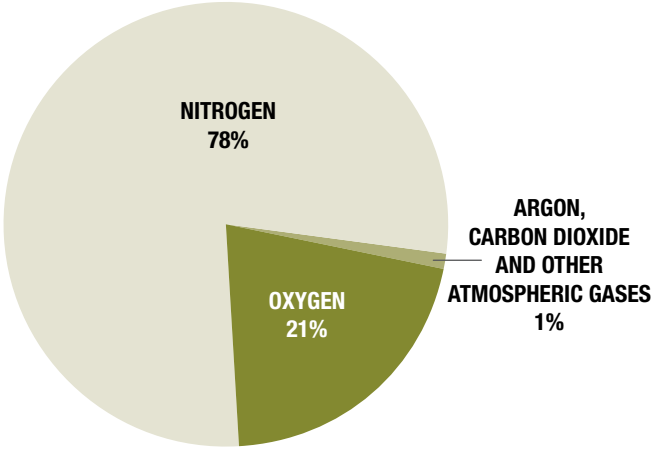
Oxygen reserves can deplete in several ways. Decomposers consume oxygen as they work to break down materials. If your compost pile becomes compacted, oxygen will be pushed out of it. If your pile's moisture content is too high, water can replace oxygen in pore spaces, leading to anaerobic conditions.

The transition between anaerobic and aerobic decomposition is not like a light switch that turns on and off—it's more like



The transition between anaerobic and aerobic decomposition is not like a light switch that turns on and off—it's more like a dimmer. One of your most important responsibilities as a composter is to pay close attention to the availability of oxygen in your pile and make sure that the "dimmer" stays around 10 percent oxygen.

AMBIENT AIR



Did you know the air we breathe is only 21% oxygen? Compost should be at least 10 percent oxygen to maintain aerobic conditions. If oxygen levels drop below 5 percent, compost becomes highly anaerobic.

a dimmer. Anaerobic decomposition still occurs in very wet pockets of a compost pile that has mostly ideal moisture content, but it does not dominate. Mixing your materials helps break up any sneaky anaerobic pockets!

MANAGING OXYGEN

How can we tell if our compost contains enough oxygen? By simply observing it!

If the decomposition rate is satisfactory for your needs and you're not finding putrid odors or pests, the oxygen content is probably fine.

If your compost is smelly and decomposing slowly, it probably doesn't contain enough oxygen. To maintain sufficient oxygen levels, you'll want to make sure your pile is neither compacted nor too wet. To do this, you can:

- **Mix your recipe.** Do this before adding materials to your compost system to help evenly distribute oxygen.
- **Turn your pile.** While turning only adds oxygen to your pile for a short period of time (see sidebar), it does break up and redistribute materials and create new air channels. We recommend turning your recipe every one to three weeks.
- **Add bulking agents.** Bulky carbon-rich materials help create air pockets and prevent compaction. Bulking agents can be wood chips, chopped branches, pinecones, corncobs, or any other bulky, carbon-rich material.

DOES TURNING COMPOST ADD OXYGEN TO THE PILE?

It's a common misconception that turning adds oxygen to a compost recipe.

In fact, studies show that while there might be a temporary increase in oxygen immediately after turning, the amount of oxygen will return to its level prior to turning within minutes.

But this doesn't mean that turning isn't important! It has huge benefits. It redistributes materials so that decomposers can better access them. Materials at the edges of a pile will take long to break down; turning compost will push materials at the edge to the center of a pile where there are more decomposers.

Turning also creates new air pathways, breaks up pockets of anaerobic decomposition, and redistributes moisture.

- **Add dry, absorbent materials.** Such as wood shavings, newspapers, or even finished compost.
- **Expose more of your recipe's surface area to the air.** This follows the same principle as hanging up wet laundry or putting it in the clothes dryer as opposed to leaving it piled in a basket. Keep in mind that spreading out wet food may attract pests and generate odors. To prevent this, keep food scraps covered with a few inches of browns and use a bulking agent to increase air circulation.
- **Install an aeration system.** There are a variety of aeration systems that composters can use to help oxygen better reach the insides of their compost heaps. Some methods are as simple are installing perforated tubes. Others use more complex methods that involve fans and systems of perforated pipes that "force" air into the recipe, which can significantly speed up decomposition and eliminate the need to manually turn piles. We'll talk more about aeration systems in Chapter 3.

If you've mastered the basics and want to speed your compost's decomposition rate by adjusting your recipe to contain more precise oxygen content, you can conduct a bulk density test. ***Bulk density*** is a measure of mass per unit of volume—in our case, pounds per cubic yard. If you know your pile's bulk density, you can determine your pile's porosity, or non-solid space, due to their inverse relationship: the lower the bulk density of your pile, the higher the porosity (and therefore oxygen) content.

You can calculate the bulk density of your compost pile using the "Bulk Density & Free Air Space Test."

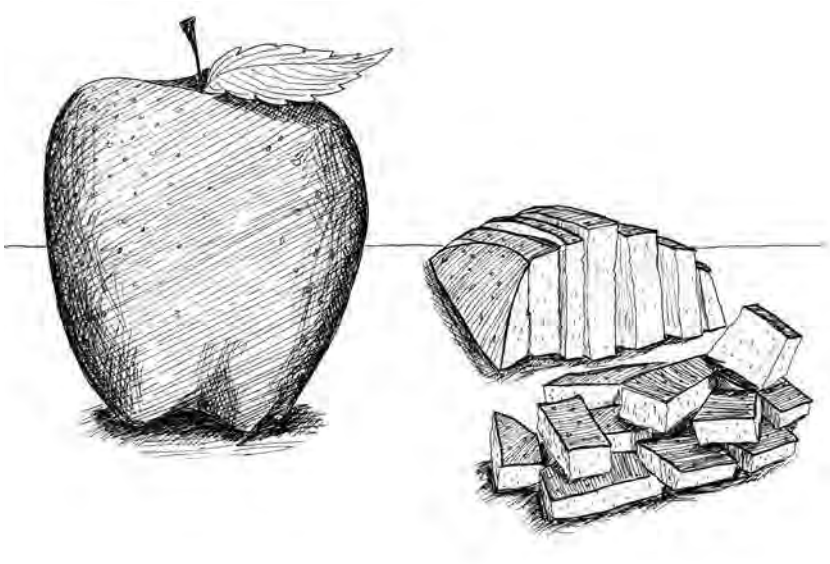
SMALL GROUP ACTIVITY:

CALCULATE BULK DENSITY & FREE AIR SPACE

At a compost site, students work in small groups to calculate the bulk density and free air space of a compost recipe by completing the "Bulk Density & Free Air Space Test" on page 2-27.

4. SIZE OF INGREDIENTS

You went apple picking and couldn't use all of the apples. They went bad, so you tossed them into your compost pile. Three weeks later, you notice they are still largely intact. Why? Because you didn't chop them up!



Breaking up materials before you add them to your compost system increases the surface area of particles, or the total area of the pile's faces or curved surfaces. Creating more surface area makes food more readily available to decomposers and dramatically increases the decomposition rate. Picture a melting block of ice: a large block of ice melts slowly, but when broken up into smaller pieces the ice melts quicker.

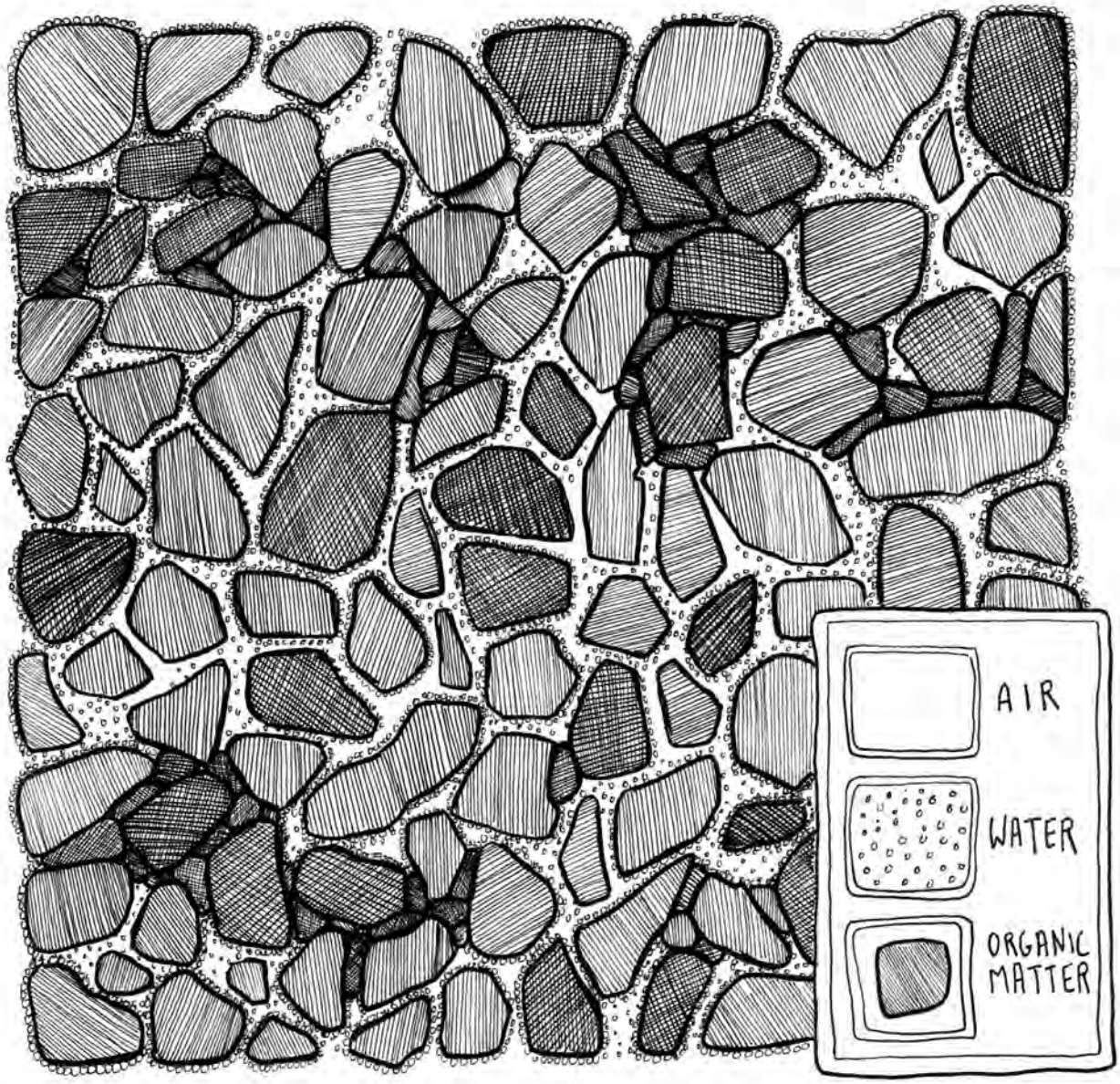
However, as the particle sizes of what you add to your compost pile decreases, so do the pore spaces between those particles. Imagine, for example, a pile of branches: Chipping branches to produce wood chips increases surface area and decreases the size of the pile while also decreasing the pore spaces within it. If you reduce the size of the woodchips even further by shredding them into sawdust, you've further increased the surface area, but the pore spaces between the particles decrease even more. Ideally, you want to incorporate materials of diverse shape and size and moisture content in your compost recipe to avoid compaction and anaerobic conditions.

MANAGING INGREDIENT SIZE

Here are some tools you can use to chop it up! (We'll discuss tools in more detail in Chapter 3.)

- Your hands are great tools for shredding, tearing, or breaking materials into smaller pieces.

POROSITY



When developing your compost recipe, you will not only need to consider the types of ingredients that you are using. You will also need to manage their size and shape, and ultimately the spaces created between materials. These pore spaces create channels that distribute moisture and air throughout your compost pile. ***Porosity*** is the measure of how much pore space there is in your pile. You can control porosity by altering the size of your ingredients.

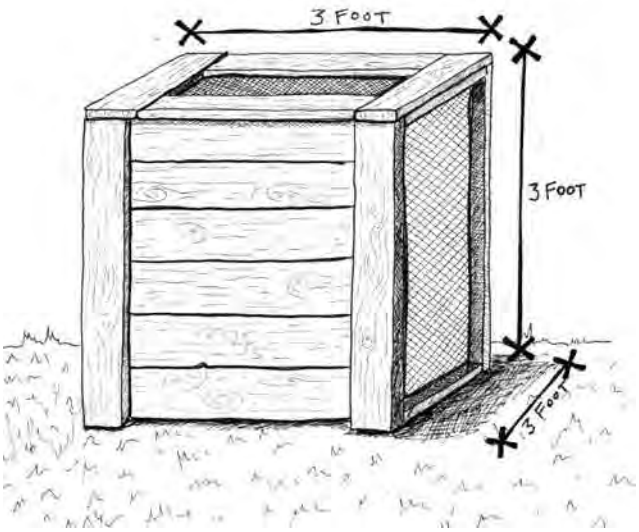
- Running a mulch mower over a pile of leaves will help you shred them up before adding to your compost system.
- The sharp edges of shovels, edgers, garden shears, or scissors work great for chopping greens like fresh weeds and food scraps.
- Loppers, clippers, chippers, or shredders can break down sticks, branches, or other woody materials.

5. SIZE & SHAPE OF BIN OR PILE

Just as the size of the materials you are composting matters, the size—and shape—of the bin or compost pile itself will affect decomposition.

Smaller bins or piles allow for greater airflow, particularly at the center of the compost, since there are fewer materials compacted together. It's much easier to manage materials that have high bulk density which are prone to compaction, such as manures and food scraps, in smaller bins or piles.

Larger bins or piles are better at retaining heat. Bins or piles of one cubic yard (three feet x three feet x three feet) or larger can retain high temperatures even during the coldest NYC winters. These piles are more difficult to maintain and monitor, however, because their large size will cause significant compaction in the center and bottom of the pile. Adding bulking agents, like wood chips, can greatly help with compaction.



The internal temperature of compost in bins that are at least one cubic yard can reach over 140°F, even in the coldest months of winter!

Piles can be shaped to increase or decrease water capture. Piles with pointy, prism-like tops will shed more water, while piles with a depression on top it will capture more water (see illustration on page 2-12).

If you are a beginning composter, we recommend starting with a smaller pile and slowly growing your system as you gain experience and a better sense of how to maintain a healthy and well-structured pile.

A small bin like this metal can will not contain enough decomposer organisms to generate a lot of heat, so decomposition will likely be slower.

Larger bins contain enough decomposers to generate enough heat to speed the decomposition rate and kill potentially harmful pathogens in compost.

Very large piles, like this aerated static pile system (viewed from above) can get too hot! NYC Compost Project staff closely monitor temperatures, and adjust air and moisture to maintain temperatures below 160°F (ideally below 150°F).

TEMPERATURE

When you do your part in creating a healthy compost pile, the decomposers do theirs. As microorganisms work to break apart organic materials and reproduce, they generate heat inside the compost pile. In larger piles, the internal temperature can reach up to 160°F! This heat can be retained in the pile, lost to the surrounding air, or cooled by moisture.

A compost piles releases steam in winter.

The temperature of compost piles fluctuates throughout the year, as well as during different stages of the decomposition cycle. As temperatures change and different materials become available, the populations of various decomposers grow and shrink. Some decomposers work best in cold, winter temperatures. Most worms prefer moderate temperatures, like people. The most active decomposers in an outdoor bin like it much hotter at 104°F or more.

THERMOPHILIC COMPOSTING

Compost piles that reach temperatures above 104°F attract heat-loving decomposers. These decomposers are composting superstars—they're fast-acting and able to break down tougher materials like fats, proteins, and complex carbohydrates, thus promoting rapid decomposition. When these decomposers take charge of the pile, ***thermophilic composting*** or "hot composting" is happening.

Larger composting systems, such as windrows and bins that are at least one cubic yard in size, have the ability to reach thermophilic temperatures. Smaller composting systems, such as indoor worm bins, do not.

Thermophilic temperatures are high enough to kill weed seeds and pathogens (disease-causing organisms) which are harmful to plants, animals, and humans.

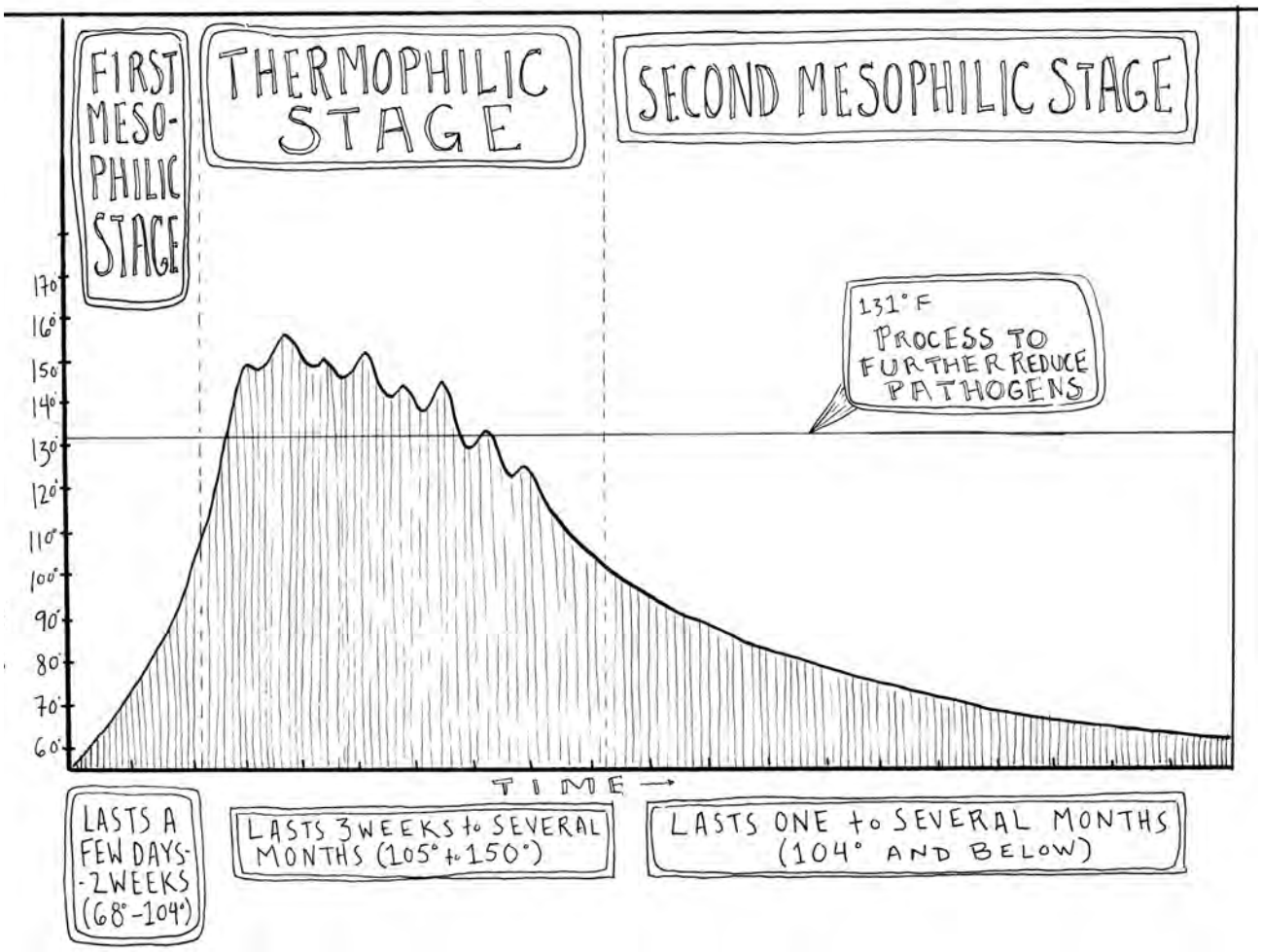
To test if the conditions of your compost pile are warm enough to favor thermophilic decomposers, take your pile's temperature using a compost thermometer. Map the progress of thermophilic composting by taking periodic temperature measurements and charting a "temperature profile."

One kind of compost thermometer.

To use a compost thermometer, simply push its metal pole into the center of your compost and read its temperature.

Even during snowy winters, the center of a compost pile can retain temperatures above 100 degrees Fahrenheit.

THERMOPHILIC COMPOSTING



PROCESSES TO FURTHER REDUCE PATHOGENS (PFRP)

Composters who manage large thermophilic systems that process items such as meat and dairy follow a set of standards called Processes to Further Reduce Pathogens (PFRP). This ensures that pathogens are adequately suppressed.

PFRP refers to the time and temperature requirements to assure pathogen reduction. Home and community composters working with only plant-based kitchen scraps or garden trimmings generally do not need to follow PFRP.

However, if you plan to grow a composting program, it's important to monitor your compost regularly and incorporate best management practices into your work so you can produce high quality compost for your community.

TROUBLESHOOTING

The primary problems associated with composting—odor, pests, and slow decomposition—can be prevented by effectively managing the Five Factors of Composting discussed earlier in this chapter. However, if you do encounter any of these problems, here are some troubleshooting guidelines.

ODOR

Too many nitrogen-rich materials (greens) in a compost recipe can cause it to become smelly due to excess moisture and lack of sufficient air, leading to anaerobic conditions. To solve this problem add more dry browns, such as autumn leaves, wood chips, or newspaper, and turn the recipe frequently. If you're composting in bins, make sure the bin has a way to drain excess moisture (drill drainage holes in bottom of bin if needed) and leave the lid off periodically to allow for more air flow.

If you only encounter odors in some parts of your compost while other parts seem to be dry and decomposing slowly, it might mean that your greens and browns may not be adequately mixed. Mix your greens and browns before adding them to your compost pile to help ensure materials are spread out evenly. Also make sure to turn your recipe regularly, ideally every one to three weeks.

Record additional troubleshooting ideas related to odor from your instructors and classmates here:

1. _____

2. _____

3. _____

PESTS

Food waste can attract both insect pests, such as fruit flies, and mammal pests, such as rodents. To avoid pests:

- Make sure your recipe's C:N ratio is balanced.
- Make sure you cap your pile with a thick layer of carbon-rich material if composting with food scraps.
- Consider composting in enclosed bins.
- If fruit flies are a problem in indoor worm bins, see Chapter 3 for guidance.

Record additional troubleshooting ideas related to pests from your instructors and classmates here:

1. _____

2. _____

3. _____

SLOW DECOMPOSITION

Some composters are content to wait a year or more for finished compost. Others however, need to produce compost quickly so they can use it in their gardens or process a large quantity of organic waste. If you notice that your compost is decomposing slowly, you'll want to revisit the Five Factors of Composting to make sure they are in balance.

Remember, for speedy decomposition you'll want a carbon-to-nitrogen ratio that's between 25:1 and 40:1; approximately 45-65 percent moisture content; approximately 10 percent oxygen content; materials that are variously sized with a large surface area; and a larger pile that can reach thermophilic temperatures.

You can determine a lot about whether your pile is balanced by simply observing it with your senses: look at, touch, and smell the compost to see if anything seems unbalanced.

For a more accurate assessment of your compost, use the tests provided at the back of this chapter.

Record additional troubleshooting ideas related to slow decomposition from your instructors and classmates here:

1. _____

2. _____

3. _____

LARGE GROUP ACTIVITY:

TROUBLESHOOTING SCENARIOS

Students work together to devise solutions for the composting issues presented on page 2-30.

CALCULATE CARBON-TO-NITROGEN RATIO

To calculate a recipe's carbon-to-nitrogen (C:N) ratio, you can use this formula or use an online compost recipe calculator such as the one created by Green Mountain Technology: **http://compostingtechnology.com/resources/compost-calculator/**.

$$\text{Carbon-to-Nitrogen Ratio} = \frac{[\text{Carbon in material A}] + [\text{Carbon in material B}] + [\text{Carbon in material C}] + [\ldots]}{[\text{Nitrogen in material A}] + [\text{Nitrogen in material B}] + [\text{Nitrogen in material C}] + [\ldots]}$$

SAMPLE CARBON-TO-NITROGEN (C:N) RATIOS FOR INGREDIENTS

Humus	10:1
Food scraps	15:1
Grass clippings	19:1
Vegetable trimmings	25:1
Various leaves	35:1 to 85:1
Corn stalks	60:1
Pine needles	60:1 to 110:1
Straw	80:1
Newspaper	170:1
Douglas fir bark	491:1

Source: Washington State University

For example, using C:N ratios taken from the table to the left, you can calculate the optimum ratio for mixing newspaper, grass clippings, vegetable trimmings, and food scraps.

1 part newspaper = **170:1**

3 parts grass clippings = 3 x (19:1) = **57:3**

3 parts vegetable trimmings = 3 x (25:1) = **75:3**

2 parts food scraps = 2 x (15:1) = **30:2**

$$\frac{170 + 57 + 75 + 30 = 332 = 37}{1 + 3 + 3 + 2 = 9 = 1} = 37:1$$

ACTIVITY: PRACTICE CALCULATING CARBON-TO-NITROGEN RATIOS

STEP 1: In pairs, pick three ingredients that you might compost at your community composting site. If you would like to use ingredients that are not listed on the above table, you can look up their carbon-to-nitrogen ratios online or ask your instructor for guidance.

STEP 2: Work together to experiment with different ratios of each ingredient, and try to figure out what recipe will yield the optimum carbon-to-nitrogen ratio of 30:1.

STEP 3: Present your findings to the class. If you were unable to find an optimal recipe, ask your classmates and instructors for help.

ACTIVITY 2-2

MOISTURE TEST

Below is a simple way to estimate the moisture level in a compost recipe. If your recipe is too wet, your compost recipe can become anaerobic and produce bad smells that attract pests. If your recipe is too dry, decomposition will be slow. It's better to err on the side of being too dry, since slow decomposition tends to be less of a problem than anaerobic conditions.

INSTRUCTIONS:

Squeeze a handful of compost and use the chart below to determine its approximate moisture level.

Observation	Approximate Moisture Content	Implications
Water flows freely out of your hand.	65% or more	Too wet! Compost is likely to become anaerobic.
A few drops of water are visible between your fingers.	60-65%	Acceptable starting point during a dry season, when you expect the pile to dry out relatively quickly.
No water flows through your fingers, but when you open your hand a sheen of moisture is clearly visible.	55-60%	Ideal starting moisture level when you expect the pile to become drier.
No sheen is visible and a ball of compost remains in your hand. If you tap the ball gently, it stays intact.	50-55%	Good maintenance moisture level.
A ball of compost forms, but breaks apart when tapped.	45-50%	Good starting point for the final (curing) stage of the composting process. Allow your compost to dry out a bit to make it easier to sift.
The compost does not remain in a ball after you open your hand.	40-45%	Good starting point for the wet season, as the compost pile will be able to absorb additional moisture. This is also a good moisture level for the end of the curing phase.
No ball forms and a dry, talcum-like feeling remains on your hand after discarding the material.	Less than 40%	Compost is too dry. Decomposition will be slow.

Source: USCC training program

BULK DENSITY & FREE AIR SPACE TEST

By measuring a compost recipe's bulk density using the test below, we can determine the amount of pore space available to accommodate oxygen. Bulk density is a measure of mass per unit of volume—in our case, pounds per cubic yard. If you know your pile's bulk density, you can determine your pile's porosity, or non-solid space, because bulk density and porosity have an inverse relationship: the lower the bulk density of your pile, the higher the porosity (and therefore oxygen) content.

MATERIALS:

- Five gallon bucket
- Scale
- Sample of compost recipe

INSTRUCTIONS:

1. Weigh empty bucket and record its weight.
2. Fill bucket about one third full with the compost that you would like to test.
3. Raise bucket six inches above a firm surface (such as asphalt or concrete) and drop it. Repeat this step 10 times.
4. Fill bucket about two-thirds full with additional compost.
5. Raise the bucket six inches above the firm surface and drop it 10 times.
6. Fill bucket to the top (so that it is five-gallons full).
7. Raise bucket six inches above surface and drop it 10 times.
8. Refill bucket to five-gallon line and do not drop it.
9. Weigh the bucket including the compost inside it.
10. Record weight and complete calculations below to find the bulk density.

A.	Weight of bucket with material (lbs):	
B.	Weight of empty bucket (lbs):	
C.	Weight of material [line A minus line B]:	
D.	Convert to pounds per cubic yard by multiplying weight of material by 40 [line C times 40]. This is your recipe's bulk density:	
Results:	Ideal bulk density is between 800 and 1,000 pounds per cubic yard (lb/y^3). If your bulk density falls below 800 lb/y^3, your recipe likely is too porous and decomposition will be slow—chop or shred materials into smaller sizes to decrease pore space. If your bulk density is above 1,000 lb/y^3, your recipe is likely not porous enough and is supporting anaerobic conditions—add bulking agents to increase pore space.	

To determine an even more precise measure of oxygen in your pile, you can use the result of your bulk density test to calculate the amount of free air space (FAS) in your compost pile.

MATERIALS:

- Same bucket full of material from bulk density test
- Water
- Scale

INSTRUCTIONS:

1. Place bucket full of material on level ground.
2. Fill bucket with water completely, but without overflowing.
3. Weigh the filled bucket. Be careful! Bucket will be very heavy.
4. Record weight and complete calculations below.

E.	Weight of bucket with material and water:	
F.	Weight of bucket with material only [result of bulk density test, line D]:	
G.	Weight of water [line E minus line F]:	
H.	Calculate percentage of free air space by multiplying weight of water by 2.4 [line G times 2.4]	
Results:	**Ideal free air space is between 55-65%.** Less than 40% can indicate compaction and/or anaerobic conditions.	

RECIPE GUIDELINES

This table provides the reasonable and ideal ranges for three out of the five factors of composting described in this chapter. C:N ranges are the target ranges for your carbon-to-nitrogen ratio. Moisture ranges refer to how wet your compost pile should be. Oxygen ranges are listed, but because you cannot physically add oxygen to your pile, composters use bulk density and free air space measures to ensure an appropriate amount of oxygen is able to flow through your pile. All of these factors are described in detail earlier in this Chapter.

	Reasonable Range	Ideal Range
C:N	25:1 – 60:1	25:1 – 40:1
Moisture	40-65%	50-60%
Oxygen	Greater than 5%	Greater than 10%
Bulk Density	Less than 1200 pounds per cubic yard	800-1000 pounds per cubic yard
Free Air Space	40-60%	50-60%

ACTIVITY 2-4

FIX IT! TROUBLESHOOT COMPOSTING ISSUES

What are some solutions for fixing the compost problems below? Work in small groups or as a large group to address the issues.

1. Your garden hosted a Pumpkin Smash event in partnership with the NYC Compost Project. During this event, neighbors brought you lots of jack-o-lanterns and decorative gourds. Your fellow gardeners threw them directly into your compost bin. Three weeks later, you looked in the bin to find the jack-o-lanterns nearly whole, still grinning at you. What can you do to speed up decomposition?

2. You manage a compost site at a school garden, and primarily compost in plastic bins. One day you arrive at the site and open a bin to find that your compost is swarming with fruit flies. (You are panicked because the principal has a serious dislike of flies and you are worried the compost program will be shut down.) What can you do to quickly reduce the number of flies (and calm the principal)?

3. You manage a compost system in a community garden and host monthly volunteer workdays during which you work together to turn the compost piles from one bin to the next. During one workday, as you start to turn the compost, you notice the first few inches of your pile smell like ammonia. You continue flipping the pile and find that the next few inches are very dry, and the compostable paper plates that you put in the bin a couple weeks ago are still completely whole. What went wrong? How can you correct this issue and make sure your volunteers don't leave with bad feelings about composting?

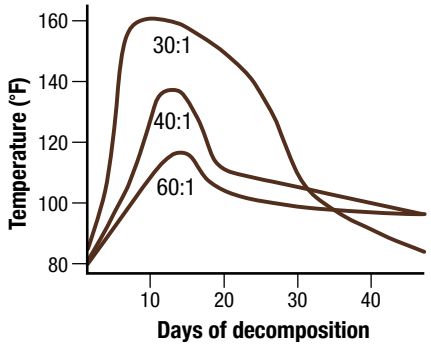
4. You and your fellow community garden members pile garden trimmings at the back of your garden in wire bins. Members are instructed to carefully place materials in the bins, but are not required to do anything else. At a garden meeting, members complain that there isn't enough compost because the process is too slow. How can you help your garden make compost more quickly?

TEMPERATURE CURVES

Take a closer look at how carbon-to-nitrogen ratios, size of ingredients, and size of pile affect temperature and decomposition rate.

1. This graph compares three compost recipes that have different carbon-to-nitrogen (C:N) ratios. Based on the graph, explain how C:N ratios affect temperature and decomposition rate.

EFFECTS OF CARBON-TO-NITROGEN RATIO ON COMPOSTING



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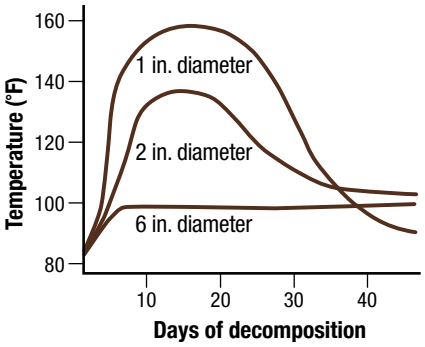
2. This graph compares three different compost recipes in which the ingredients have been chopped or shredded to different sizes. Based on the graph, explain how the size of ingredients affect temperature and decomposition rate.

EFFECTS OF INGREDIENT SIZE ON COMPOSTING



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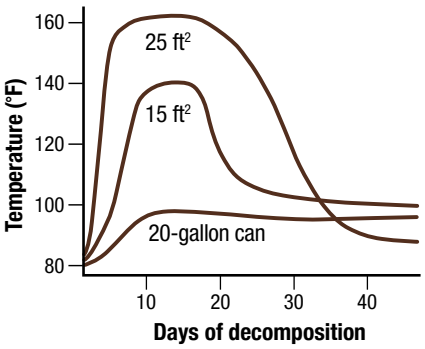
3. This graph compares three compost piles that vary in size. Based on the graph, explain how pile size affects temperature and decomposition rate.

EFFECTS OF PILE SIZE ON COMPOSTING



CHAPTER 3

COMPOST SYSTEMS & TOOLS

LEARNING OBJECTIVES

- Identify a variety of composting systems
- Identify useful composting tools

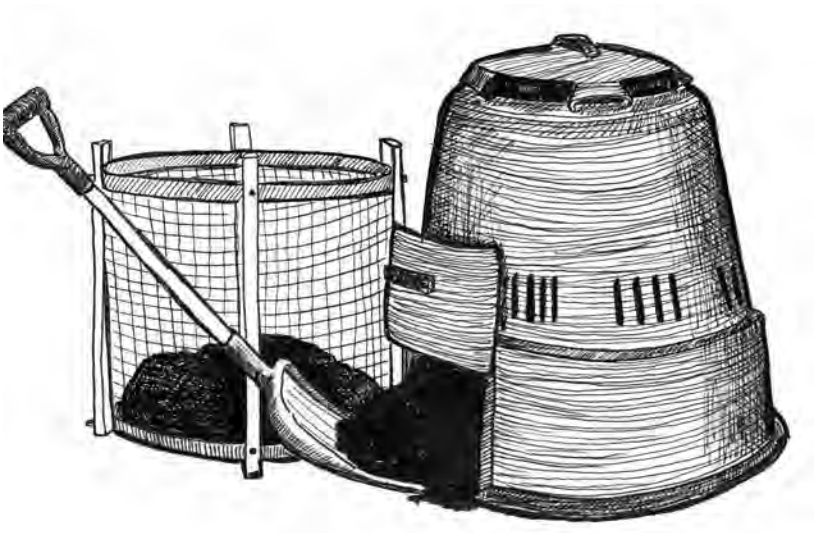
SUGGESTED ACTIVITIES

- How to Build a Windrow (page 3-16)
- How to Build a Sheet Compost Bed (page 3-19)
- Tour NYC Community Compost Sites (page 3-23)
- Compost System Match-Up (page 3-31)
- Build a 3-Bin Compost System (page 3-33)
- Make & Care for a Worm Bin (page 3-35)

COMPOST SYSTEMS

When composters refer to their ***compost system***, they are talking about the types of bins or piles they use to compost organic waste.

The kind of system you choose to use will depend on many factors: your composting goals, your community's needs, the constraints of your compost site, the amount of time you have to devote to composting, the number of people involved with a compost site, your budget, and so on. Understanding the different compost systems available to you will help you determine which might be best for your compost site.



A compost system is where organic waste is contained as it decomposes.

Remember, no matter which kind of compost system you're using, you'll rely on the Five Factors of Composting we discussed in Chapter Two to manage the decomposition process and to prevent pests and odors.

The most important things to consider when choosing a compost system are:

- the amount of organic material you plan on composting;
- the amount of space available; and
- the amount of time you and the other folks you'll be composting with can contribute to maintaining the system.

In this section, we'll review the different kinds of bins and piles that are suitable for urban composting.

If you're composting indoors, the system most suitable will be a worm bin. If you're composting outdoors, you have many options but in essence there are two basic ways you can go about it: using bins or using piles.

If you want to learn more about a particular system's benefits and challenges, your course instructors can connect you with community composters in NYC that have experience using those systems.

There are other systems not described in this manual that you might want to learn more about after you have mastered the basics. You might even be inspired to devise your own one day!

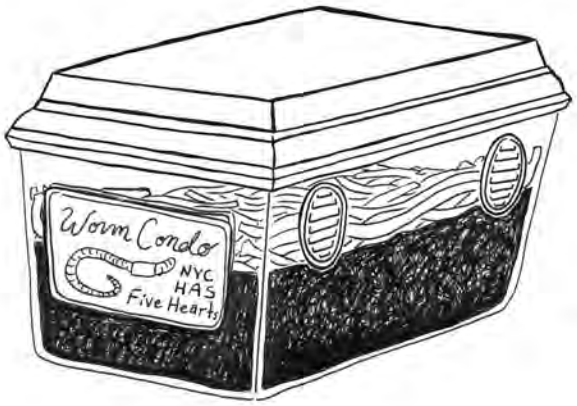
BINS

Here, we'll review different kinds of bins you can use for composting.

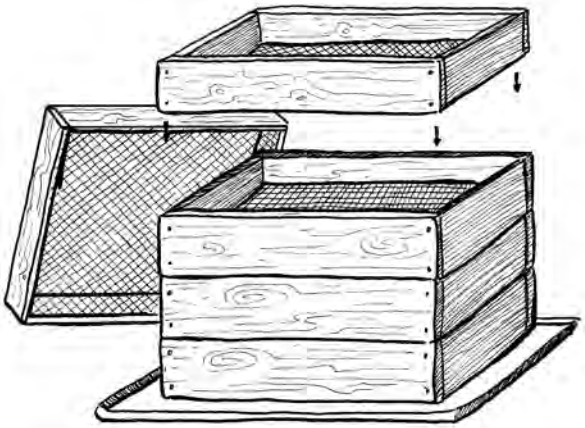
WORM BIN

A ***worm bin*** is the only system suitable for composting indoors. Worm bins are easy to maintain and generate high-quality ***vermicompost***, which plants love. They are great to use at home, or in classrooms as an educational tool (kids love worms!). Worm bins are well-suited to New York's high

Low-cost compost bins and tools are available through the NYC Compost Project. See page 3-30 or visit **nyc.gov/compostproject** for purchasing information.



You can make a worm bin yourself using any kind of plastic container with a lid. See the Make & Care for a Worm Bin activity on page 3-35 for instructions on how to build a simple worm bin. The guide also explains how to purchase, feed, and care for worms, as well as how to troubleshoot any problems that might arise.



You could make a "stacking" worm bin using wood and hardware cloth. Worm bins that have stackable parts eliminate a need for sorting out the worms when your compost is finished. When you start feeding your worms in a new layer, the worms will move up through the hardware cloth. Eventually, they will all leave the layers below.

Red wiggler worms and vermicompost.

Adding food scraps to a worm bin.

population density and tight living spaces because they allow people to compost in small areas, such as under sinks and inside closets. They require some time and attention to ensure that the worms have access to the food, water, air, and shelter they need to survive, thrive, and multiply.

If you want to compost using a worm bin, you'll need a specific kind of worm called ***red wigglers***, or *Eisenia fetida*. (When ordering worms from a supplier, use the Latin name *Eisenia fetida*).

Red wigglers are particularly well suited to composting because they are prolific, thrive in habitats that contain a large amount of organic matter, can tolerate a wide range of temperatures and moisture conditions, and can be readily handled. Unlike red wigglers, common garden worms will not survive in a worm bin.

A red wiggler processes half its own weight in food scraps every day, meaning that one pound of worms will process half a pound of food scraps per day, and three-and-a-half pounds per week.

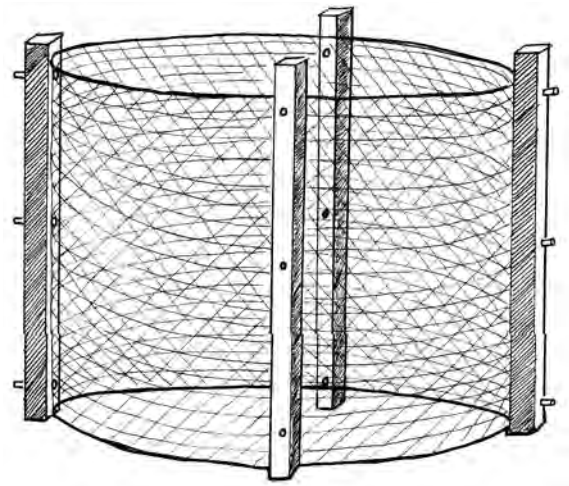
You can make a worm bin using a few basic items and tools. Check out the NYC Compost Project's guide to building and maintaining a worm bin at the end of this chapter on page 3-35.

There's also variety of worm bins you could purchase from retailers. These bins can cost more than making your own. If you'd like to purchase a ready-made worm bin, a quick internet search will yield several results. Or, ask your course instructor for suggestions.

Some composters have built larger scale, outdoor vermi-composting systems. There are a variety of styles of outdoor worm bins used in our northeast climate, from simple wooden boxes to more complex vermicompost bins. It can be challenging to keep the bin above freezing temperatures in the winter and cool in the summer. To keep outdoor worm bins warm in winter, some composters use simple heating or insulation systems. To keep bins cool during the summer, you'll want to make sure decomposer organisms aren't generating too much heat by either slowly adding greens in thin layers, or composting the material in another kind of outdoor bin for several weeks before adding it to a worm bin.

Maggie Cheney, an urban farmer, checks the temperature of an outdoor vermicomposting system at Bushwick Campus Farm in Brooklyn.

Big Reuse's Astoria center is home to NYC's largest vermicomposting system.



You can make a wire bin using hardware cloth or chicken wire from a garden supply, hardware, or home improvement store.

WIRE BINS

Wire bins are perhaps the simplest. You can build them from chicken wire, which can be purchased at hardware or garden stores. Supports aren't necessary, but can help keep the bin's shape during strong rains and winds, or if you're adding heavier materials to it.

Urban composters often use wire bins for composting leaves, yard trimmings, or garden trimmings. They can be used for composting food waste as well, but require extra careful management of the Five Factors of Composting (see Chapter 2) to prevent pests and odor since they are not fully enclosed.

Wire bins are great for storing browns until you're ready to mix them with food waste in an enclosed bin or pile. Many composters also use wire bins to cure compost.

Wire bins are a great way to store fall leaves and maintain a steady supply of browns throughout the year. To maximize space in your wire bin, consider shredding leaves.

WOOD BINS

Wood bins are popular among composters for their durability and functionality. They are also visually pleasing and can be made from salvaged materials.

If you want to build a wood bin, make sure to avoid using pressure-treated lumber—it's loaded with harmful chemicals that will leach into your compost (see sidebar). Also, make sure that one or more sides of the bin can open or be removed so that compost can easily be shoveled out of it—without this feature, it will be very difficult to remove compost from a wood bin.

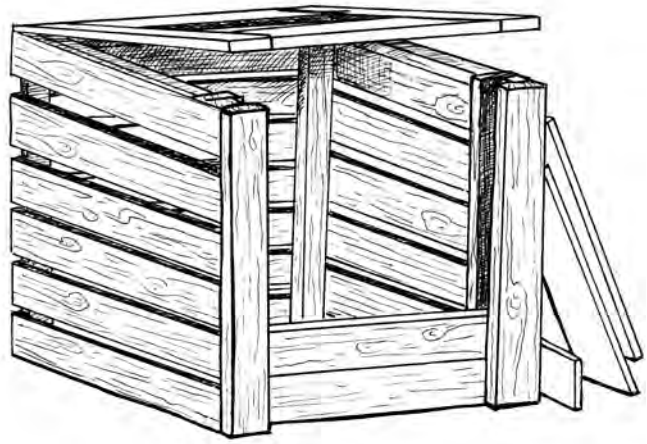
If composting food waste, we recommend lining all sides of wood bins with ½-inch gauge hardware cloth to ensure that rodents or other pests cannot access your bin. You can purchase hardware cloth at most hardware or home improvement stores. Make sure to wear gloves and use wire cutters for safely cutting hardware cloth.

If you're interested in building a compost system using wood bins, check out the NYC Compost Project's guide to building a wood three-bin system at the end of this chapter on page 3-33.

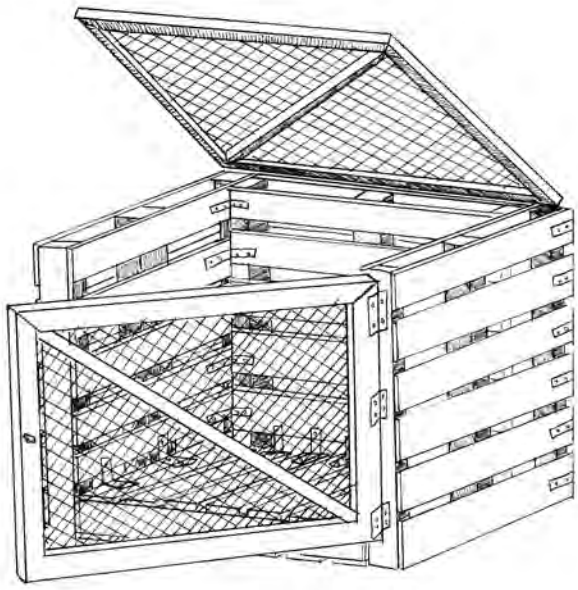
PRESSURE-TREATED LUMBER: AVOID IT!

Pressure-treated lumber is wood that's been infused with chemical preservatives to help prevent decay and repel insects. These chemicals can leach into compost, so avoid using pressure-treated lumber to build a compost bin, and never add wood chips or wood shavings that come from pressure-treated lumber to your compost system.

How can you tell if wood's been pressure treated? If you're purchasing new wood, retailers should label whether or not it's pressure-treated. If using reclaimed lumber, ask the person who's supplying the lumber if it's been treated. New pressure-treated lumber has a greenish tint, but this tint fades as the wood ages so it's not always a reliable indicator. Also, if the wood has been outdoors several years and hasn't decayed significantly, it's likely pressure-treated. Always err on the side of caution: If you can't tell for sure, don't use it.



Wood bins should always be built so that one side opens or can be removed. This enables composters to easily shovel material out of the bin.



You can build a wood bin using shipping pallets. These bins are relatively easy to make—half the construction is already done for you! Make sure one side can open or be taken off so you can shovel out material.

This compost system is composed of several wood bins with removable front planks and lids that can be propped open. Numbering bins that are part of a multi-bin system helps with record keeping and directing volunteers.

PEST PREVENTION

Some compost bins are more enclosed than others, offering extra protection again pests. You could decide to line a bin with hardware cloth to prevent pests from chewing or crawling through cracks. However, no matter what compost system you use, the best way to prevent pests is to locate the bin in a central, highly-trafficked location and to check on the bin regularly. The more human activity around the bin, the less likely pests, like rats and mice, will want to hang around. As discussed in Chapter 2, carefully managing the Five Factors of Composting will also help prevent pests.

Master Composter Dylan Oakley and NYC Compost Project Hosted by Brooklyn Botanic Garden's Emily Bell Dinan lining a wood bin with hardware cloth to prevent pests.

WANT TO BUILD A WOODEN COMPOST BIN? THE NYC COMPOST PROJECT CAN HELP!

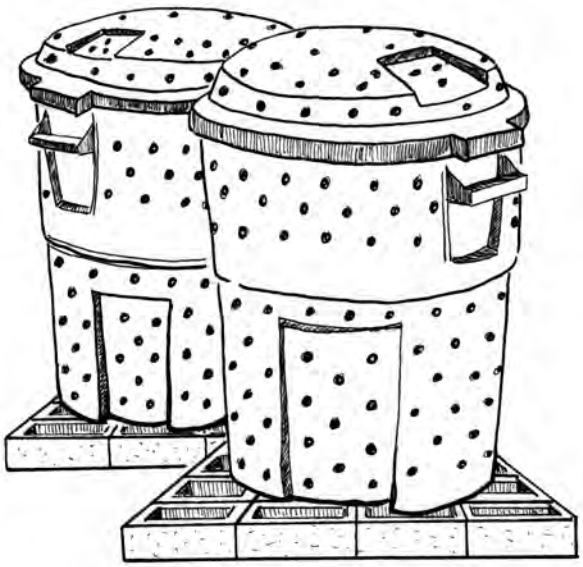
The NYC Compost Project helps community composters build bins for their sites. We can also help you organize volunteer bin-building days and recruit volunteers.

PLASTIC BINS

Plastic compost bins can be any kind of large plastic container, such as standard household trash or recycling bins. You can make them yourself by drilling plenty of holes into all sides of a plastic container, including the bottom to let leachate drain, as well as the lid. You could also purchase a variety of plastic bins from retailers.

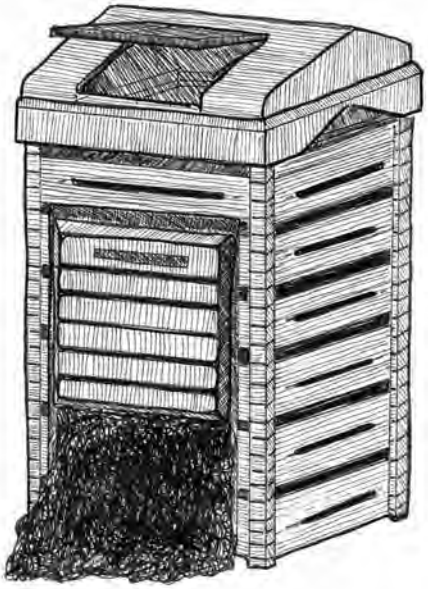
Enclosed plastic bins can last a long time and offer extra protection from pests. But remember, the best way to prevent pests (and odor) is to locate the bin in a highly trafficked area and to carefully manage the Five Factors of Composting we discussed in Chapter 2.

Compost in plastic bins can easily become too wet due to lack of airflow, so you'll want to make sure your recipe contains enough browns to absorb excess moisture.



You can make plastic compost bins yourself out of any kind of plastic container. Just drill holes into all sides, including the bottom and lid.

NYC Compost Project Hosted by Lower East Side Ecology Center staff members Chloe Bishop and Andrew Hoyles display a multi-bin system that uses Garden Gourmets, a kind of plastic bin available for purchase from retailers.

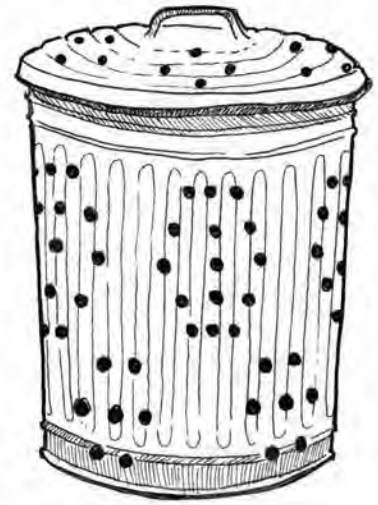


Here are plastic commercial bins that can be purchased through the NYC Compost Project. On the left is an Earth Machine, and on the right a Garden Gourmet. They work similarly: Place organic waste into the top, and open the bottom to remove compost when ready.

Saint Mark's Church, a community compost site in Queens, uses wire bins to store leaves and other yard waste before mixing them with food scraps in an Earth Machine, a kind of plastic bin you can purchase from a retailer.

METAL BINS

You can make a compost bin from any metal bin, such as a trash or recycling can, by drilling holes into all sides (including the bottom and lid). You can also purchase ready-made metal bins from retailers.



462 Halsey Community Garden purchased ready-made metal compost bins from a retailer. If you're creating a multi-bin system, clear signs help keep the system organized and functioning properly.

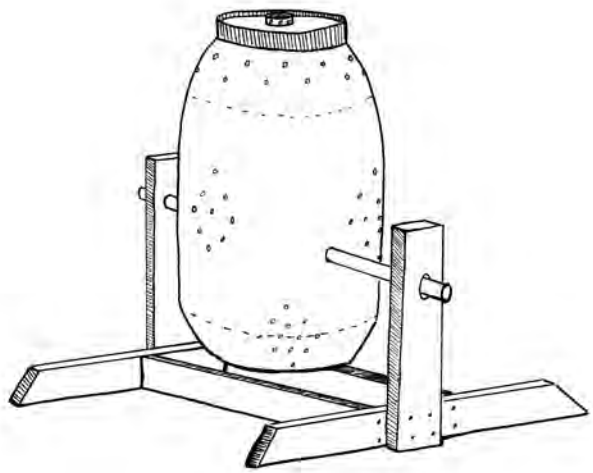
OTHER MATERIALS

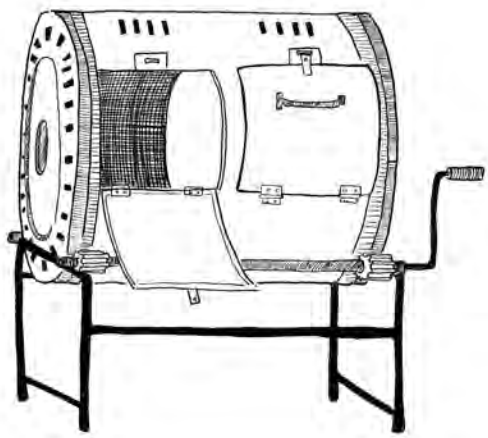
While wire, wood, plastic, and metal are most common, other materials such as concrete blocks or straw bales can be used to build a bin.

Three-sided "bins" made from reclaimed materials like straw bales (left) or concrete blocks (right) can be a great way to store curing compost or browns.

TUMBLERS

Tumblers are compost bins that can be rotated, making it possible to turn, mix, and redistribute recipe ingredients without any additional tools. They can be built at low cost from pickle barrels (commonly used in gardens across NYC) or commercial models can be purchased. They are usually made from plastic or metal and are fully enclosed and elevated off the ground, which deters rodents. It's important to note that as materials accumulate in a tumbler, it can become very heavy and require more than one person's strength to turn.





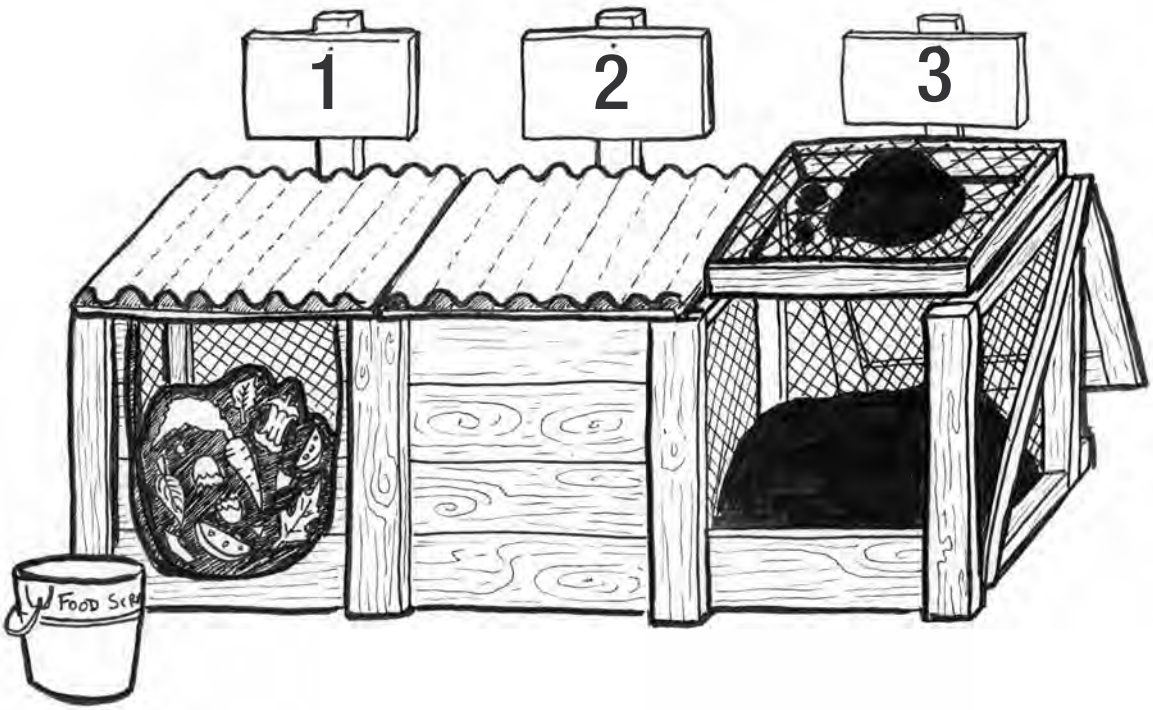
You can repurpose a pickle barrel to make a tumbler (left). Tumblers can also be purchased from a retailer (right).

Plastic tumblers at Compost for Brooklyn, a community compost site in Brooklyn. In this system, the numbers on the tumblers help volunteers and drop-off program participants identify where they should add new food scraps and yard trimmings.

SINGLE BIN VS. MULTI-BIN SYSTEMS

Composters refer to a system that uses just one bin as a “single-bin system,” and a system that uses more than one bin a “multi-bin system.” A single-bin system is simple to maintain and is good for processing a small amount of organic waste.

Using more than one bin lets you process larger amounts of organic waste, and produces a continuous supply of finished compost. If you’re composting with more than one bin, you might want help managing the system because of the amount of waste you’re dealing with, so it’s helpful to have access to a reliable group of volunteers.



Multi-bin systems can be managed in any way that suits your site. Here are two examples:

- Add new greens and browns to the first bin until it is full. When the next round of greens and browns needs to be added, move the contents of the first bin to the second bin, and so on. By the time the materials make it to the third bin of the system, they least resemble their original materials.
- Another way to manage a multi-bin system is to fill one bin completely and turn the materials in the bin until they are fully composted. Each bin is treated as its own individual system.

PILES

Using a bin to compost has its benefits, such as neatly containing organic waste to help make a compost site orderly and minimizing the risk of pests. However, composting does not need to take place inside of a bin, and composting in open piles has its own benefits. Piles maximize space efficiency and are capable of handling larger volumes of organic waste. Also, some kinds of piles let you "compost in place," meaning you can grow plants directly in the location where you're composting. In this section, we'll go "outside the box" and show you systems that let you compost without a bin.

WINDROWS

Windrows are piles of compost, sometimes up to hundreds of feet long, that are often used on farms or in industrial facilities for large-scale composting. In recent years, windrows have been increasingly found on small urban farms and at community compost sites throughout NYC.

Windrow

These "urban windrows" are usually much shorter in length—generally no more than 25 feet long—and are turned by hand with shovels or small machines. Because they do not require physical structures and can be moved as needed, windrows allow for a more efficient and flexible use of space. Windrows must be at least three feet wide and three feet high to maintain heat inside the pile.

Windrows can compost a much larger quantity of food scraps than bins, but they require much manual labor to maintain. Because they are open piles, they must be managed adeptly to deter pests. The piles require careful construction, strict adherence to the Five Factors of Composting (see Chapter 2), regular turning, and consistent temperature monitoring. If you decide to use this type of system, you'll likely need help regularly from volunteers in your community.

Windrows at Red Hook Community Farm, which are managed by the NYC Compost Project Hosted by Brooklyn Botanic Garden. This system is used to compost food scraps accepted at residential drop-off sites and all of the farm's waste, such as weeds and stalks.

NYC Compost Project Hosted by Earth Matter NY's Marisa DeDominicis and Charlie Bayrer in front of windrows they use to compost tens of thousands of pounds of food waste each month at the Compost Learning Center on Governors Island.

The NYC Compost Project Hosted by Big Reuse uses windrows to cure compost at their site under the Queensborough Bridge in Long Island City.

HOW TO BUILD A WINDROW

1. **Determine your compost recipe.** Windrows require a lot of organic materials mixed in optimum ratios. Identify where your materials will be coming from. Then use an online compost calculator (see Chapter 2) to calculate your recipe.

2. **Recruit volunteers.** Windrows require much regular maintenance. You should be confident that you have enough people willing to help you support this system before deciding to use it. When working with volunteers, make sure drinking water is available—maintaining the system will involve physical labor.

3. **Get tools.** You'll need gloves, buckets, wheelbarrows, shovels, pitchforks, and push brooms to build and manage your windrow.

4. **Build a foundation for the windrow with wood chips.** Use wood chips to build a 6-12 inch high rectangular pad that will serve as the foundation for your initial pile.

Volunteers place the first layer of greens on the wood chip foundation of a windrow at the NYC Compost Project Hosted by Big Reuse.

5. **Add organic materials in layers.** Following the recipe that you have calculated, add browns and greens in layers. If your recipe is one part wood chips and one part leaves for every one part food scraps, you should layer the materials in equal amounts, as if you are building a giant lasagna. To do this, add one 4-8 inch layer of leaves directly on top of the wood chip pad. Then add a 4-8 inch layer of food scraps directly on top of the leaf layer. Next add a 4-8 inch layer of wood chips. Repeat this process until you have used up all of your ingredients, or feedstocks. As you layer the ingredients, you may find large or whole materials. NYC composters sometimes call these "rolly-pollies" because they tend to be heavier and roll off the pile. When you come across these larger scraps, follow the "Rule of Hand"—if an item is larger than your hand, chop it up!

Volunteers add a layer of leaves in a predetermined ratio.

Chop up large materials.

6. **Mix it up.** If you leave the material in layers, the micro-organisms in the greens layer won't have enough access to browns and oxygen; conversely, the microorganisms in the browns layer won't have sufficient access to moisture and nitrogen. This will create some very odorous pockets in between layers that are dry and slow to decompose. Mixing the material will ensure that carbon, nitrogen, moisture, and oxygen are evenly distributed throughout the pile.

   Since you'll be working with a large amount of material, mixing a windrow involves flipping or moving the entire windrow to a new location. One way to do this is to gradually scoop up the entire pile using pitchforks and remake the pile near the original location. As you scoop up materials and relocate them, the layers of browns and greens will mix. You can either move the pile directly to the left or right of the original pile, or forward or backward a few feet (think of it moving like an inchworm).

   The best way to learn how to mix a windrow is to see the process in action! Attend a windrow build. Ask your instructors about volunteer windrow build workdays with the NYC Compost Project.

7. **Cap the pile.** Cover your mix with 6-12 inches of finished compost to prevent odor and pests. Use mulch if you don't have enough finished compost.

NYC Master Composter Chris Bivens monitors the temperature of a windrow.

8. **Clean up and stack your bins to dry.** Wash out and rinse any tools or bins that were used to manage organic waste to prevent flies and other pests or pathogens.

9. **Monitor pile temperature.** When managing large amounts of material, it is very important to track temperatures and achieve PFRP (Processes to Further Reduce Pathogens) standards (see Chapter 2). Make sure the pile reaches and stays above 131 degrees for 15 days and that you turn the pile five times during that period.

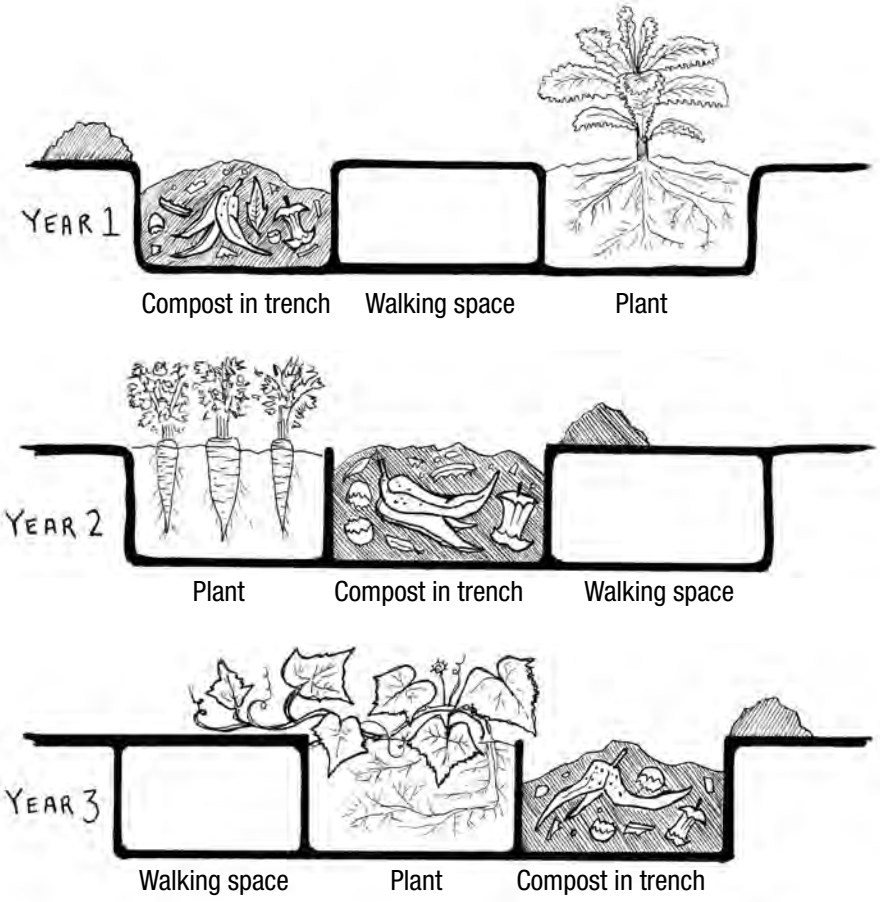
TRENCH COMPOSTING

Trench composting lets you compost directly in the spot you plan to grow food or other plants. It's simple: Dig a trench where you eventually want to plant into, chop and mix browns and greens outside the trench, and then pour your recipe into the trench and cover it with finished compost or top soil.

You can then either immediately plant shallow-rooted plants (such as lettuce) in the top soil layer or, since most plants will have trouble growing in actively composting waste, wait several months for the materials to decompose sufficiently to plant more deep-rooted plants.

You can do this as a one-time soil improvement technique, or you can trench compost in a rotation so you can continuously replenish soil beds, as shown in the image below, which demonstrates a three-year rotation.

In the first year, a gardener would dig a trench and use it to bury organic material. Throughout that year, the material decomposes and becomes humus. In the second year, a gardener would plant seeds or transplants into the area used as a composting trench in year one, then use the next row over to trench compost new organic waste. The pattern repeats in the third year, and starts again in the fourth year.



SHEET COMPOSTING

Sheet composting (also known as lasagna gardening) is a passive composting method that allows you to garden while composting. It involves layering organic material so that it fully decomposes while simultaneously constructing a garden bed. This method allows sites with limited space to create a bed full of compost without building a separate compost area.

To make a sheet compost bed, you will need four times as many browns as greens (C:N ratio of 120:1). Sticking to this approximate ratio will keep your bed from heating up like a normal compost pile would. Put nitrogen-rich materials closer to the bottom of the pile to prevent the top from heating up and causing damage to plants.

A sheet compost bed at Brooklyn College Community Garden. Sheet compost beds can also be built in boxed garden beds.

HOW TO BUILD A SHEET COMPOST BED

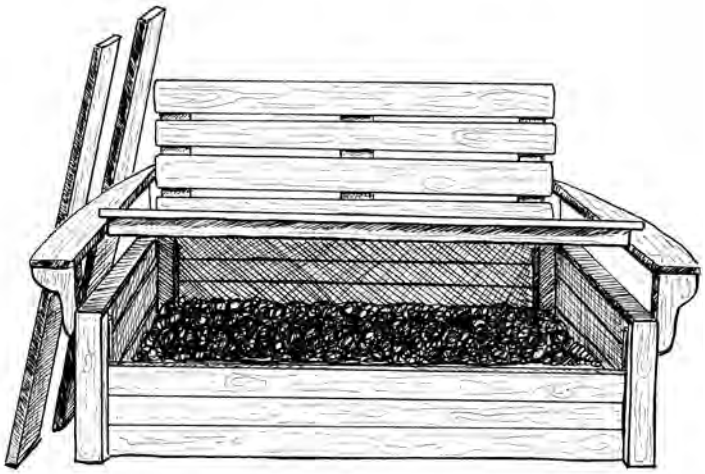
1. **Choose the right location.** Because you'll be planting directly into the sheet compost bed, make sure to choose a location that's suitable for the plants you intend to grow.
2. **Build a foundation.** Cover the area with a layer of cardboard or an inch-thick layer of wet newspaper to prevent weeds or grass from growing into the bed. If you are building on a lawn the cardboard will help to smother the sod, so you don't need to remove it.
3. **Add organic materials in layers.** Layer organic materials in the following order:
   - 4-8 inch layer of shredded leaves or straw
   - 1 or 2 inch layer of finished compost or coconut coir to hold moisture
   - 4 inch layer of food scraps or other nitrogen-rich materials
   - 1 or 2 inches of finished compost or coconut coir

   Water the bed (ideally with non-chlorinated water) after each layer is added to ensure the material is moist. Continue to repeat these layers in the same order until your bed is 18-24 inches high.
4. **Cap the pile.** Cover the pile with a layer of straw, and then a layer of finished compost and/or soil (especially important if you plan to plant in the bed immediately).
5. **Plant!** Sow seeds or transplants directly into the sheet compost bed. Start by planting shallow-rooted crops like lettuces until organic materials have had a couple of months to decompose.

CREATIVE COMPOSTING

There are many other creative ways to compost. Check out some of these interesting methods—perhaps one (or several!) could work great for your site.

Tiered bins let you compost on a steep slope.



Build a bench compost bin to create a multi-use space.

Emily Bell Dinan and NYC Master Composters demonstrate how to build a compost bench at Maker Faire NYC.

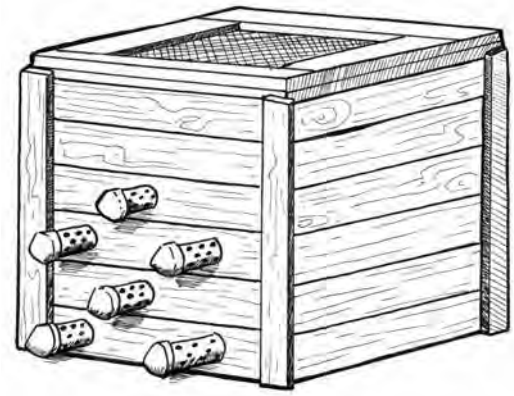
AERATED SYSTEMS

If you're managing a composting system according to the Five Factors of Composting we discussed in Chapter 2, air will naturally flow through your bin or pile. However, even the most carefully built compost pile may develop anaerobic pockets as the decomposer organisms consume oxygen throughout the composting process. Additionally, if you're composting wet materials like food scraps in large piles or windrows, the sheer weight of the materials can create compaction over time at the center of the pile. To minimize compaction and oxygen depletion, some composters choose to add perforated tubes to their systems. Aeration systems generally fall into two categories: ***passive aeration*** and ***forced aeration***.

Passively aerated windrow

PASSIVE AERATION

To increase air flow in your compost pile—particularly near the bottom where compaction is most significant and moisture levels tend to be highest—you can add perforated tubing (tubes that have holes drilled into them). You can purchase tubing from a hardware store, and use a standard drill to create perforations.



Passively aerated bin

You can add perforated tubing to any type of pile of bin. It is easiest to add tubing to a windrow or open pile, as all you need to do is set several rows of tubing across the area where you plan locate the windrow, and build or turn the windrow directly on top of the tubes.

Composters at Castleton Hill Moravian Church Community Garden on Staten Island added a perforated tube into the center of a bin to create a passively aerated system.

Composters at Garden of Union in Brooklyn cut holes into their bins to add horizontal perforated tubing for increased passive aeration.

The easiest way to add a passive aeration tube to a bin is to place the tube vertically at the center of the bin and fill your mixture of ingredients around it. You can also build a passive aeration system into the structure of your plastic, metal, or wood bin. To do this, drill holes into the side of the bin, through which you can slip the tubes. If this is a feature that you want to incorporate into your system, it is best to do so when you first build the system.

FORCED AERATION

Building a forced aeration system—also referred to as an "Aerated Static Pile" (ASP)—can greatly reduce the amount of labor it takes to maintain a composting system. A forced aeration system is very similar to a passive aeration system in that it utilizes perforated tubing running through a compost bin or pile, except it involves using a fan to blow air into the perforated tubes and ultimately into the compost pile.

A major benefit to creating a forced aeration system is that turning your compost is not required! However, because this system involves an electric blower it can be costly and require access to utilities.

Timer used to control how often and for what duration the fan is on.

Fan used to blow air into perforated tubing.

A forced aeration system in a windrow, also known as an aerated static pile, used by the NYC Compost Project Hosted by Big Reuse. The portion of the tube that is sticking out of the pile is not perforated and the end of the piping is capped. This is an important component of the design. The perforated portion of the piping must be fully covered by the pile; otherwise, the fan will expend too much energy and short out the system.

Solar powered forced aeration system in wood bins built by the NYC Compost Project Hosted by Big Reuse at Brooklyn Grange's rooftop farm in Long Island City.

SMALL GROUP ACTIVITY:
COMPOST SYSTEM MATCH-UP

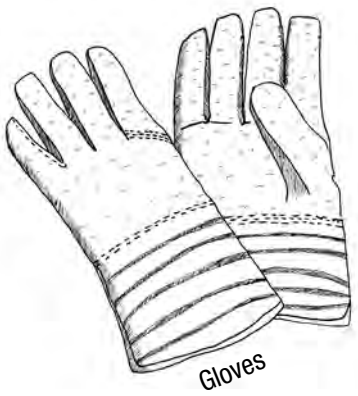
Provide recommendations for suitable compost systems based on the scenarios presented on page 3-31.

LARGE GROUP ACTIVITY:
TOUR NYC COMMUNITY COMPOST SITES

Visit two or three community compost sites in NYC that use different compost systems. Informally interview a site manager or site member about the system. Some questions you might want to ask:

- Why did they choose that specific system?
- What are its benefits? What are its challenges?
- How much compost do they process each month?
- How many people are helping maintain the system? Is it labor intensive?
- How much did it cost to build? To maintain?
- How much time does it take to manage the system?

TOOLS



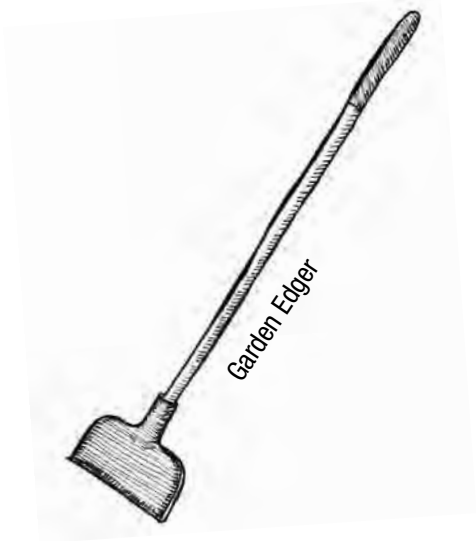
Composting systems can be maintained with basic garden tools. Below is a list of tools that are commonly used by backyard and community composters. At a community site, it's important to store tools in a secure location to prevent injury and keep the site neat.

GLOVES

Gloves can prevent blisters and injury when sifting compost or performing other tasks.

CHOPPING & SHREDDING DEVICES

Chopping and shredding organic waste before adding it to the compost pile can significantly increase the rate of decomposition. Tearing off the protective outer layers of food wastes (such as peels and shells) and decreasing the size of the organic materials added to the pile facilitates easier decomposition.



GARDEN EDGER

Use garden edgers to chop food scraps before adding them to a compost bin or pile. If you're composting using a bin, place food scraps in a bucket or concrete mixing tray before chopping. That way, when you are done, you can lift the bucket and dump materials directly into the bin, reducing labor and keeping your site neat and tidy.

If you're composting using a windrow or open pile, you can chop materials directly on the ground or on the pile.

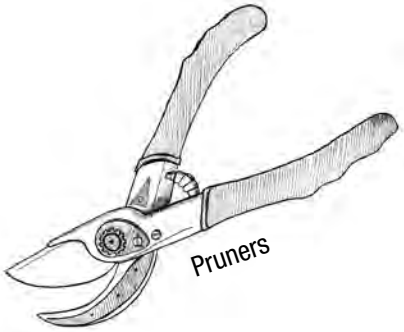
To ensure easy chopping, regularly sharpen your garden edger with a tool file. Just make sure to be very careful with sharp tools (or any tool for that matter).

SPADE SHOVEL

The sharp, pointed edge of a spade shovel is an ideal tool for breaking apart larger and thicker materials such as stalks, vines, melons, and uneaten vegetables. Straight-edged spades or garden edgers can also be useful in chopping up food waste.

PRUNERS AND LOPPERS

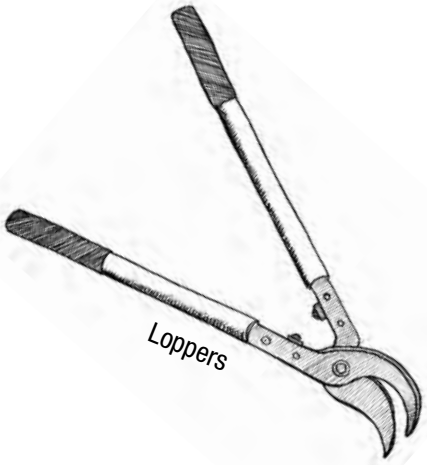
You can use these sharp, scissor-like tools to cut large pieces of organic waste into small pieces. These tools can be particularly helpful for chopping sunflower stalks, tomato plants, tree trimmings, and other woody or brushy materials that are hard to shred or tear by hand.



WOOD CHIPPER

A wood chipper can be used to increase the surface area of woody or fibrous materials. This is an important tool for composters as it can transform a log that will take years to decompose into wood chips, which make great browns and bulking agents for a compost recipe.

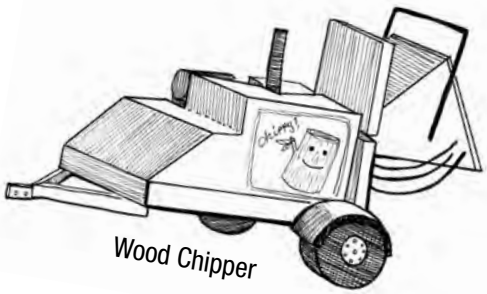
However, even the smallest wood chippers can be costly. Plus, if a community compost site is able to procure a chipper, it will likely require electricity and regular maintenance. So when you are just starting out as a backyard or community-scale composter, it generally does not make sense to invest in a chipper. Instead, you can ask your instructors for advice on locations where you could get wood chipped locally.



MULCH MOWER

A mulching mower can quickly shred large amounts of fall leaves. By shredding leaves, you can reduce the amount of space needed to store the them by half (or even more!). Taking advantage of the fallen leaves nature presents to New Yorkers once a year makes it much easier to store and maintain a supply of browns throughout the year.

When purchasing a mower for shredding leaves, make sure that the product description specifically says it's a "mulching" mower. Then, when using it, make sure there are not branches, plastic, or trash in your pile of leaves, as these materials can clog or break your mower or end up in your compost recipe.



NEED HELP CHIPPING AND SHREDDING?

The NYC Compost Project provides technical assistance to community compost sites that need help chipping and shredding fall and winter leaf and yard waste for composting.

Jenny Blackwell of the NYC Compost Project Hosted by Brooklyn Botanic Garden is demonstrating how to use a mulch mower to shred leaves at the High School for Public Service, a community compost site in Brooklyn.

The NYC Compost Project helps chip branches and tree limbs at The Bainbridge Avenue Garden, a community compost site in the Bronx.

MIXING & TURNING TOOLS

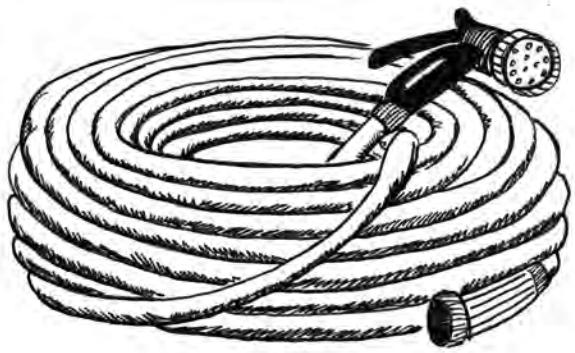
COMPOST CRANK AND WING DINGER

Compost cranks and wing dingers are commercially produced mixing tools. They are great for creating new air channels in your compost piles. To use the wing dinger, simply insert the tool into the top of the pile and push it down to the bottom, then pull it back up and out of the pile to loosen and mix the compost. To use the compost crank, rotate the tool into the pile, just as you would use a cork screw. Compost cranks are available for purchase at most NYC Compost Project host sites.

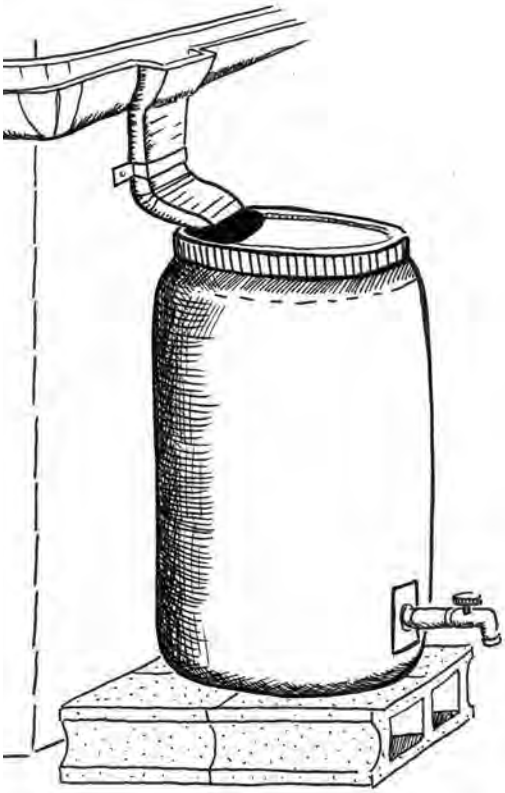
PITCHFORK AND SPADE FORK

No shovel can turn or grab pre- or partially-decomposed materials as effectively as a pitchfork. The tines on the fork make it much easier for you to penetrate a heap of tangled ingredients and scoop up a fork-full of compost. Spade forks are similar to pitchforks, but have shorter handles and shorter, wider tines.

Pitchforks can also be used to harvest finished compost. However, if your compost pile is on the drier side and has evenly decomposed, it may be challenging to keep the finer particles (the good stuff!) from falling out from in between the tines. This is where your shovel comes in handy!



Garden Hose

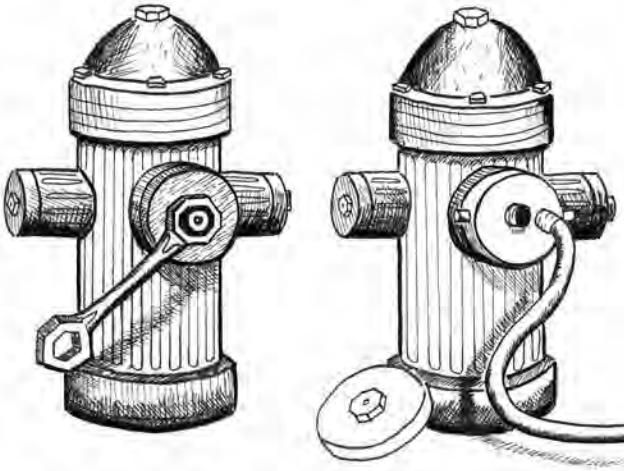


Rainwater Catching Tank

WATERING TOOLS

A compost pile breaks down faster when it is as moist as a wrung-out sponge (see Chapter 2). Prevent your compost from drying out by watering it as necessary with a hose, bucket, or watering can. If you do not have access to a water supply, you might be able to secure a hydrant key through the NYC Department of Environmental Protection.

You can also consider building a rainwater harvesting system. Using rainwater as opposed to municipal water sources can enhance the microbial activity in your compost pile. Municipal water contains chlorine, which can delay decomposer activity and reproduction.



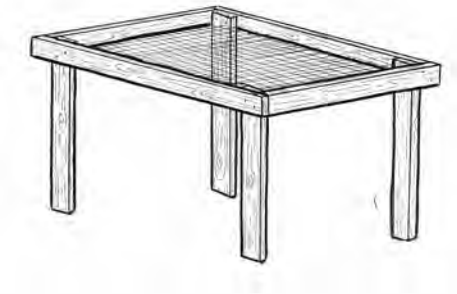
Sites that are certified by GreenThumb—an NYC Parks and Recreation program that supports community gardens and urban farms—can apply for a permit to access and use nearby water hydrants. After gaining permission, you can open a hydrant using a hydrant key (left) and attaching a garden hose (right).

Learn more at **greenthumbnyc.org**.

HARVESTING TOOLS

SIFTER

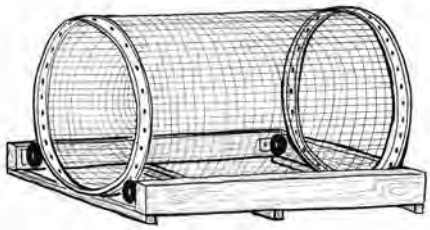
Sifters, also called screeners, are used to separate woody, non-decomposed material and non-compostable materials, like stickers on fruit, from the rich, fine particles of finished compost. You can build your own or purchase a sifter from a retailer. Sifters come in different sizes but are most often are made of ½" or ¼" hardware cloth (square metal mesh). The NYC Compost Project offers workshops and leads sifter builds at community compost sites.



Sifting Table

Morika Tsujimura, a Bronx Master Composter, uses a portable sifter that can be placed on top of a wheelbarrow. As she sifts, the finished compost falls into the wheelbarrow, which she then uses to transport the compost to her community garden plot.

Sifter on a Wheelbarrow



Rotating Sifter

SCOOP SHOVEL

Because finished compost is relatively homogeneous and soil-like in its composition, a scoop shovel is the easiest tool to move large quantities of fine compost. Scoop shovels have a broad, flat blade similar to a snow shovel that passes through finished compost easily.

RESOURCE 3-1

LOW-COST COMPOSTING EQUIPMENT

The NYC Compost Project sells at-cost compost bins and equipment suitable for urban composting to NYC residents. Items must be picked up (all fit easily into a vehicle); delivery is not available.

GARDEN GOURMET COMPOST BIN

Height: 36"
Width: 24"
Depth: 24"
Weight: 29 lbs
Capacity: 11 cubic feet
Cost: $65 (tax included)

STAINLESS STEEL COMPOST CRANK

Length: 45" long
Shaft: 3/8" diameter
Weight: 2 lbs
Handles: 100% recycled black nylon
Cost: $35 (tax included)

How to purchase:
Contact any of the following
NYC Compost Project host sites:

The New York Botanical Garden:
compost@nybg.org • (718) 817-8543

Brooklyn Botanic Garden:
compost@bbg.org • (718) 623-7290

Lower East Side Ecology Center:
info@lesecologycenter.org • (212) 477-3155

Snug Harbor Cultural Center & Botanical Garden:
compost@snug-harbor.org • (718) 425-3558

Queens Botanical Garden:
compost@queensbotanical.org • (718) 539-5296
(Compost Crank only)

EARTH MACHINE COMPOST BIN

Height: 33"
Diameter at Top: 23.5"
Diameter at Base: 33"
Weight: 15 lbs
Capacity: 10.5 cubic feet
Cost: $65 for bin;
$20 for rodent screen
(tax included)

How to purchase:
Contact the **NYC Compost Project**
Hosted by Queens Botanical Garden:
compost@queensbotanical.org • (718) 539-5296

METAL CAN COMPOST BIN

Height: 23"
Diameter of Lid: 17"
Diameter at Base: 15.25"
Weight: 7.3 lbs
Capacity: 3 cubic feet
Cost: $23 (tax included)

How to purchase:
Contact the **NYC Compost Project**
Hosted by Lower East Side Ecology Center:
info@lesecologycenter.org • (212) 477-3155

WORM BIN AND RED WIGGLER WORMS

Height: 16"
Width: 19"
Depth: 12"
Weight: 1 lb
Capacity: 3 lbs food scraps/week; indoor use
Cost: $55 (tax included),
includes 1 lb red wiggler worms

COMPOST SYSTEM MATCH-UP

Recommend a kind of compost system(s) that would likely be suitable for the scenarios below.

1. A science teacher wants to teach her students about decomposition. She has access to both outdoor and indoor space, but because of her busy schedule wants to spend as little time as possible maintaining a system.

What kind of compost system(s) would you recommend? Why?

_____

_____

_____

2. Community gardeners want to compost big piles of fall leaves, food scraps from nearby neighbors, and garden trimmings. They are dreaming big and hope to compost larger quantities of organic waste, but have little experience managing a compost site. The space they can devote to composting is about 30 square feet.

What kind of compost system(s) would you recommend? Why?

_____

_____

_____

3. Two roommates want to start composting food scraps in their backyard. They cook frequently, and have a small budget to purchase a compost system but would prefer to reuse materials if possible.

What kind of compost system(s) would you recommend? Why?

_____

_____

_____

4. A team of experienced community composters have been given permission to use a large vacant lot to build a compost site. They plan to compost large amounts of garden trimmings and food scraps. The site will be located next to a high school that has a popular gardening club and a similarly popular community service club. Also, the composters plan to offer and promote educational compost workdays to neighbors and other interested New Yorkers.

What kind of compost system(s) would you recommend? Why?

_____

_____

_____

5. A group of neighbors living in a large building want to start a small compost site in their backyard. They want anyone who's interested in composting to be able to, but they also want to ensure that the people who are participating are putting suitable materials in the system and maintaining it correctly. Two more things: They want to be able to add materials to the system at their convenience, and they've noticed their building already has a problem with rodents.

What kind of compost system(s) would you recommend? Why?

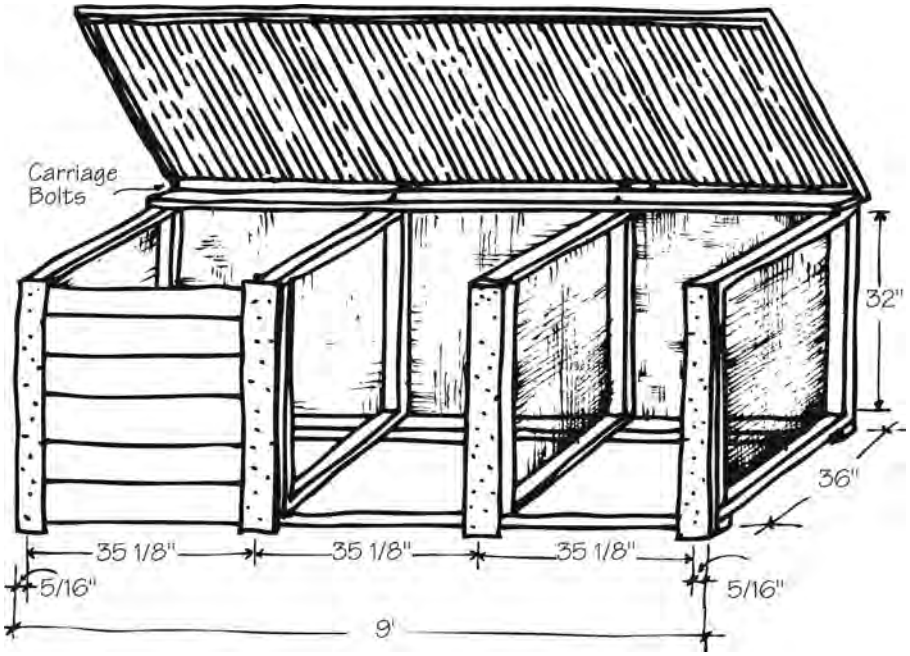
_____

_____

_____

BUILD A 3-BIN COMPOST SYSTEM

These are instructions for one type of 3-bin composting system. There are many different ways to build a wooden multi-bin system. We encourage you to ask your instructors which plans or bin types they like best.



MATERIALS

- 8 – 12' cedar 2x4s
- 3 – 8' cedar 2x2s
- 1 – 12' cedar 2x6
- 5 – 12' cedar 1x6s
- 31' of 36" wide 1/2" hardware cloth
- 12 – 1/2" carriage bolts, 4" long
- 12 washers and 12 nuts for bolts
- 2 lbs of 3 1/2" galvanized screws
- 200 poultry wire staples

Note: Cedar, fir, hemlock or other naturally rot-resistant lumber will last longer than less expensive options.
Avoid pressure-treated lumber.

TOOLS

- Handsaw or circular power saw
- Drill/driver with 1/2" and 1/8" bits
- Hammer
- Tin snips
- Tape measure
- Pencil
- 3/4" socket or open ended wrench
- Carpenter's square or T-square
- Safety glasses, ear protection, and dust mask

CONSTRUCTION INSTRUCTIONS

Build dividers & end sections (Use 2x4s)

- From the 2x4s, cut eight 32" pieces for the vertical uprights.
- From the 2x4s, cut eight 36" pieces for the horizontal connectors.
- Butt 2 vertical uprights between 2 horizontal connectors to form a frame. Mark and pre-drill the holes. Use screws to secure. Check frame for squareness.
- Make a total of four frames.
- Cut four 35" long sections of hardware cloth.
- Clip extra wire off ends.
- Stretch the hardware cloth across each frame. Attach the screen tightly into place with poultry staples hammered in every 4" around the edge (36" width of cloth is attached to 36" horizontal connectors).

Set up dividers & attach bottom baseboards and top support (Use three 2x4s)

- From the 2x4s, cut three 9' lengths to create 2 baseboards and a top support.
- On the side of the boards, mark 36" in from each end.
- On each divider, measure and mark centers on both ends of the 36" pieces (top and bottom horizontal connectors).
- Stand the dividers parallel to one another and 36" apart.
- Place one 9' baseboard on top of the dividers.
- Position the baseboard flush against the outer edges of the end dividers.
- Line up center lines of middle dividers with marks on the baseboard.
- Use a screw to temporarily hold the baseboard to each divider.
- Drill a 1/2" hole through each junction, centered 1" in from the inside edge of baseboard and 1" from inside edge of divider upright.
- Insert carriage bolts from the baseboard side through the divider. Secure with washers and nuts but do not tighten yet.
- Place second 9' baseboard on top of the dividers and repeat process for attaching it.
- Turn the unit right side up and attach 9' top support in the same manner as baseboards (the board will be at the back of the bin).
- Use the carpenter's square or measure between opposite corners to make sure the bin is square.
- Check that the dividers and end sections are at a 90º angle to the top board. Tighten all top support bolts securely.
- Turn bin over and check to make sure bin is square, and dividers and end sections are positioned properly. Tighten all baseboard bolts securely.

Attach hardware cloth

- Using scrap from 2x4s, cut two 28-1/2" pieces to insert in gap between the baseboards along the end sections of bin. (Measure gap before cutting scraps.)
- Insert scraps and screw into place on the bottom of the bin.
- Fasten a 9' long piece of hardware cloth securely to the bottom of the bin with poultry staples every 4" around the frame.
- Attach a 9' long piece of hardware cloth to the back of the bin.

Front & back runners for slats
(use 2x6s and 2x2s)

- From 2x6s, cut four 36" pieces for front runners.
- Center the boards on the front of the dividers, flush with the top edge, and screw in securely.
- From 2x2s, cut six 34" pieces for back runners.
- Attach the back runners on insides of divider. Back runners should be parallel to front runners and set back 1" (the gap will hold the slats).

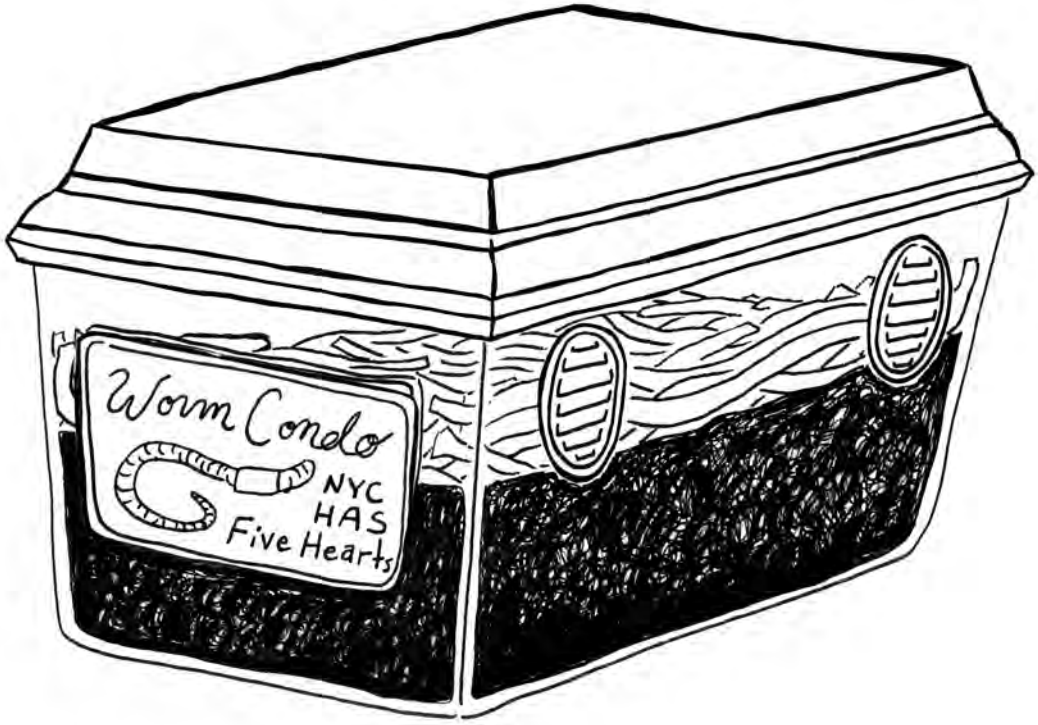
Slats (use 1x6s)

- From 1x6s, cut eighteen 31" pieces for front slats. (Measure clearance before cutting and test 1st slat before cutting the rest.)

MAKE & CARE FOR A WORM BIN

Don't have access to outdoor space? You can compost food scraps indoors using a worm bin!

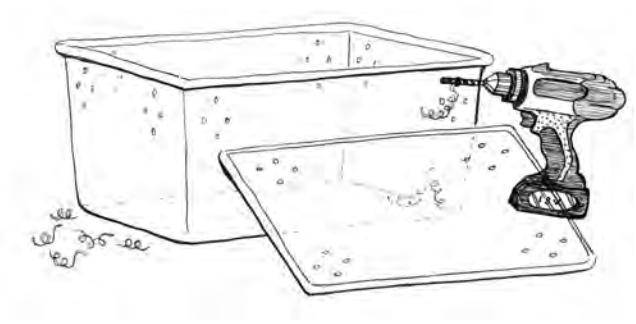
The following pages provide step-by-step guidelines for making and caring for a worm bin. These instructions are also available as a booklet, called "Indoor Composting with a Worm Bin," and are provided free of charge to residents and organizations by the NYC Department of Sanitation.



1 MAKE OR BUY A WORM BIN

You can buy a ready-made worm bin (visit **nyc.gov/compostproject** for options) or you can make your own by following these instructions.

MATERIALS:



- **Plastic container with a lid**
  Dimensions should be approximately 12 x 12 x 12 inches (one cubic foot) but do not have to be precise. A standard plastic storage tub from a household goods store is a great option.
- **Drill**
- **Fine screen to keep out pests (optional)**
  Purchase at a hardware store.
- **Tray (optional)**

DIRECTIONS:

- Drill at least 10 quarter-inch holes in the lid. These holes will provide oxygen to the worms and other decomposer organisms in the bin.
- Drill at least 10 quarter-inch holes in the sides of the bin. These holes will also provide oxygen in your bin.
- Drill at least 10 quarter-inch holes in the bottom of the bin. These holes are for drainage (optional).
- Use non-toxic glue to attach fine screen over holes (optional).
  This will help prevent pests like fruit flies from entering your bin.
- If you drilled holes in the bottom on the bin, place a tray under the bin to catch any "leachate"—this is a waste product of the composting process made of excess moisture.

After you make or buy a bin, store it in a good location for both you and the worms. Worms prefer temperatures between 55°F and 80°F (13°C and 27°C). Most indoor locations will meet these temperature needs. Worms can tolerate temperatures a bit beyond this range, but they will be less active.

2 GET WORMS

You will need a specific worm species called "red wiggler" or *Eisenia fetida*. Night crawlers and other common garden worms, which are usually brown or gray in color, will not survive in a worm bin.

You can purchase red wigglers from a local retailer or order them online and have them shipped to you. To find out where to buy worms, visit **nyc.gov/compostproject**.

We recommend most households start with purchasing one pound of worms. One pound of worms can process about three and a half pounds of food scraps a week. If you want to process more than that, you can start a second worm bin or, if your bin is big enough, add more worms to your bin.

ABOUT RED WIGGLER WORMS

Did you know there are over seven thousand species of earthworms? One species in particular is well suited for indoor composting: red wigglers (or *Eisenia fetida*).

Red wigglers live in the upper layer of soil where they feed on small organisms and decaying organic matter. Unlike other species of earthworms, red wigglers don't tunnel deeply or make permanent burrows. They reproduce quickly, thrive in habitats with high organic matter, can tolerate a wide range of temperatures and moisture conditions, and can live close to one another. An indoor worm bin mimics all of these natural conditions, which makes red wigglers ideal for indoor composting.

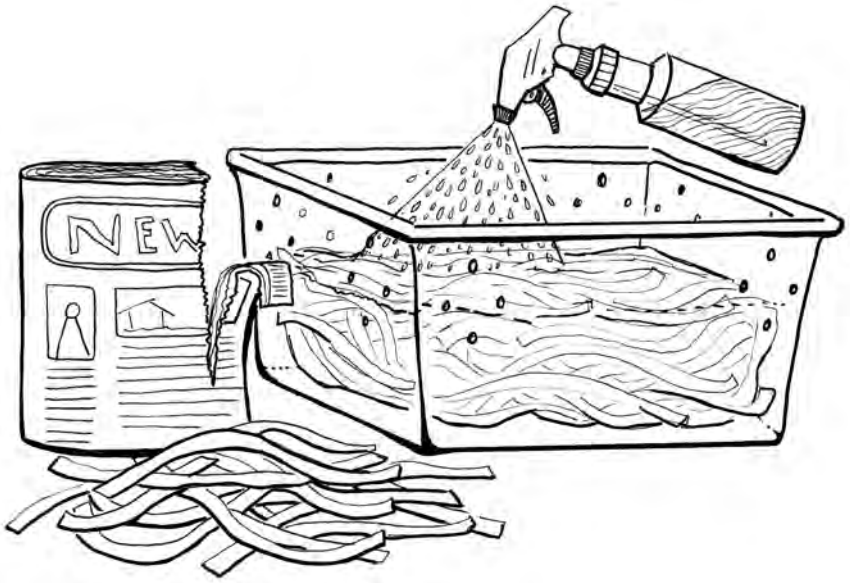
FUN FACTS

- Red wigglers can eat half their body weight in food scraps a day.
- Worms have five hearts.
- Worms have both male and female reproductive organs, but still need another worm to reproduce.
- One mature worm can give birth to about 100 worms a year. The space and amount of food in a worm bin will keep their population size in check.
- A worm's life span is approximately one year.

3 MAKE BEDDING AND ADD WORMS TO YOUR BIN

Bedding provides a place for the worms to live, absorbs moisture, and covers your food scraps to prevent odor. Bedding can be made from a variety of materials, but torn or shredded newspaper is the most common.

Before adding worms to your bin, follow these simple steps to make bedding.



- **Tear newspaper into one-inch wide strips.** You can tear by hand or use a paper shredder. *Important: Do not use glossy paper or full color paper as the toxic chemical dyes and heavy metal residues could end up in your finished vermicompost.*
- **Moisten strips of newspaper.** Gently squeeze out excess moisture; newspaper should be the consistency of a wrung-out sponge.
- **Fill your bin about two-thirds full of bedding.** Use your hands to fluff up the bedding.

After making the bedding, gently pour worms on top of it. They will burrow their way down on their own.

4 FEED YOUR WORMS

What to feed: Feed worms fruit and vegetable scraps. You can also feed them coffee grounds and paper tea bags (remove staples from bags). Dried flowers or household plants are also okay.

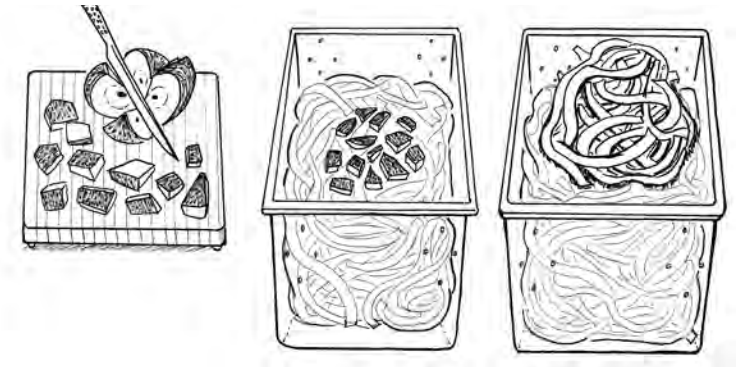
Do not feed worms meat, dairy products, or food scraps that have been cooked with oil. These items will attract pests and produce odors in a small indoor worm bin. Also avoid very spicy or salty foods, large amounts of citrus, or toxic ingredients like alcohol.

How much to feed: As mentioned in step two, the amount of food scraps you can feed your worms depends on the amount of worms in your bin. If you have one pound of worms, you can feed them approximately three and a half pounds of food scraps each week.

When to feed: You can feed your worms small amounts every day or their whole week's food supply at one time. If you feed your worms weekly (which is probably the most convenient way), it's best to store food scraps in your freezer or refrigerator throughout the week to prevent odor and pests.

If you don't have room in your freezer or refrigerator, you can store food scraps anywhere that's convenient. Cover food scraps with torn newspaper to help mask odors.

HOW TO FEED:



- **Chop large food scraps into one- or two-inch pieces.** If you are freezing food scraps, you should chop them up before freezing them for easier chopping.
- **Move some bedding to the side and add food scraps.** Each time you feed your worms, place the food scraps in a different area of the bin. This will evenly distribute the food scraps. It will also give you a sense how long it takes for the food scraps to break down and how much you can add to the bin each time.
- **Cover the food scraps by adding more torn up newspaper strips.** This prevents pests and odors. Never leave food scraps exposed on top of the bin.

5 OBSERVE THE CONDITIONS IN YOUR BIN

Monitoring your worm bin regularly lets you ensure you are providing healthy living conditions for your worms and avoid problems with pests or odor.

A healthy worm bin smells earthy like soil, has food scraps/bedding disappearing over time, and is damp but not soggy (worms have glistening skin from sufficient moisture).

Also, a healthy bin should have small quantities of other decomposer organisms, such as mites or little white worms. It's actually a good thing to have controlled populations of these and other insects—they help with the decomposition process. Compost critters want to stay where the food is so you don't need to worry about them leaving your bin.

Every time you feed your worms or at least once a week, review the troubleshooting guide below to evaluate the conditions in your bin and amend as needed.

TROUBLESHOOTING GUIDE

- **Are the bin contents too wet?** Worms can drown or your bin can produce putrid odors if your bin is too wet. Bedding should feel about as moist as a wrung-out sponge. If your bin is too wet, add dry bedding so that it can soak up pooling water. Also, reduce the amount of food you feed your worms—food scraps add moisture to your bin.
- **Are the bin contents too dry?** Because worms breathe through their skin, bedding should be consistently moist (like a wrung-out sponge) in order to create a comfortable habitat for your worms. Food scraps will naturally add water to your bin and should keep the bedding moist. However, if your bedding seems dry, add more water with a spray bottle or watering can. Another option is to add more food scraps.
- **Does the bin smell?** Make sure all food scraps are covered with bedding to prevent odor. Some foods are naturally odorous when decomposing (such as onions, broccoli, or cabbage). Therefore, remove foods that produce unpleasant odors if it bothers you. Don't add meat, bones, dairy, or oil products.
- **Are food scraps taking too long to decompose?** Break food into smaller pieces, especially hard, woody items like stems. You can also freeze and thaw food scraps to break down cell walls. If decomposition is still slow after chopping food scraps, feed worms less.

(continued on next page)

- **Are there fruit flies near your bin?** If fruit flies are a problem, you can try using flypaper traps or make your own fruit fly trap. (House flies should not be attracted to your worm bin if you cover the food scraps with bedding material.)

  Freeze fruit before feeding to worms or microwave fruit for 60 seconds. These actions help to kill fruit fly eggs. You can also simply avoid adding fruit.

  Here are two kinds of easy fruit fly traps you can make yourself:

  - **Funnel fly trap.** Pour some apple cider vinegar or beer into a glass jar and add a drop of detergent. Cut the corner off a plastic sandwich bag and place it into the jar; secure the plastic bag "funnel" with a rubber band around the rim of the jar.

  - **Bottle fly trap.** Cut a small plastic water or soda bottle in half. Fill the bottom half with some apple cider vinegar or beer and a drop of detergent. Turn the top half upside down and place it into the bottom half so that the neck forms a funnel. Secure the two halves with tape.

- **Are there a lot of mites in your bin?** A small mite population is good, but if you notice large collections of mites you should try to remove them. Remove any food that has a congregation of mites. Then, bring bin outside and leave it open in the sun for one to two hours to dry it out a little. Repeat as necessary until mite population is reduced.

  To trap mites, place a slice of fresh bread in the bin, wait until mites congregate on it, and then remove the bread.

- **Is there any other kind of pest infestation?** Remember, it's healthy to see controlled populations of insects in your bin. But if your bin is swarming with insects, there is a problem in your bin. The best solution may be to harvest the worms (see step six) and start a new bin from scratch, using what you've learned from your experience to create a better bin.

- **Are there few or no worms in your bin?** Dead worms decompose rather quickly—you can have a bin with no worms before you realize it. If your bin is too wet or too dry, worms can die. They can also die from lack of air, so make sure your bin has enough ventilation.

  Also, make sure your bin is located in a place where the temperature is between 55°F and 80°F (13°C and 27°C). If contents of your bin seem very compacted, add paper tubes or other bulky paper products such as torn up paper egg cartons to increase air flow. Worms can also die if they have not been fed for a long time, though they can usually live many weeks before lack of food becomes an issue.

6 HARVEST FINISHED COMPOST

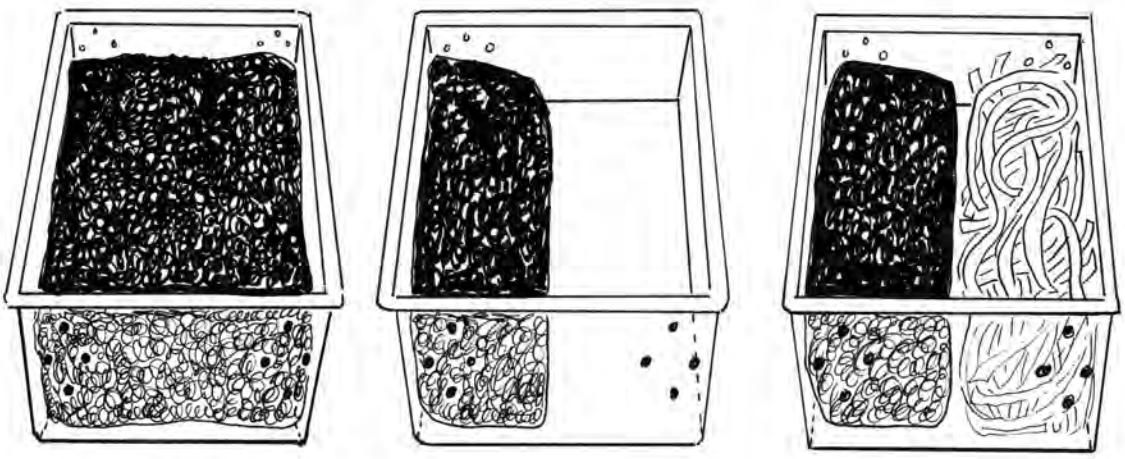
It usually takes about three to six months to accumulate finished compost, which resembles dark, crumbly soil. When your bin is nearly full, it's time to harvest your vermicompost! *Harvesting* is when you remove the vermicompost from the bin and separate it from the bits of bedding, food scraps, or worms that are in it. (Vermicompost becomes toxic to worms if left in the bin for too long without adding new food scraps.)

Here are two ways to harvest finished compost:

THE EASY WAY

This method is very easy but it takes about a month to complete.

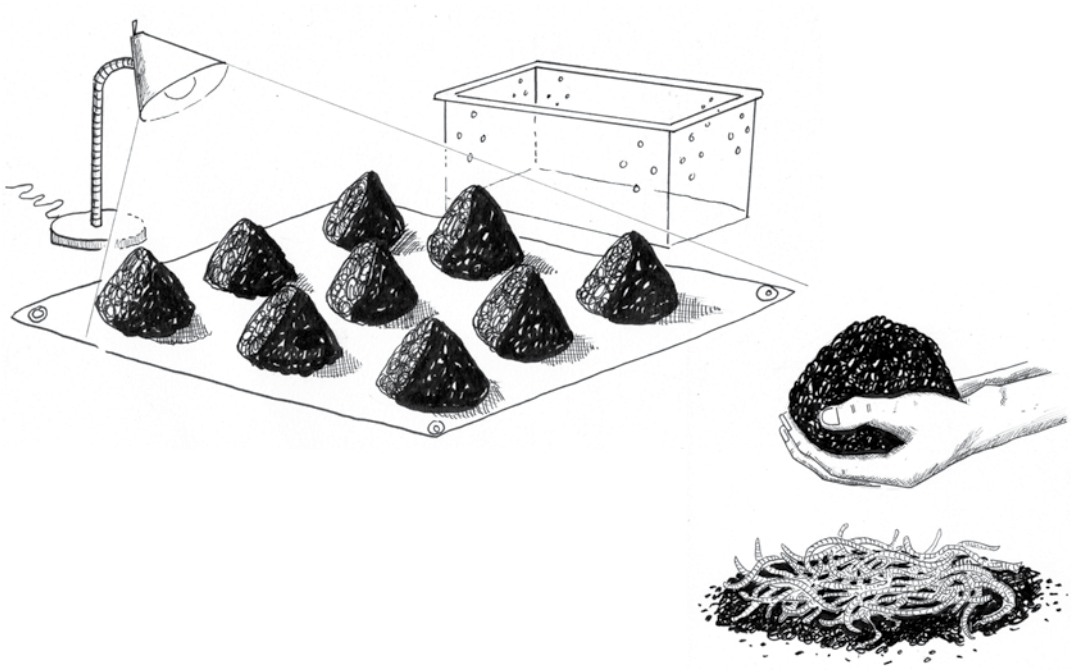
1. Move all the contents over to one side of the bin.
2. Add new moistened bedding (strips of newspaper) to the empty side, then start placing food scraps on that side.
3. Over about a one-month period, most of the worms should move over to the new bedding, allowing you to scoop out the relatively worm-free vermicompost.



THE FAST WAY

This method is fast but it is more involved.

1. Spread out a newspaper or tarp on the ground or on a table.
2. Move bedding over to one side of the worm bin.
3. Remove dark crumbly material from the worm bin.
4. Make small piles of vermicompost on the newspaper. (The worms will gather in the center of the piles to avoid bright light.)
5. While you are waiting for worms to gather into the center of the vermicompost piles, make new bedding.
6. Brush the castings off of the top and sides of each small pile. Put this finished material in a bag or container.
7. Add new bedding to the empty side of the worm bin.
8. Add fresh food scraps to the empty side of the worm bin.
9. Gently harvest the castings from the outside of each pile and put the castings in a bag or container.
10. Carefully remove the worms that have clustered in the center of each pile. Put them back into the worm bin.
11. Scoop up any remaining vermicompost and return to the bin.
12. It's okay if there are a few worms still in the vermicompost if you are going to use it in a garden. However, if you are using it in potted plants, it's best to remove all worms.



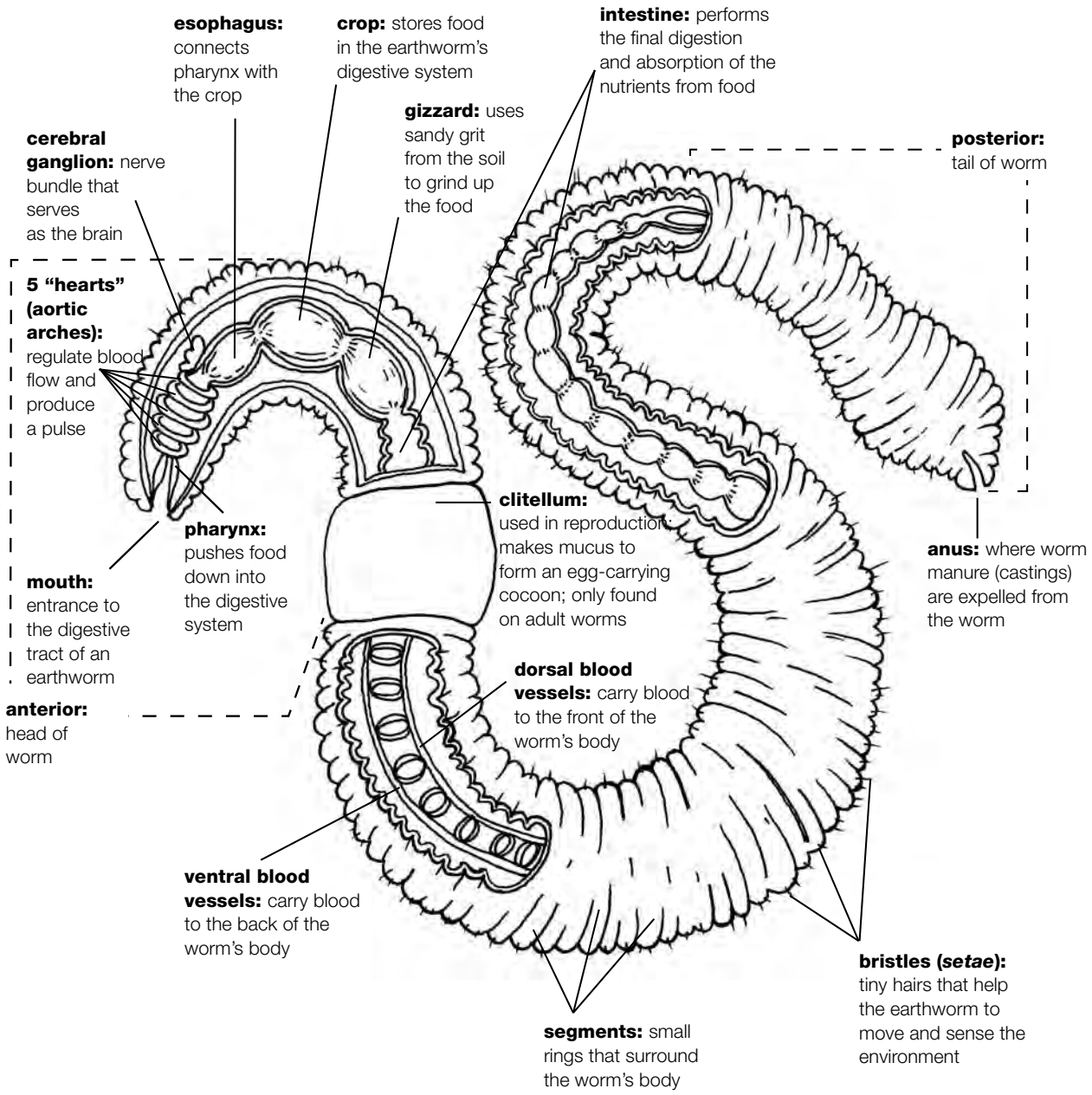
7 USE YOUR COMPOST!

Vermicompost is an excellent source of nutrients for plants. When you transplant, throw a handful into the hole before you plant. You can also mix vermicompost into the top layer of soil for your potted plants.

If you don't have a garden or own any houseplants, add vermicompost to the soil around street trees on your block or consider donating it to a local community garden.

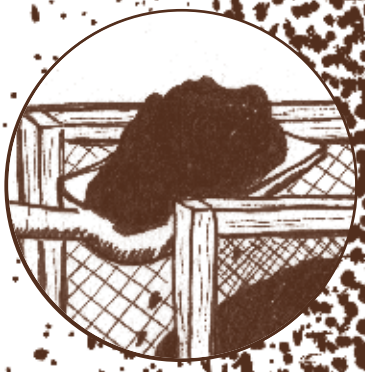
WORM ANATOMY

Once you've built your worm bin and nurtured a healthy population of worms, get to know your worms and share your knowledge with others! Below is a diagram of a worm's anatomy that can help you and your friends, family, neighbors, and/or students better understand how these magnificent creatures make compost.



CHAPTER 4

SITE DESIGN & MANAGEMENT



LEARNING OBJECTIVES

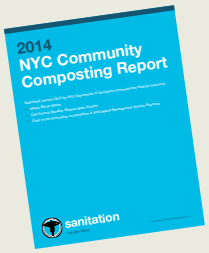
- Identify benefits and limitations to each of the three scales of composting operations: household, community, and industrial
- Know how to join an existing compost site or start a new compost site in NYC
- Understand how to design a compost site with the six essential stations, and other important site attributes
- Understand how to manage a community project (volunteers, record keeping, etc.)

SUGGESTED ACTIVITIES

- Compost Site Assessment (page 4-43)
- Design a Community Compost Site (page 4-45)

COMPOST SITES

2014 NYC Community Composting Report



In January 2015, the NYC Department of Sanitation (DSNY) published the first comprehensive report on community composting in NYC. View or download it at **on.nyc.gov/DSNY-reports**.

At this point, you know how compost improves soil and how to manage the process of decomposition using the Five Factors of Composting. You've also reviewed a wide range of compost systems and helpful tools. Now, let's tie all of this information together by talking about how to design and manage a compost site.

New Yorkers have built an expansive network of hundreds of community compost sites across NYC. This course equips Master Composters with the knowledge and skills they need to expand and improve this network by either working with existing compost sites or starting new ones. In this chapter, we'll explain how to design a community compost site, and share "best practices" for managing a safe and efficient urban composting operation. can provide support for an existing compost site, as well as how you can start a new compost site in your community.

SCALES OF COMPOST OPERATIONS

Household composting

Community composting

There are three scales of composting operations: household, community, and industrial. ***Household composting*** is the smallest scale; it involves family members or roommates working together to compost the organic waste they generate at home. In NYC, household composting typically takes places indoors using a worm bin, or outdoors in a front- or backyard.

At a larger scale is ***community composting***, which involves the people of a community working together to compost at a shared site. These sites can be located in a wide range of places, such as schools, community gardens or urban farms, places of worship, community centers, parks, or donated space on private properties. Community compost sites in NYC are often managed by people who volunteer their time, though some are managed by paid staff. They can range in size from 10 square feet (the size of a small shed) to 20,000 square feet (more than four basketball courts).

At the largest scale are ***industrial compost sites***. These sites are usually located outside of the community where the material is generated. They are always operated by paid staff, and might accept organic waste from various businesses or a city's curbside organics collection program. Industrial-scale composting functions almost exactly like smaller scale systems—the main difference being sheer size. To learn more about large-scale composting, we recommend that you check out the U.S. Composting Council at **compostingcouncil.org.**

Industrial composting

Each scale of composting has its own advantages and limitations depending on how you evaluate them. Household composting provides a person total control over the process. For some people, it can be the most convenient method because they don't have to follow anyone's schedule but their own, and they can use the finished compost any way they'd like. For others, household composting might not be convenient because it requires a level of composting knowledge and a certain amount of time and effort to maintain a composting system.

Community composting has several benefits. It can produce significant amounts of compost that can be used locally; foster connections between neighbors; and provide New Yorkers the opportunity to get their hands dirty and connect with nature. However, space restrictions, labor requirements, and other factors limit the ability for community composters to handle all of a city's organic waste.

Industrial composting can greatly reduce the amount of waste being sent to landfills (nearly a third of NYC's residential waste is suitable for composting!). Also, unlike home and community composting, this scale is more suitable for processing challenging organics like biosolids and compostable service ware. However, industrial composting doesn't necessarily give city residents access to the compost being produced, and at such a large scale it usually doesn't build engaged communities.

Considering that each scale of composting has benefits and limitations, a strong urban composting program operates at all three scales. That way, a city doesn't miss out on any of the advantages each of the scales offer.

This Master Composter course focuses primarily on the community composting scale, though putting community composting into context offers a greater understanding of its benefits and limitations.

As you read the rest of this chapter, keep in mind that each community compost site in NYC is as unique as the people who run it. Because these sites were built from the ground up, they have their own "personalities." Meaning, they have different compost systems, different management models, choose to compost different kinds of organic wastes, and have different amounts of people involved with the site with varying levels of composting experience. Because of these traits and others, some community sites are more similar in appearance to the household or backyard scale, while others look and operate more like industrial sites.

JOINING AN EXISTING COMMUNITY COMPOST SITE

Many community compost sites in NYC are eager for help—especially help from a knowledgeable Master Composter! There are many benefits to joining an existing site: the land is already secured, at least some community members are already involved, and there is at least one other composter on site who can help guide you as you practice what you've learned in this course. You might also have access to some of the basic tools (like gloves, shovels, etc.) we reviewed in Chapter 3, so you won't need to raise money for them or purchase them yourself.

You can support an existing compost site by:

- Improving or building a new system that will better suit the site and its goals.
- Repairing or renovating the site's existing composting system.
- Organizing open hours when community members can bring their food scraps or yard waste to the site.
- Organizing regular volunteer workdays to accomplish specific tasks, such as harvesting and sifting finished compost, turning a windrow, or applying compost to street tree beds.
- Starting a compost education program that provides tours of the site and teaches community members how composting works (more on outreach and education in Chapter 6).

- Organizing a fundraiser or participating in grant writing.
- Helping promote the site by creating and posting flyers around the neighborhood, writing a monthly newsletter, or tabling at a community event.
- Redesigning or improving the site to be more aesthetically pleasing—maybe by building a toolshed or rethinking the layout and flow of the site.
- Creating engaging and helpful signs that explain how to use the composting system.
- Translating signs and promotional materials into other languages to make the composting program more visible and accessible to all neighbors.
- Getting your hands dirty and working on the site!

So, how can you get involved with an existing community compost site? Ask your instructors! They can connect you with a site in your area looking for support.

STARTING A NEW COMMUNITY COMPOST SITE

If you live in an area without a convenient composting site, you might consider starting a site of your own. Remember, starting a new compost site can be a hefty task and involves much time, effort, and commitment. We don't say this to dissuade you—if you want to start a new site, the NYC Compost Project is here to help! But we do want you to be honest with and kind to yourself: don't take on more than you can handle. There are plenty of existing community composting site managers who need all the help they can get and would absolutely love your Master Composter skills and knowledge to help maintain the site and grow its impact.

If you feel up to the task, the first thing to do is secure a location. You can do this on your own or team up with a core group of composters also interested in starting a site. Working with a team of committed people can be very helpful—consider asking some of your classmates, reaching out to neighbors and community members, or asking your course instructors if they know of any other composters looking for a home base.

The following locations are great places to start a compost site:

A compost site located at a Manhattan apartment building that is managed by building residents.

A community compost site located within The Bainbridge Avenue Garden, a community garden in the Bronx.

- **Your building.** Find out if any of your neighbors are interested in composting and join forces. Make sure to ask your building management, custodial staff, or co-op board for permission to compost in shared spaces in or around your building. If they have concerns about composting, you can start by holding a workshop or attending a co-op board meeting to address these concerns and answer questions. (More on compost education and outreach in Chapter 6).
- **Community gardens.** If a community garden is not composting, see if the gardeners are open to letting you help them start a composting operation. Or, if they are already composting garden trimmings, you could see if they are interesting in expanding their site to process food waste as well.
- **Schools.** Composting in a classroom or school garden is a great way to introduce New Yorkers to composting at a young age. For example, a Master Composter in Staten Island built a worm bin for every classroom in her school as her independent project. Others have built outdoor bins to produce compost that will feed garden beds in the school's garden, where students can see scraps from their cafeteria transformed into compost and, ultimately, into

food again. If you're interested in setting up a composting program at a school, make sure to get permission and involve as many stakeholders as possible, including administrators, teachers, custodial staff, and kitchen staff.

- **Vacant lots.** Some of NYC's community compost sites refer to themselves as "Compost First" gardens, because they devote most of the space on their site to composting. These site have generally been developed on vacant lots, enabling site managers to start from scratch and have complete control over the site design. If there is a vacant lot in your area that you are interested in developing, there are a number of resources that can help you identify the lot's owner and other relevant information. The group 596 Acres (**596acres.org**) has created a fantastic resource for identifying the city agencies responsible for vacant public land in your community and explains how to contact them for permission to use the site. 596 Acres can also help you connect with people working together to secure a vacant lot for a community project, like building a community garden. You can connect with one of these organizing groups to support their efforts and offer to take charge of building a compost site on the property if it gets secured.

A community compost site at PS9 on Staten Island. Their wooden three-bin compost system was built by the NYC Compost Project Hosted by Snug Harbor Cultural Center & Botanical Garden.

Volunteers building a windrow at Queens County Farm Museum.

A compost site using "Earth Tubs" at Manhattan College in the Bronx.

- **Urban farms.** If there are any urban farms in your community, they are most likely doing some basic composting. You could ask the farm manager if he or she would be open to letting you start and manage a more effective composting system. Collecting food scraps from neighbors could help drive traffic to such farms, which could be a win-win scenario!
- **Colleges and Institutions.** Stop by any colleges or local institutions (such as the public library) to ask about the interest level in starting a compost site.
- **And beyond…** Take a walk around your neighborhood and consider places that could be suitable for composting. Keep an open mind—you might be surprised with what you come up with!

Once you secure a location, the best advice we can give to new community composters is to start small. Run a pilot program with a small group of people and start by composting a small amount of material. This way, you can troubleshoot any unexpected problems and identify ways to improve your site's productivity. Once you've assessed your system on a small scale, you can open your site to more people and process more organics.

SMALL GROUP ACTIVITY:

COMPOST SITE ASSESSMENT

Students work in small groups to assess a site for composting following the instructions on page 4-43.

START SMALL, DREAM BIG

No matter what kind of compost system you use or how much organic waste you ultimately want to process, it's best to start by composting only a small amount of material at first.

You can increase the amount of material you compost once you and anyone else maintaining your compost system become comfortable and confident with managing it. You can increase the size of your system or impact of your work by adding additional bins or pilesto the site, increasing the number of hours the site is open, or growing membership by promoting the compost site more broadly.

The NYC Compost Project Hosted by Big Reuse is a great example of a compost site that started small, in a tiny corner of Two Coves Community Garden, and eventually grew into a city-funded program that composts over a million pounds of residential food scraps each year. Check out the timeline to the right to see how this site started small, but dreamed big.

2007

NYC Master Composter Shirley Chai rallies gardeners at Two Coves Community Garden in Queens to start composting plant trimmings.

Photo: Shirley Chai (right) and Stephanos Koullias (left) at Two Coves Community Garden.

2009

Inspired by the success at Two Coves, NYC Master Composters Leanne Spaulding and Stephanos Koullias found Western Queens Composting Initiative (WQCI), a decentralized network of food scrap drop-off and composting sites throughout western Queens.

Photo: Composting system managed by WQCI at Long Island City Community Garden.

2010

Through crowd-funding, WQCI raises money to purchase a bicycle to transport material from residential food scrap drop-off sites at three farmers markets to community gardens, where the material is composted and ultimately used to grow food.

Photo: New Yorkers drop off food scraps at a WQCI drop-off site at Sunnyside Greenmarket.

2011

WQCI receives funding through the North Star Fund's Greening Western Queens Fund, allowing it to establish an office at Big Reuse, hire two paid staff, and build two larger composting sites at Brooklyn Grange and Queensbridge Park.

Photo: WQCI's Christopher Bivens (left) and a volunteer turning a compost windrow at Brooklyn Grange's rooftop farm in Queens.

2012

WQCI is funded by the NYC Department of Sanitation (DSNY) through the NYC Compost Project and changes its name to BIG!Compost. With DSNY's support, BIG!Compost more than doubles its composting capacity and expands from six to 14 food scrap drop-off sites.

Photo: Volunteer work day at BIG!Compost's largest site in Queensbridge Park.

2015

Three years and another name change later, the NYC Compost Project Hosted by Big Reuse diverts, on average, 500 tons of residential food waste per year and redistributes its finished material to local public greening initiatives.

Photo: Before adding material to its newly installed GORE system, site managers mix feedstocks using a Jaylor agricultural feed mixer.

SITE DESIGN

If you're planning to start a new compost site—whether it's a household, community, or industrial site—you'll need to think about how to design it. What equipment goes where? How will people or equipment move through the site? How can the space be used most effectively? If you're not starting a new site but are working with an existing site, understanding site design can help you evaluate the site for ways it could be improved and made more efficient.

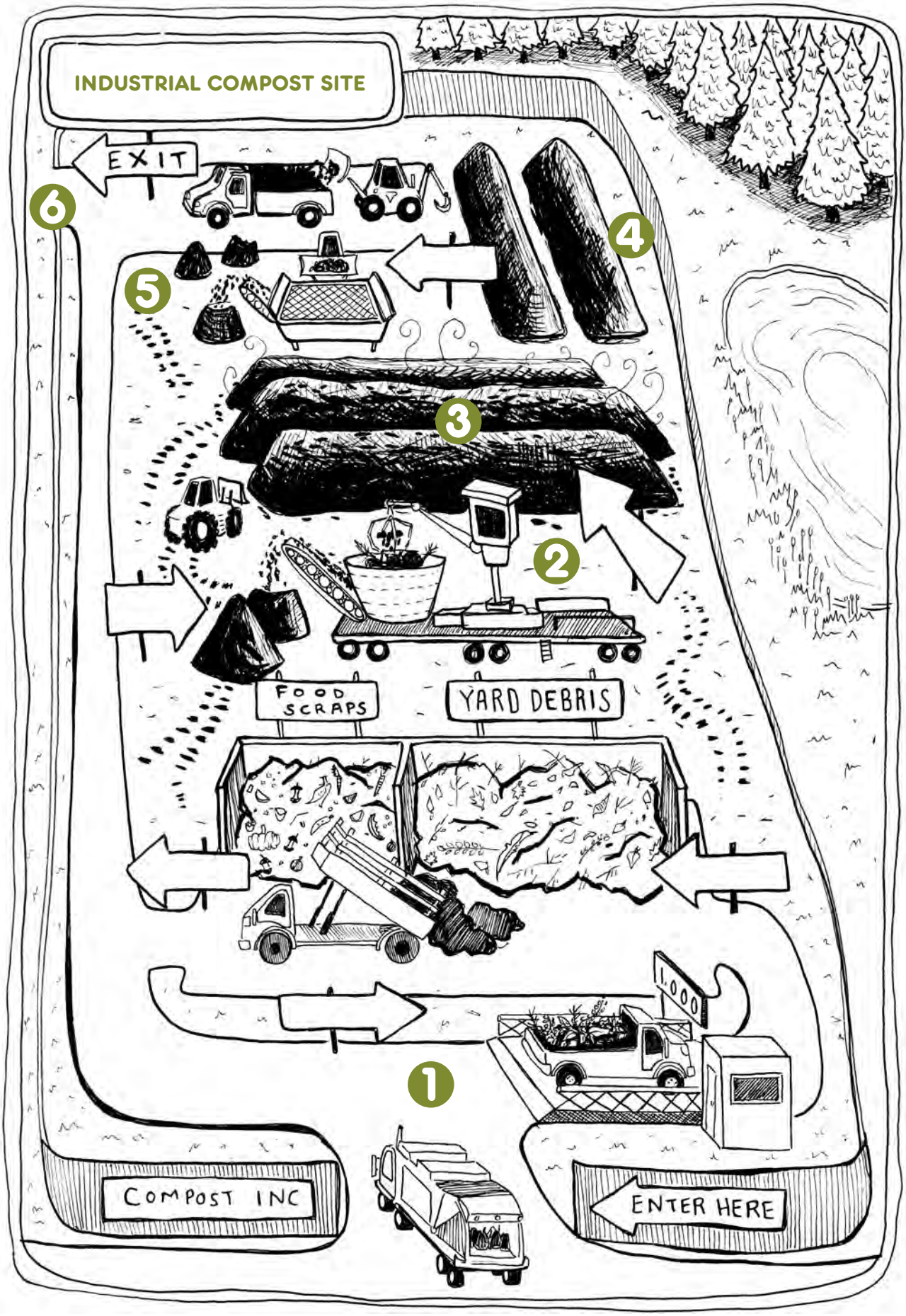
STATIONS

Designing a compost site might sound like a big task, but we have good news: **all compost sites, at all scales, have the same six essential stations**. Understanding these stations will help you design a smooth-running, efficient compost site.

The six stations that make up all compost sites are:

1. Organic waste intake
2. Feedstock preparation
3. Active composting
4. Curing
5. Sifting
6. Distribution

In this manual, we're going to explain how these stations function at the community scale. Keep in mind that the equipment or management of each station might look different from one another at different sites, though their primary purpose remains the same. As we've mentioned above, community compost sites in NYC are very diverse. Stations at smaller sites might resemble a household-scale operation, while stations at larger sites might resemble an industrial-scale operation.


INDUSTRIAL COMPOST SITE
EXIT
6
5
4
3
2
FOOD SCRAPS
YARD DEBRIS
1,000
1
COMPOST INC
ENTER HERE

1. **Organic Waste Intake:** Commercial or municipal waste haulers bring organic waste to the compost site in trucks. Before dropping it off, they generally weigh the truck to record how much material is being dropped off at the site.

2. **Feedstock Preparation:** Organic waste ingredients, generally called "feedstocks" at industrial sites, are prepared for composting. Preparing feedstocks might include chopping, shredding, or decontamination (during which plastics and non-compostable materials are picked out). Next, all feedstocks are mixed in a specific, predetermined ratio to create the site's compost recipe.

3. **Active Composting:** This is where the mixture of feedstocks is placed to compost. In this example, the site is using windrows, which are actively managed using machinery such as skid steers and windrow turners.

4. **Curing:** After compost has completed its thermophilic stage, it's moved to a curing pile or windrow to finish decomposing. At industrial sites, the curing piles are generally located away and uphill from active composting piles. This ensures that leachate from newer piles will not runoff into curing piles and contaminate the nearly finished compost.

5. **Sifting:** Compost is sifted using an industrial scale screener. This process removes materials that have not fully decomposed like larger woody materials and inorganic materials like plastic utensils. Industrial sites generally offer a variety of grades of finished compost, ranging from completely unsifted material that is ideal for erosion control, to very finely sifted compost that can be used for vegetable gardening. To make these different grades, they might have multiple screeners or switch the screens on a single machine.

6. **Distribution:** Finished compost is sold for a variety of purposes. Most industrial composting operations use the compost they produce to create a variety of products, from bagged potting mixes to unsifted bulk material.

COMMUNITY COMPOST SITE
6
I ♥ STREET TREES
4
3
5
2
BROWNS
FOOD SCRAPS
FOOD SCRAP
YARD DEBRIS
YARD DEBRIS
1
WELCOME TO OUR COMMUNITY COMPOST SITE!
YES
NO
DROP OFF HOURS
QUESTIONS? CONTACT US

1. **Organic Waste Intake:** Site members or nearby residents drop off organic waste at a community compost site. Site managers or volunteers use a scale to weigh the waste and record its weight in a log book.

2. **Feedstock Preparation:** Organic waste ingredients are chopped, shredded, chipped, or torn to reduce the particle size. Next, browns and greens are thoroughly mixed in specific ratios according to a site's recipe before they are added to the compost system.

3. **Active Composting:** This is where the site's compost system is located. In this example, the site is using a multi-bin compost system. The new materials are placed in the bin to the far right, and turned through the system to the left as they decompose.

4. **Curing:** After compost has completed its thermophilic stage, it's left to cure. In this example, curing compost might be piled in the second or third bin, depending on the rate of intake of new organics at the site. Curing compost can also be stored in a wire cage or any other type of bin, like the garden gourmet to the left of the multi-bin system in this illustration.

5. **Sifting:** Once a successful bag test is complete (see page 4-25), the material is ready to be sifted. Compost is sifted using any kind of sifting tool to remove any materials that have not fully decomposed, like woody materials that take longer to decompose, and inorganic materials, like fruit stickers.

6. **Distribution:** Finished compost is used to improve soil in shared green spaces. In this example, finished compost is used to care for neighborhood trees.

HOUSEHOLD COMPOST SITE
WHAT TO COMPOST
NEWSPAPER
1
2
3
4
5
6

1. **Feedstock Preparation:** Large food scraps are chopped into smaller pieces before they are stored in the freezer. Note that stations one and two are a bit different in this example of household composting, since it's easier for household composters to chop up food scraps before they are frozen.

2. **Organic Waste Storage:** Household members store food scraps in a bin or bag in their freezer. If the household has a yard, they could also save yard debris in a pile or bin outdoors.

3. **Active Composting:** This is where the household's compost system is located. In this example, a family is using a worm bin to compost indoors.

4. **Curing:** Compost is left to cure in the worm bin when the household stops adding new food scraps to the bin. In the example, a family has started a second worm bin so they could continue to compost their food scraps while the compost in the first bin is left to cure.

5. **Sifting:** If composting in a backyard, you can sift just as you would at the community scale. If composting indoors with a worm bin, you will need to carefully separate finished compost from your worms. This can be a fun family activity that's suitable for young children.

6. **Distribution:** Finished compost is integrated with soil used to grow houseplants. Extra compost can be shared with neighbors, or integrated with soil in street tree pits.

A community composter accepts and chops residential food scraps in five-gallon buckets. To make cleaning the buckets easier, the buckets are lined with wood shavings before food scraps are added to them.

A site participant drops off food scraps in a five-gallon bucket at a community compost site. Scraps are then chopped up directly in the bucket before they are mixed into the compost system.

STATION 1: ORGANIC WASTE INTAKE

This is where organic waste is collected or dropped off at a compost site before it is mixed into the compost system. At this point, the waste should be weighed on a scale so that site managers can keep track of the amount of waste they are accepting and managing at their site.

Organic waste can be accepted several ways, depending on a site's goals and needs. Here are some common ways to set up organic waste intake:

- At a community garden, designate a wire bin, clearly-labeled pile, or other storage location for gardeners to toss their plant trimmings.
- Set "open hours" for a compost site, during which anyone from the neighborhood can drop off their food scraps (see food waste management guidelines on page 4-22).
- If you want to limit or control the amount of organic waste a site is managing, create a membership model where people must register with site managers before dropping off waste. Consider locking your compost system and only providing keys to members so they can drop off their organic waste whenever it's convenient for them. Make sure to train all new members to properly use the compost system so they don't require supervision.
- If you're prepared to compost a larger amount of organic waste but a compost site isn't in a high-traffic location, consider accepting waste off-site in a more convenient location and then transporting the waste back to the site. (Make sure you have permission to set up an organic waste intake station at an off-site location from any relevant parties.) The NYC Compost Project uses this organic waste intake method by accepting food scraps at farmers' markets and near public transportation stations.
- If you're composting at a school, you might coordinate monthly "compost days," during which you collect all fruit and vegetable scraps from the cafeteria with students and bring them to the compost system in your school garden.
- If your site only accepts leaves during the fall, organics intake might include hosting a "Leaf Drop" event, during which you accept your neighbors' leaves and work with site members to shred and store them in wire bins.
- If you're composting at an urban farm, you might coordinate your organics intake schedule with the farm's harvest

schedule. This might include hosting a volunteer workday right after the last tomatoes are harvested, so that you have extra help chopping tomato stalks.

STATION 2: FEEDSTOCK PREPARATION

Feedstock is another term for the ingredients that make up your compost recipe. This station is where you chop, chip, or shred any large organic materials into smaller pieces. It could be part of your organics intake station, or in a separate location. Materials the size of your palm or smaller ensure a quicker decomposition rate. But be careful not to chop materials down to a mushy sludge—it will prevent air to circulate through your compost.

After you've chopped all of your ingredients down to the right size, thoroughly mix them together *before* adding them to your compost system. This helps minimize overly homogeneous pockets of materials, such as a thick layer of banana peels on top of a thick layer of shredded newspaper. It also ensures that microorganisms have access to the right amount of browns,

By thoroughly mixing ingredients before adding them to your compost system at the feedstock preparation station, you can encourage faster rates of decomposition.

greens, air, and water. (Note: You don't have to mix ingredients before adding them to a worm bin, because the worms will do the mixing for you!)

Compost site managers could require people who drop off organic waste to shred or chop their waste before leaving. Community sites that compost a lot of woody debris like branches might want to invest in a woodchipper (see Chapter 3), or contact the NYC Compost Project to provide wood-chipping services.

Chopping food scraps

NYC Compost Project Hosted by Queens Botanical Garden's Jeremy Teperman chops pumpkins.

Chopping food scraps is a fun task for kids.

A sharpened garden edger makes chopping food scraps easy. (See "Tools" in Chapter 3.)

MANAGING BROWNS

Managing browns is easier than managing food scraps because they are less likely to cause odor. However, while browns may not make a good meal for a rodent, they can make a very attractive home because they are often available in large batches and must be stored on site over longer periods of time.

When sourcing browns, you'll also want to try to bring in browns of different sizes to create a balanced compost recipe.

Here are some guidelines for managing browns.

- **Store browns in open and highly trafficked areas.** Browns storage bins are not the most attractive, so many composters tuck them away out of sight at the back of site. Unfortunately, this is exactly what creates an ideal shelter for rodents. If your site-mates are concerned about aesthetics, work with them to design something more attractive.
- **Turn browns regularly.** Even though piles of browns don't need to be turned before they're added to a compost system, regularly fluffing them will deter rodents from making your pile their home.
- **Shred or chip browns to save space.** Shredded leaves, for example, take up a fraction of the space required for full leaves. (See Chapter 3) for shredding and chipping tools.)
- **Mix different kinds of browns together before adding them to a compost system.** You'll often receive browns in batches of consistent materials, like leaves from your neighbor or wood chips from a fallen tree. As discussed in Chapter 2, compost recipes call for a mix of diverse browns that provide different benefits to your pile. Dry, shredded leaves increase the immediate availability of carbon, while larger wood chips act as bulking agents and create air spaces in your compost. Rather than storing these browns separately and mixing them later, you can mix them in your preferred ratio as soon as you receive them to save both time and space.

Leaves

Straw

Wood shavings

MANAGING FOOD-SCRAP INTAKE

If you're accepting food scraps at your organic waste intake station, it's critical to manage them properly to prevent odors and pests. Here are some guidelines.

- **Secure a steady and sufficient supply of browns.** **DO NOT** accept food scraps if you don't have this.
- **Determine where your food scraps will come from.** Will you accept food scraps from anyone in your neighborhood or only from a limited number of registered site members? Will you be composting a school's cafeteria scraps? No matter where your greens are coming from, make sure to communicate clearly and often with the people who will be dropping off food scraps. For example, you might collect email addresses so that you can notify site participants about closures, or post updates or information on a website for your site.
- **Always add food scraps into the compost system as soon as possible.** The longer they sit out without being mixed with browns and capped, the greater the risk of odors and pests. If you can't immediately incorporate food scraps into the compost pile, store them in a rodent-proof container (e.g., a perforated metal can) and cover food scraps with browns.
- **Collect food scraps in small containers.** Food scraps are heavy because they contain a lot of water. Large bins are difficult to transport or lift. You don't want to limit or potentially injure your volunteers by requiring them to lift heavy buckets. Try using small, five-gallon buckets. Additionally, try to collect food waste close to your compost system so you don't need to carry the buckets far. If you need to transport food waste across your site, consider placing bins in a wagon or other wheeled device.
- **Control odor and moisture from food scraps with browns.** Line the bottom of bins you collect food scraps in with finer browns that are very dry and will immediately absorb moisture, like sawdust, wood shavings, shredded paper, grains, shredded leaves, or finished compost. Every time a person adds food scraps to the collection bin, add a scoop of browns to cap the layer before another person adds their scraps. Not only does this control odor and moisture, it "pre-mixes" your materials before you add them to your compost bin or pile.

Staff at NYC Compost Project food waste drop-off sites pour wood shavings over layers of food scraps to minimize odors and pre-mix materials.

- **Ask people to freeze their food scraps at home.** This is an easy and very effective way to control pests and odor. This will also lengthen the amount of time you can store food scraps before adding them to a compost system.
- **Host regular, supervised food scrap drop-off hours.** By hosting supervised weekly drop-off opportunities during specific hours, you can ensure proper participation, accurately track the amount of organic waste that your site is composting, and get to know the people who contribute to the compost site. Additionally, drop-off hours can double as volunteer opportunities. For example, let site participants know that during food scrap drop-off hours they can also volunteer to help turn compost piles and sift finished compost if they'd like.

Poster inviting neighbors to drop off their food scraps during specific times at Compost for Brooklyn.

Site managers at 462 Halsey Community Garden chose an organics intake system that lets people drop off food scraps at any time. To make this system work, they require food scrap drop-off participants to place fresh food scraps in perforated metal cans and cover the scraps immediately with browns.

STATION 3: ACTIVE COMPOSTING

This station is where your compost system is located. Here are a few guidelines to help you choose the best location for your system:

- Compost systems can be set up in the sun, but shady spots are ideal. A common myth about composting is that your pile needs the sun to warm up. As you know from Chapter 2, it's the decomposer organisms, not the sun, that heat up compost! Plus, if your compost system is located in direct sun, it is more likely to dry out faster and require more water.
- Compost systems can be placed on any surface, including concrete, soil, wood chips, or gravel. Concrete surfaces can be preferable if you're trying prevent pests from burrowing into a bin or pile from underground. Additionally, it can be easier to scoop and turn compost piles on hard surfaces like concrete or asphalt. However, most systems will produce a liquid runoff called leachate, which can stain concrete and other non-porous surfaces. Soil and other porous surfaces will absorb leachate.

Turning your pile is a very important part of maintaining a healthy active composting pile. As discussed in Chapter Two, turning releases trapped heat, moisture, and gases; redistributes moisture, air, and nutrients; recreates air channels; breaks up clumps of materials; and "fluffs" your pile.

STATION 4: CURING

Curing is when compost is set aside to "finish" after it has completed its hot thermophilic stage and has returned to cooler internal temperatures (see Chapter 2). The curing phase can take anywhere from a few weeks to several months. While you let older materials cure, you can continue processing new materials by adding them to a new bin or pile.

Compost has finished curing when:

- It is dark brown in color
- It contains no recognizable original materials
- It smells earthy, like a forest floor
- Crumbly soil-like particles are all about the same size

But don't think you're finished just yet—compost that meets these physical qualities might still need more time to cure if small pieces of organic matter are not fully decomposed.

The simplest way to tell if compost has finished curing is by conducting a "Bag Test": Leave a handful of moist compost in a zip-lock bag for three days. After three days, take a sniff. If you detect an ammonia or sour odor, the microorganisms are still at work and you need to let your compost cure longer. When your compost in the bag smells like earthy soil, it's finished curing!

Note that woody and fibrous browns can take years to finish decomposing. If other criteria for readiness are met, but the pile still contains recognizable wood chips, a coconut shell, or tough fruit pits, all you have to do is sift them out (we'll explain sifting in the next station). Add these materials to a new compost pile where they will continue to decompose.

Conduct a "Bag Test" to determine if compost has finished curing. Place a handful of moist compost in a ziplock bag and set it aside for three days. Then, take a sniff. If you detect an ammonia or sour odor, the compost needs more time to cure. If it smells like earthy soil, it's done curing.

STATION 5: HARVESTING & SIFTING

After compost is cured, it's ready to be ***harvested*** and ***sifted***.

Harvesting involves using garden tools to remove finished compost from bins. Scoop shovels (see Chapter 3) and pitchforks (see Chapter 3) are especially useful tools for outdoor bin harvesting. It has a broad, flat blade (similar to a snow shovel) that can pass through finished compost easily and hold up to three times as much material as a spade.

A "sifting table" constructed at a community compost site.

Sifting removes any materials that are not fully decomposed, like fruit pits and wood chips, as well as inorganic materials like fruit stickers, pieces of plastic, or rocks. Sifting compost is simple: place cured compost on a mesh screen, and let the small crumbs of humus fall into a container beneath it while removing any material that isn't humus. Non-humus material, or "overs" can be returned into the composting system or your browns storage bin (they are usually browns that take a longer time to decompose such as woody materials or pits).

There are many different sifting methods. You can build a sifter by stapling ½" or ¼" hardware cloth (metal mesh) to the edges of a square or rectangular wooden frame. Place the sifter on top of a wheelbarrow, or large bucket to catch the sifted compost.

Harvesting compost that's finished curing and sifting it using a screen placed on top of a wheelbarrow.

You can also use a simple colander or plastic crates to sift smaller amounts of compost.

Place a sifter over a wheelbarrow so that you can easily transport the sifted compost.

You can use a standard plastic crate to sift smaller amounts of compost.

You could sift compost before curing it if you'd like. Place a sifter above the bin where you plan to cure the compost. This way, after compost finishes curing it's ready to be used immediately.

SIFTING PARTIES

Sifting compost can take a lot of time, especially if your compost is moist. Consider hosting a "sifting party" at your community compost site to make the process fun. A sifting party focuses on moving finished compost out of a compost system to make room for new organic waste. These work days can be fun for volunteers of all ages. They do not require significant labor, like turning compost piles (though you will need at least one person to scoop compost onto the sifter or sifting table). Sifting can also be a social activity, as volunteers can meet one another and chat while they sift.

Host a "sifting party" to move finished compost out of your compost system to make room for new organic waste.

Sifting is a simple, low-labor activity. People of all ages can participate!

STATION 6: DISTRIBUTION

This is where compost is prepared to be distributed. Having a lot of finished compost on site can take up precious space. Create a plan for how you'll put your compost to good use. Will you use compost on-site for growing vegetables? Will you use it to care for street trees in your neighborhood? Will you distribute it to volunteers or site members you have participated in producing it?

Having a pre-determined distribution plan will help your operation run smoothly and let site members know how the finished compost will benefit the community. (We'll discuss ways you can use finished compost in the next chapter.)

Above: Many of NYC's community composters produce compost that is used to grow food in urban farms and gardens.

Left: Five-gallon buckets full of finished compost produced at a community compost site.

OTHER IMPORTANT SITE DESIGN ATTRIBUTES

Beyond the six stations of a compost site, here are a few other important site attributes to take into consideration as you think about designing or improving a compost site.

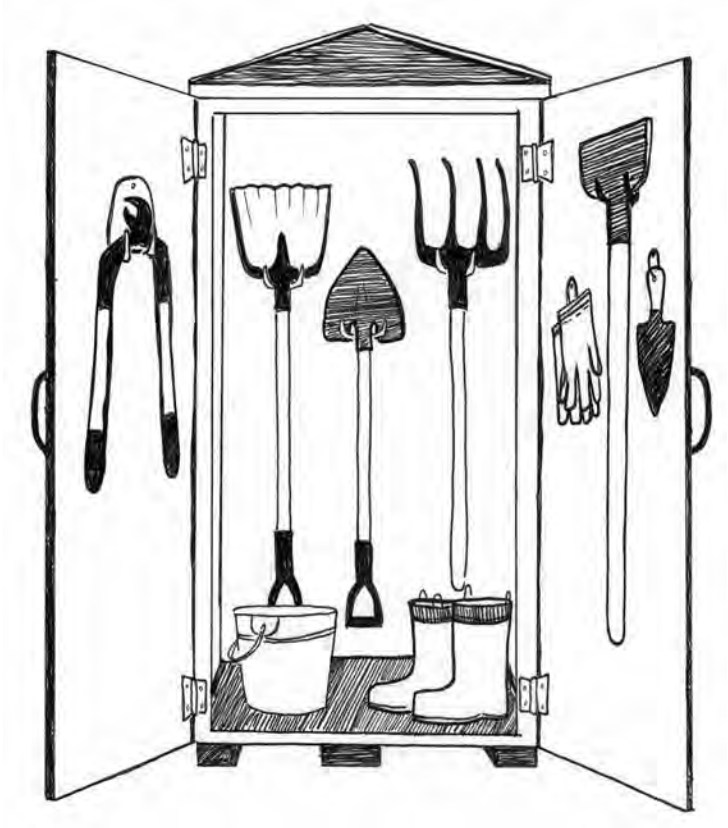
WATER

You'll need an easily accessible water source for your site. See if there is a fire hydrant nearby that you can get permission to use (see "Tools" in Chapter 3), or if your site has a water spigot. You can also consider building a rainwater harvesting system.

Rainwater harvesting system at Schervier Community Garden in the Bronx.

STORAGE

You'll need a place to store your tools, notebooks for record keeping, and other items. A built or purchased storage shed is ideal. Access to a nearby basement can also work well. For safety, you should be able to lock items in storage when the compost site is not in use.



Keep storage areas neat and organized.

La Plaza Cultural Compost Site's compost area is very clean and well organized.

Wheelbarrows stored neatly at Red Hook Community Farm. Storing wheelbarrows upside-down prevents rainwater from pooling inside them.

AESTHETICS

While aesthetics might not be your first concern as a composter, it is likely a concern of neighbors, park-goers, volunteers, gardeners, drop-off program participants, or other community members. A messy, unkempt site can be a neighborhood eyesore that may generate complaints. Also, there is no better advertisement for composting than a thriving garden or planting. Creating a neat, engaging, and beautiful space helps build community support for composting. Consider growing plants around the perimeter of the space to beautify it, of course using the compost you produce to nurture them. Sometimes all it takes to get neighbors involved in your site is a lovely display of tulips.

Plant flowers around the perimeter of your site, using the compost you produce to keep them healthy.

SIGNS

Clear signs are a critical component of every compost site. Make sure your sign includes the following information:

- **Site name.** You could also include information that lets passersby know why the site it there. If the site has a website, email address, or other contact information, include that too.
- **Open hours.** Let neighbors know when they can visit, volunteer, and/or drop off their organic waste.
- **Accepted materials.** Inform people what items can and cannot be composted at the site.
- **Site rules** will let people know how the site is managed. Does the site accept organic waste from everyone in the neighborhood, or are materials only accepted from registered members? Do you need to be a volunteer to be allowed to drop off food scraps?
- **Get creative** and think about what information might be helpful or interesting to know while passing through a composting site. It could be great to have signs that explain the basics of composting to visitors or kids, or signs that explain what's happening at each of the six stations.

A sign at Eldert Street Garden in Brooklyn tells neighbors about the site's mission, how to contact site managers, and invites them to get involved.

Composters at Drew Gardens in the Bronx created colorful signs to help indicate how each bin of their three-bin system should be used.

Compost for Brooklyn applied for and received a grant from DesigNYC, which offers pro bono design support to community groups and nonprofit organizations. Shown above is a sign DesigNYC created for Compost for Brooklyn that shows the layout of the compost site.

SMALL GROUP ACTIVITY:
DESIGN A COMMUNITY COMPOST SITE

Use the worksheet at the end of this chapter on page 4-45 to design a compost site. Include all of the six composting stations, and make sure to consider the other important attributes of a compost site (water, storage, aesthetics, signs).

MANAGING A COMMUNITY PROJECT

We've talked a lot about how to manage the compost part of a community compost site. Now, let's talk about the community part.

Projects that involve bringing community members together for a specific cause usually have the same core elements: a group of core members and volunteers, a clear mission and goal, a plan for community engagement, and secured resources.

We'll briefly describe these elements here, but this is a very large topic that could be a course of its own. We recommend you explore resources developed by organizations that specialize in managing a community project, such as Citizen's Committee for NYC, ioby.org, or the Open Space Institute's Citizen Action Program.

BUILD A MANAGEMENT TEAM

Community compost sites organized and maintained by groups will make a bigger impact. Create a management structure that works for your site, your site's goals, and the amount of time each team member can personally commit. Your site management team should work together to determine site policies. Delegate ownership, and ensure that each person has a manageable workload. For example, one team member is responsible for managing the compost system operations, another is responsible for organizing and hosting food-scrap drop off days, another is responsible for teaching workshops and guiding site tours, another is responsible for fundraising, etc. Another efficient way to manage a team is to rotate responsibilities among team members. Be sure to schedule regular management meetings throughout the year to keep everyone up to date on the site's progress.

RECRUIT VOLUNTEERS

The more ways you can find to get your community members involved, the better! Recruit volunteers to help build a new composting system, host food-scrap drop offs, turn a windrow, sift finished compost, distribute finished compost…the list goes on. Posting a sign is an easy and clear way to corral your community. You can also brainstorm creative activities that cater to individual interests.

Consider giving volunteers clearly defined rewards. For example, in exchange for two hours of volunteer time per month, you might give a volunteer ten pounds of finished compost. Make sure volunteers are trained well. For a true community-run site, you want to create a core group of volunteers who can manage the garden without you. It's important to have regular meetings and orientations with management and volunteers to both share composting and site management knowledge and to celebrate everyone's hard work.

When organizing a big volunteer workday, it's important to reward volunteers for their time and work. Make sure to have handy water and safety equipment, such as gloves or goggles. Also, make sure there's a clear way for people to get involved. If you have never recruited or managed volunteers before, consider asking the NYC Compost Project to help you get started.

Check out these organizations that can help you recruit volunteers:

- **New York Cares: newyorkcares.org**
- **NYC Service: nycservice.org**
- **New York Association for Volunteer Administration: nyava.org**
- **Retired and Senior Volunteer Program: cssny.org/programs/entry/retired-and-senior-volunteer-program**

The NYC Compost Project can also help you recruit volunteers. Our teams collaborate with community compost sites to organize, promote, and implement volunteer workdays. Interested? Ask your instructor!

PLANNING FOR VOLUNTEER WORK DAYS

Hosting volunteer workdays at a community compost site offers neighbors the opportunity to get involved with the site by getting their hands dirty outdoors alongside their neighbors.

- **Create a clear and specific goal for the day.** Host food-scraps drop offs for two hours; integrate compost in ten street tree beds; clear a vacant lot of debris to prepare for a new compost site.
- **Have a plan for all volunteers.** If more volunteers show up than you have tools for, make sure you have another useful task for people to do. Consider rotating volunteers between different tasks.
- **Explain and provide safety protocols and equipment**. All volunteers should know how to complete the task at hand safely and have access to the appropriate equipment to do so. If using power tools, provide goggles, and make sure volunteers are properly trained and supervised while using the equipment. Tell volunteers to take breaks whenever they need to. Time to rest means more time to explore and enjoy the site!
- **Tell volunteers where they can access a restroom.** Easy to overlook, but very important! Make sure there's a restroom, port-a-potty, or composting toilet available on site. You can also investigate if there is a public bathroom at a nearby park, if a site member or neighbor who lives nearby is willing to share their restroom, or if you can strike a deal with a supportive nearby business.
- **Plan to work, rain or shine.** Let volunteers know if your volunteer workday will occur rain or shine, or if there will be a rain date. If you plan to work no matter the weather, always be sure to have basic rain parkas to sunscreen, and bug spray available on site.
- **Offer water and, if possible, refreshments.** It's important to have water available for volunteers, especially if they are doing physical work. Also offer refreshments if your budget allows—volunteers certainly deserve treats!
- **Know where water sources and power outlets are located.** It's important to have this information handy to all volunteers to make sure composting runs smoothly.
- **Give back.** Volunteers are supporting you and your site, so it's important to find ways you can support them! Create a rewards system (e.g., for every two hours a volunteer works, give them a 10-pound bag of compost), host picnics and other events, organize meetings to update volunteers about the compost site and give them a chance to provide constructive feedback.

PROMOTE YOUR SITE

Promoting your site can be as simple as posting a clear sign. Post a sign outside your site, or consider asking local businesses if you could post flyers in their shops.

GET FUNDING

Whether starting a new composting operation or improving an existing one, you'll need money to purchase tools and equipment. Before you start buying equipment, plan a budget and research costs to create a fundraising plan. Often, the most important financial support will come from your neighbors and community members—when you make your needs known, you might find that someone in your community will have an idea for making it happen.

You can also consider applying for small grants. You may need a fiscal sponsor, usually a nonprofit organization with a similar mission, that administers the grant on your behalf. Through its Citizen Action Program, the Open Space Institute provides fiscal sponsorship for many grassroots organizations in NYC. Applying for grants can take time, but there are many available to small community projects. Ask your instructors if they know about other great resources out there.

Here are a few funding or materials resources to get you started:

- **CCNYC: citizensnyc.org/grants/composting-grant**
- **ioby.org: ioby.org**
- **Big Reuse: bigreuse.org**
- **DesigNYC: designyc.org/get-involved**

Ask your instructor about other funding and materials resources in your community and record them below.

_____

_____

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COMMUNICATE REGULARLY WITH SITE MEMBERS

When people visit, volunteer, or drop off their food scraps ask them to add their name, email address, and phone number to a contact list so that you can share information about the site with them.

KEEP ACCURATE RECORDS

Record keeping is an important aspect of managing a compost site. Accurate records can help you make decisions about how to run the compost site and evaluate the site's impact. They are very important for applying to grants—if you can concretely show a grant sponsor that a compost site is well managed and is making important contribution to a community, you'll have more of a chance of securing funding.

Here are some records we recommend you keep:

- Number of people who drop off organic waste
- Number of people who visit your site to learn about composting
- Number of volunteers who contribute to your site
- Weight or volume of browns and greens composted at your site

A TOOLKIT FOR DATA COLLECTION AT COMMUNITY COMPOST SITES

The Design Trust for Public Space, Farming Concrete, and community partners worked together to create a wonderful data collection toolkit for urban composters, farmers and gardeners. You can create an account and start using the tool here: **farmingconcrete.org/barn**

RESPECT YOUR NEIGHBORS

While a compost site is created to benefit the community, conflicts can still arise. The best way to deal with conflicts is to try put yourself in the shoes of the different people who interact with the site, and understand what might upset them: How might a messy sight make neighbors or passersby feel? Might someone who doesn't know much about composting worry about? How do you reassure someone who is concerned about the site attracting rodents? Think of possible conflicts and plan to prevent them or respond to them respectfully. Keep in mind that the more aesthetically pleasing your compost site is, the more neighbors will welcome the site's presence.

BUILD COMMUNITY PARTNERSHIPS

Create a relationship in which both partners benefit. Working with other community groups, organizations, and businesses could greatly benefit your site—your site could benefit them as well! Contact organizations and businesses in your community that you think might be supportive of your site to see if you can partner to create a specific outcome. If there a school nearby, for example, you could offer a composting workshop for families. As a win-win, it will help you get more people involved while providing the school with fun, hands-on programming to offer their students and parents.

NEGOTIATE SPACE

Green space is extremely valuable in New York City. Sharing spaces in a way that keeps all users happy can often be an issue. This does not mean it's impossible; there are hundreds of sites where composting has been successfully incorporated into mixed-use spaces across the city. Holding community meetings to discuss the goals and benefits of composting can give you an opportunity to respectfully address the concerns of other site users. Ask how you can offer your help to other projects on the site. Your instructors can provide guidance and perhaps even attend a meeting.

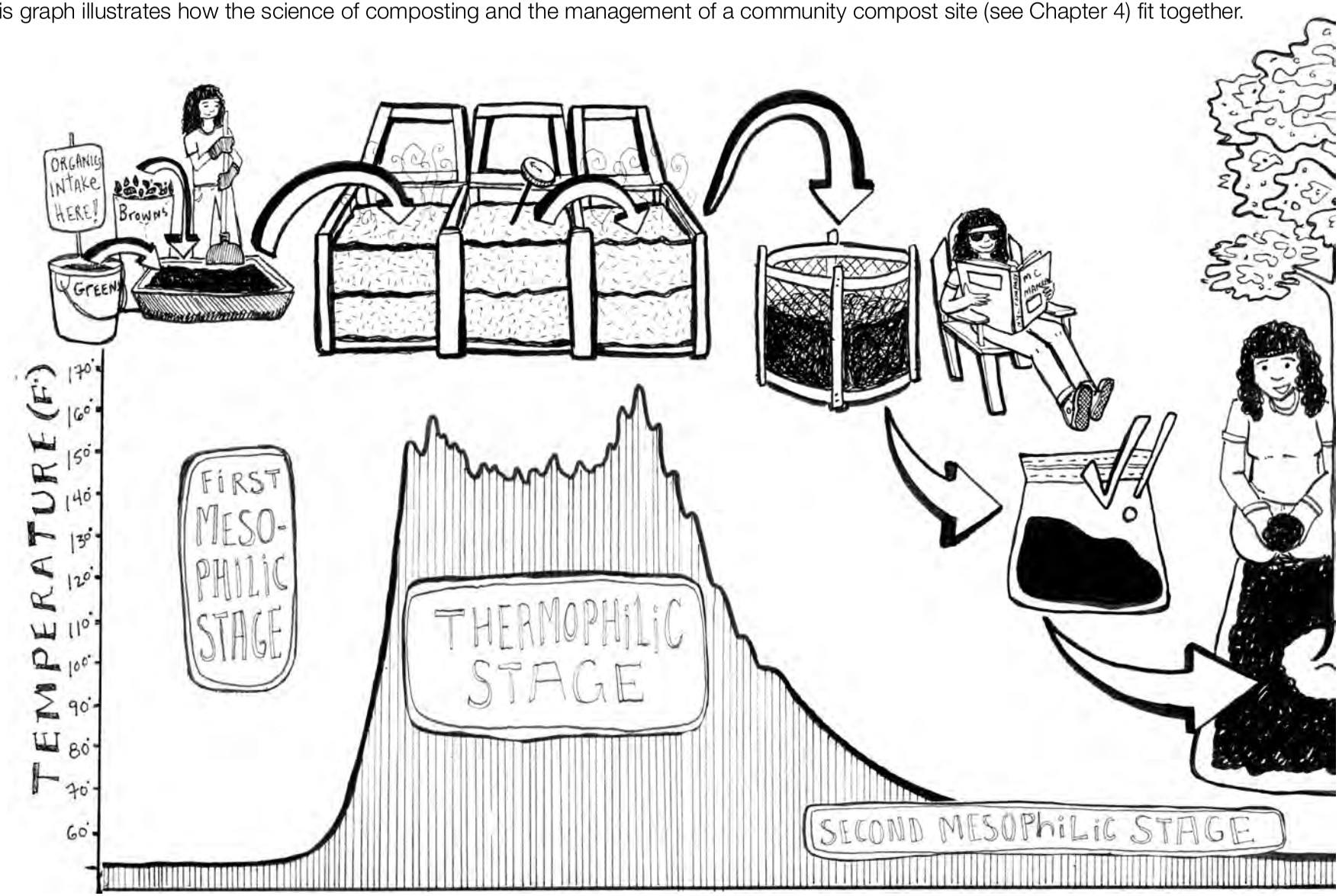
IDENTIFY ASSETS

Assets are things that you already possess that can benefit your site. Identify the people, tools, equipment, financial resources, partnerships with local businesses, etc. that can help launch your site off the ground. Also identify the skills that you and your community members can offer.

TYING IT ALL TOGETHER

RESOURCE 4-1

This graph illustrates how the science of composting and the management of a community compost site (see Chapter 4) fit together.



COMPOST SITE ASSESSMENT

PERMISSIONS

Use OASIS or 596 Acres to determine the following:

1. What is the site's block and lot number?

2. Who owns the site? Is it a public or private owner? (Use OASIS to determine this)

3. Other than the site owner, who else might you need to talk with to get permission to use the site? (e.g., a school principal)

HISTORY

What is the history of the site?

ACCESSIBILITY

1. Is the site accessible to children, the elderly, and people with disabilities?

2. What could be done to improve the site's accessibility?

NEIGHBORS

1. What is in the site's near vicinity? Residents, businesses, a school, a park, etc.?

2. How will the neighbors affect how you manage the site?

3. Are other people or groups sharing the site itself? How they affect how the site is managed?

SPACE

1. How can the site be utilized to include the six basic composting stations discussed in this chapter, as well as other important site elements such as a place to store tools and equipment?

2. If the site is small, what could be done to more effectively utilize the space?

UTILITIES

1. Where can water be accessed?

2. Where can power be accessed?

SAFETY AND HEALTH

Are there any potential safety or health hazards? If so, what might need to be done to create a safer site?

ACTIVITY 4-2

DESIGN A COMMUNITY COMPOST SITE

Draw a plan for a community compost site using the template on the following page. Choose a name for your site and write it in the space provided.

Feel free to draw directly on the template, or transfer your design to graph paper or a computer program.

Include the six basic compost site stations:

1. Organics intake
2. Feedstock preparation
3. Active composting
4. Curing
5. Sifting
6. Distribution

Also include other important elements of a compost site:

- Water
- Storage
- Aesthetics
- Signs

CHAPTER 5

REBUILD NYC'S SOILS

USING COMPOST, MULCH, & COVER CROPS

LEARNING OBJECTIVES

- Identify how improving NYC's soils can improve public health and urban living
- Understand how to integrate compost into NYC's soils
- Know what compost tea and soil drenches are, and how to make them
- Identify and utilize a full range of soil care methods, including mulching, cover cropping, and using leaf mold

SUGGESTED ACTIVITIES

- Care for a Tree Pit (page 5-12)
- Interview a Community Gardener or Urban Farmer (page 5-19)
- Make Compost Tea (page 5-21)

SOIL IN THE CITY

Approximately 75 percent of the soil in NYC comes from "fill dirt." Not our original soil base, fill dirt usually consists of subsoil—the soil underneath topsoil. Fill dirt is typically used to fill holes in the ground, create mounds, or otherwise alter the grade or elevation of a landscape.

Fill dirt is generally high in minerals and low in organic matter. It can contain coal ash; construction debris; dredged sand, silt, and other debris that have built up in the bottom of water bodies; even municipal solid waste.

Decades of industrialization. Construction and deconstruction. Contamination from leaded gasoline, paint, and other environmental toxins. New York City's soil has been through a lot.

The result: poorly structured and poorly textured soil that's depleted of nutrients and, in many areas, contaminated with toxins, which could harm human and animal health. That's why the NYC Compost Project and community composters are working hard to rebuild soil in neighborhoods across NYC. Healthy soil means a safer and more beneficial environment for us, our families, our neighbors, and our pets.

BENEFITS OF COMPOST

In Chapter 1, we discussed how compost improves soil texture, soil structure, and pH levels. We also discussed how healthy soil contains a wide variety of macro- and microorganisms. Let's test our memory and briefly review some of the ways that compost improves soil health. Making compost is a critical part of rebuilding NYC's soils because compost:

Adds vital nutrients into soil. Nutrient-depleted soils stunt plant growth and metabolic activity, leaving plants prone to pests, disease, and premature death.

Adds "life" to soil. Compost supports a soil ecosystem that's full of small organisms, beneficial bacteria, and fungi. The living organisms can form symbiotic relationships with plants—such as fungi that help plants uptake nutrients—and help prevent pests and disease. Synthetic fertilizers do not add living organisms to soil, increasing a need for synthetic herbicides, pesticides, and fungicides to prevent crop failures.

Improves soil texture. Compost enables soil to better absorb water for plants to consume. In urban locales, well-textured soil can help manage storm water runoff, as it can effectively absorb and filter storm water. Well-textured soil also lets plant roots grow more easily by creating pore spaces in compacted soil.

Improves soil structure. Compost helps soil particles bind together into small, irregularly shaped balls called ***aggregates***. Soil particles that are tightly bound within aggregates resist erosion. Erosion is when wind and water displace topsoil. It can cause agricultural land to rapidly lose healthy topsoil and pollute

bodies of water. Also, erosion makes it difficult to build and maintain infrastructure such as roads and buildings. With compost, a slope along a highway can be rapidly re-vegetated.

Neutralizes soil pH level. Most plants thrive in soils that have a neutral pH level. If a soil becomes too basic or too acidic, plants can suffer from nutrient deficiencies or nutrient toxicities. Additionally, soil with a neutral pH level helps prevent plants from consuming environmental toxins, like lead and other heavy metals.

Applying compost mixed with plant seeds to control erosion at Freshkills Park in Staten Island.

WHY REBUILD NYC'S SOIL?

Now, let's step away from the microscope to look at a bigger picture: the public health and urban living benefits of strengthening our soils.

Healthy soils support a diversity of plant life. The plants living in New York City do many fantastic things. They help clean NYC's air and mitigate climate change by consuming carbon dioxide and turning it into glucose—a food for plants—through the chemical process of photosynthesis.

Plants also provide New Yorkers with fresh, organic, locally grown food. NYC has a rich tradition of community gardens, and many farmers'

Brooklyn Master Composters proudly show sifted compost.

markets are providing New Yorkers with produce grown practically in their own backyards.

Furthermore, plants beautify our neighborhoods. They are naturally soothing and promote mental wellbeing—especially important in a place as hustling and bustling as NYC! Beautiful environments also give reason for communities to take pride in their neighborhoods and spend more time outdoors, thereby fostering increased social interactions and safety.

Compost helps dilute, degrade, and eliminate toxins that might be present in urban soils, making it safer for everyone—adults, children, and pets—to get their hands dirty and play outdoors.

Healthy soils let children, adults, and pets experience the outdoors safely. Compost helps remediate contaminated soils. Contaminants such as heavy metals, petroleum products, and other pollutants pose a threat to our health. By moderating pH, binding soil particles together, and enhancing microbial communities, compost helps soil hold, dilute, degrade, or otherwise eliminate toxins. It's important to remember that although compost can mitigate some soil contaminants, it will not completely rid it of toxins. Also, depending on the level and source of contamination, the effects of remediation can take decades to surface.

Compost also helps eliminate a need for synthetic fertilizers, herbicides, pesticides, and fungicides. When landscapers, gardeners, and farmers use compost and other natural weed and pest management techniques instead of synthetic amendments, they help reduce public exposure to toxins. Making compost from your garden trimmings and kitchen scraps as an alternative to using purchased compost or synthetic fertilizers reduces transportation, reduces garden expenses, and guarantees that you will know exactly what is going into your garden.

Remember, if you're planning to grow food crops, make sure to get your soil tested for heavy metals before planting.

Soil encourages ecosystem diversity. Healthy soil is the foundation of an ecosystem that can support itself without high levels of human intervention. Beneficial soil organisms, pollinators, insects that prey on garden pests, migratory birds—these are examples of creatures that healthy soils with diverse plant life can attract. Soils can help restore "wild" habitats such as forests, stream beds, park land, and waterfront greenways, thereby supporting ecological diversity. Additionally, a high level of biodiversity in soil can help control and limit the spread of soil-borne pathogens.

Soil can help manage storm water in cities. In nature, much rainwater is absorbed by the soil and used by plants and soil organisms. In contrast, urban environments are filled with impermeable surfaces (surfaces that liquids cannot pass through) so rainwater must be managed by human-made infrastructures such as storm drains, sewers systems, and wastewater treatment facilities. These systems are not perfect—during heavy rains, a certain percentage of unfiltered wastewater water overflows NYC's sewage treatment system and is then drained directly into NYC waterways. This is a chronic public health and environmental issue that the Department of Environmental Protection and other city agencies are working to mitigate.

Flooding after a heavy rain in NYC. Absorbent, healthy soils can help prevent this kind of flooding.

Absorbent, healthy soils can help capture some of this rainwater for plants to use beneficially instead of letting it flow into sewers where it becomes a waste product. It can also help naturally filter contaminants in urban storm water and prevent flooding.

Soil can build support for organic waste recycling. Nearly a third of NYC's residential waste is comprised of organic materials. Many NYC residents are unfamiliar with composting and its benefits, so they might not be motivated to participate in programs. One of the ways the NYC Compost Project builds support for and participation in composting is by showing residents firsthand how composting can create healthier, more beautiful neighborhoods.

There is no better way to demonstrate the importance of composting and maintaining heathy soils than a thriving planting or garden bed, like this plot at the 64th Street Community Garden in Brooklyn.

SAFETY

If you will be working with NYC's soil, make sure to do so safely. Always do the following:

- Wear gloves while handling soil.
- Test soil for contaminants before growing food or allowing children to play in it. If soil is contaminated, grow food in containers or boxed beds with a thick liner at the bottom as a barrier to contaminated soil. If you work to restore contaminated soil in a certain area for several years, it could eventually become be safe to grow food in but it should be tested again to be sure.
- It might be surprising to hear, but poison ivy grows vigorously in some areas of NYC. Before removing weeds, survey the space to see if poison ivy is present. This invasive weed can be identified through its clusters of three leaves and "hairy" vining stem. Newer leaves have a reddish tint and more mature leaves are usually green. If you discover poison ivy, call 311 or report it online on **nyc.gov**.

Poison Ivy

Grow food in boxed beds or containers if soil is contaminated.

Search thrift shops for low-cost containers you can use for gardening.

COMPOST TESTING

We recommend testing the compost you're producing periodically so you can ensure its safety and quality. The U.S. Composting Council offers compost tests that analyze pH level, soluble salts, nutrient content, moisture content, organic matter content, maturity, stability, particle size, pathogen content (Fecal Coliform or Salmonella), and trace metals. Learn more: **compostingcouncil.org/seal-of-testing-assurance**.

USING COMPOST

There are many places to use compost in NYC. Community gardens, urban farms, street tree beds, parks, schools, landscaping, indoor planters, backyards, front yards, and other public green spaces can all benefit from compost.

All soil can benefit from compost. But a specific soil's need for compost depends on its existing quality and future use. For example, urban farmers try to regularly integrate compost into soil used to grow crops because it's being used so intensively—plants are often grown very close together to optimize the use of space and crop yields, so nutrients in agricultural soil are consumed rapidly.

In many cases, close observation and an understanding of the basic soil science we reviewed in Chapter 1 can help you determine how much compost a soil might need. If you want to see exactly how much organic matter is in a soil, you can get it tested by a soil lab and then make a decision about how much compost should be added. Some soil labs even provide quantity recommendations.

Remember, mixing compost that hasn't fully cured into soil can potentially be problematic. When compost is still actively decomposing, much of its nutrients will not yet be available in plant form. Also, applying hot compost (compost that is still in its thermophilic stage) could result in "burning" your plants, causing yellowing, stunting, or even plant death.

Here, we'll provide some basic guidelines for integrating compost into soils. Note that vermicompost can be applied in all of the same ways as outdoor compost, though it can be used in smaller quantities due to its high nutrient density.

GARDENS OR URBAN FARMS

If planting in boxed beds or containers: Evenly mix a two- to four-inch layer of compost into the bed or container using a pitchfork, trowel, or other suitable tool before planting. If you don't have enough compost to layer entire beds, put a handful of compost in each hole while planting seeds or transplants.

If planting directly into soil: This common tilling method used by urban farmers before planting is called "double digging," which helps loosen compacted soil. Dig a six- to eight-inch trench the width of the soil bed and about a foot across. Add a two- to four-inch layer of compost into the trench, and then stick a pitchfork into the bottom of the trench to push compost deeply into the bed and loosen compacted soil. Then, dig another trench the same size directly next to the first trench, using some more compost and the soil you dig up to refill the first trench. Repeat this process until you reach the end of the bed. When you dig the last trench, refill it with the soil you dug up from the first trench.

Staten Island's Castleton Hill Moravian Church Garden members make compost on site that is used to grow food in these raised beds

A less intensive way to add compost to a soil bed is to spread a two- to four-inch layer on top of it and mix it into the soil using a pitchfork, ideally to a depth of six to eight inches. This method doesn't integrate compost or reduce soil compaction deeply, so deep-rooted plants might not reap the full benefits of the added compost.

If you don't have enough compost to layer entire beds, put a handful of compost in each hole while planting seeds or transplants.

LARGE GROUP ACTIVITY:

PREPARE A SOIL BED AT A COMMUNITY GARDEN OR URBAN FARM

Visit a garden or farm that needs to prepare a soil bed for planting. Help gardeners or farmers prepare the bed, integrating compost into it according to the site's preferred method.

TREES AND SHRUBS

Before planting a tree or shrub, dig a hole twice the size of the plant's root ball. Place the plant into the hole, and fill it with a mixture of the soil you dug up and compost.

LARGE GROUP ACTIVITY:
CARE FOR A TREE PIT

Following the "Tree Pit Care" guidelines on page 5-12, instructors and students work together to improve the soil for neighborhood street trees using compost. If possible, try to care for a full block of trees! Consider planting flowers in the tree pits and/or installing tree guards.

Volunteers use compost to care for the soil in a street tree bed in Astoria, Queens.

INDOOR CONTAINERS AND WINDOW BOXES

Integrate about a one-inch layer of compost into indoor containers and window boxes before planting.

LAWN CARE

When establishing new turf, incorporate up to three inches of compost into the existing soil base. If possible, till to a depth of five to eight inches before seeding. Otherwise, seed directly over the compost.

On existing turf, you can treat bald spots by incorporating an inch of compost into the soil and then reseeding. This will fight compaction and help suppress soil-borne diseases. You can also top-dress existing turf with as much as one-half inch finely screened compost. This is easiest with a spreader, but you can use a shovel for small areas where you want to add compost. Rake the compost evenly throughout the grass area to enable the compost to readily sift down to the soil. The compost will settle down into the soil, improving its structure and providing nutrients. Over time, this will mean less compaction and fewer bald and dry spots.

Teaching garden

TREE PIT CARE

A city tree must battle many urban hazards daily—from air pollution and bicycles to dogs and people. In addition to above ground threats, tree roots also must contend with tough below-ground conditions. A tree pit or lawn strip provides limited space for these forest giants and this soil is a tree's only source of nutrients.

GUIDELINES

- **Using a hand cultivator, loosen the top 2-3 inches of soil to alleviate compaction and help water and air reach the roots.**
- **Apply a three-inch layer of compost and mulch (preferably shredded bark) to the tree pit.** Do not pile the mulch against the trunk of the tree; water will accumulate and rot the trunk.
- **The soil level around a tree should not change from the soil level at which it was planted.** Adding soil (even 6 six inches) can smother roots and rot a tree's trunk. Digging soil out can damage shallow roots.
- **Keep dogs and dog waste (both liquid and solid) out of the tree pit.** The waste will overwhelm a tree, burning its trunk, and throwing the soil nutrients out of balance.
- **Remove unwanted competing plants,** i.e., weeds.
- **Keep garbage and de-icing salt out of the tree pit.** Try alternatives to rock salt (sodium chloride) such as calcium chloride or granular urea. In the spring, flush the tree pit with water to dilute winter salt buildup.
- **Don't lock bikes to trees.**
- **Don't leave decorative lighting on past February.**
- **Remove supporting wires if they are left on more than one year after planting.**

TOOLS

- **Hand cultivator or trowel**
- **Shredded bark mulch or wood chips**
- **Flowers or bulbs**

SUGGESTIONS

If done carefully, you can plant flowers or bulbs in the tree pit (see separate sheet for recommended types). Flowers that have shallow roots and die back each year (annuals) will not seriously compete for limited resources. However, be sure to provide enough water for the tree, not just enough to perk up the flowers. Please do not plant flowers within one foot of the tree trunk. Consider installing tree guards. Strong metal guards around the edge of the pit protect the soil by discouraging pedestrians and dogs from walking through the pit. Do not place tree guards close to the tree. Do not build solid walls; these encourage people to add soil to the tree pit (see above guideline). We do not recommend tree grates, the metal grating that sits flush with the sidewalk. Trash accumulates beneath the grates and trees that outgrow a grate can be fatally girdled or strangled.

(Source: NYC Parks Website: **nycgovparks.org/trees/tree-care/tree-pit-care**)

COMPOST TEA

Compost tea is a liquid extract of finished compost. It contains a dense population of beneficial microorganisms that can help suppress plant diseases and foster thriving soil biology. It's applied directly to leaves and stems, which can be sites where diseases are transferred to plants. By applying compost tea, you provide a coating of healthy microorganisms that make these potential infection sites resist disease.

You can purchase a compost tea brewer from a retailer, or you could make one yourself by following the instructions on page 5-21 at the end of this chapter.

Compost tea should not be confused with leachate, the dark colored waste liquid that may drain from the bottom of the compost bin or pile. Also, compost tea is a beverage for plants—not for humans—so don't drink it!

Luke Halligan from the NYC Compost Project Hosted by Brooklyn Botanic Garden makes compost tea.

A gardener applies compost tea to plant leaves and stems using a sprayer.

LARGE GROUP ACTIVITY:
MAKE COMPOST TEA

Follow the instructions on page 5-21 to make compost tea and apply it to plant stems and leaves.

COMPOST SOIL DRENCH

A ***compost soil drench*** is made similarly to compost tea, except it usually does not use the complex sugar and protein additives. Instead, a soil drench uses a larger amount of compost in the tea bag and is aerated from six to 24 hours.

The benefit of a soil drench is not so much the nutrients—which are minimal in such diluted form—but the added microbiological diversity to the soil. This diversity can help plants uptake nutrients that would otherwise be unavailable.

Unlike compost tea, the drench is not intended as a foliar spray; apply it directly to soil above plant root zones.

OTHER WAYS TO REBUILD SOIL

In this course, we've talked a lot about using compost to rebuild NYC soils. There are two other important—and pretty simple—things you can do to improve soil health. The first is to add mulch, and the second is to plant cover crops. The best kind soil management utilizes the full range of soil management methods: composting, mulching, and cover cropping.

Straw mulch being applied to a raised bed at QBG Farm in Queens.

MULCH

Mulch is essentially a protective cover layer for soil that can be made from many different materials: woodchips, grass clippings, leaves, or any combination of these materials. Gardeners and farmers love mulch for the following reasons:

- It suppresses weeds, reducing both the need for weeding and herbicides.
- It shields soil from direct exposure to sun and wind, helping to keep soil moist and reduce the amount of watering required.
- It buffers soil from heavy rains, which can cause soil compaction and erosion.
- It moderates soil temperature, helping plants survive unexpected short periods of intense heat or cold.
- It replenishes organic matter in soil as it decomposes.

The mulching materials listed below are some of the most commonly used and are often readily available.

Grass mulch. You can mulch using grass clippings by mulch mowing, which is when you leave mowed grass clippings on a lawn. To mulch mow, remove the attachment on a standard lawn mower that catches grass clippings so that the clippings fall back onto the lawn.

Leaving grass clippings on the lawn to improve soil and grass health.

REDUCE NYC'S WASTE BY 78,000 TONS PER YEAR … BY DOING NOTHING

Grass clippings and leaf waste account for approximately 78,000 tons of waste per year in NYC. The NYC Department of Sanitation (DSNY) requests that city residents and institutions leave grass clippings on their lawns instead of setting them out for collection and disposal.

DSNY has deemed it illegal for private landscapers to place grass clippings at the lawn for collection. Landscapers must work with their customers to adopt "leave it on the lawn" practices OR transport grass clippings and leaf waste to a composting or waste-disposal facility.

Shred up leaves using a lawn mower and use them as mulch.

If you or a property owner is concerned about the aesthetic of stray grass clippings, follow these simple steps to make mulch mowing more attractive:

- **Face the blower back into the lawn.** This will ensure that clippings don't fly into the street or the sidewalk.
- **Mow your lawn when the grass is dry.** Wet grass clippings mass together into clumps.
- **Don't mow off more than an inch at a time. Shorter clippings** don't mass together as much as long ones do.
- **Mow a second time.** This will further shred your clippings and make them less obvious.
- **Use a sharp mower blade.** Dull mowers can give the lawn a frayed appearance. Generally, mower blades should be sharpened twice a year.

Leaf mulch. Make leaf mulch by shredding leaves into smaller pieces with a lawn mower. This prevents leaves from piling up into an impenetrable, matted layer and also helps decomposer organisms break them down faster. After removing weeds from the area you want to mulch, sprinkle shredded leaves around individual plants or on pathways and play areas.

Be aware that some leaves (e.g. pine needles and oak leaves) are highly acidic and may alter your soil's pH level. Avoid using leaves from allelopathic trees—trees that naturally impede plant growth—for mulch in planting areas. It is, however, fine to use allelopathic leaf mulch on pathways where you don't want plants to grow. Common allelopathic trees are black walnut, eucalyptus, sugar maple, tree-of-heaven, hackberry, American sycamore, black cherry, red oak, black locust, and American elm.

Wood mulch. Wood chips, shredded branches, wood shavings, and coarse ground bark make great woody mulches. Because they decompose slowly, woody mulches last longer than many other kinds of mulches. Make woodchips by using a chipper (see "Tools" in Chapter 3). If your garden or farm doesn't have a chipper available but you have wood that can be chipped, contact the NYC Compost Project for chipping services.

Never use wood chips or sawdust to mulch herbaceous plants. As with unfinished compost, woody materials compete with plants for nitrogen when they are mixed with soil, which can cause plants to become yellow and stunted. Only use wood mulch near perennial plants that have woody stems, like trees or shrubs.

Wood mulch is also a great covering for garden or farm paths—they are comfortable to walk on, keep weeds at bay, and offer a neat aesthetic. Most importantly, applying wood mulch on pathways can provide a protective layer over soils contaminated with heavy metals. This can help prevent soil dust from getting into the air and being swept onto plants, or being brought into homes on shoes.

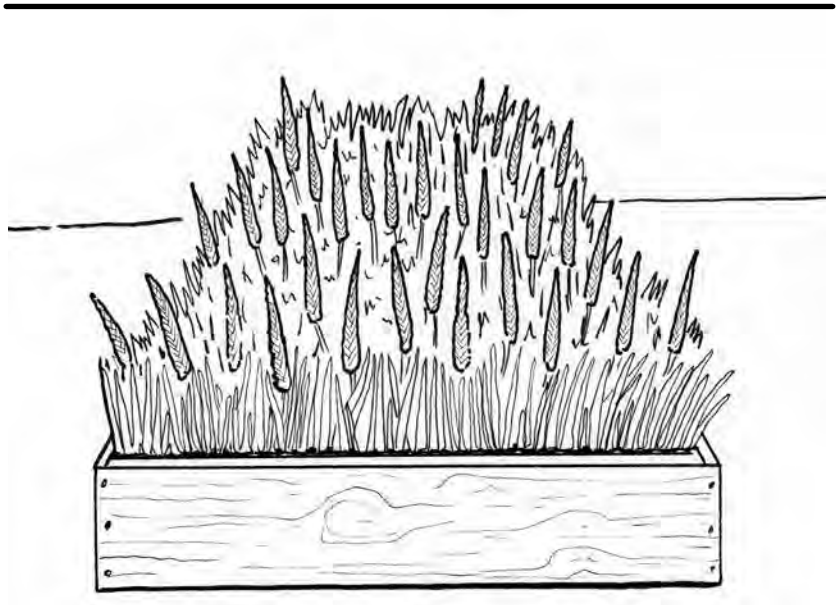
WOODCHIPS FOR NYC RESIDENTS

Unlimited woodchips are available to NYC residents during Mulchfest in January, or through NYC Parks and Recreation borough offices. Also, tree trimming companies will often deliver woodchips for free.

COVER CROPS

Cover crops—also known as living mulch or green manure—are plants you grow in fallow (empty) growing plots. Planting cover crops have several benefits. They prevent weeds from quickly taking over a fallow growing plot, prevent erosion, add organic matter to soil, hold soil moisture, and contribute to biodiversity.

While a variety of plants can be suitable cover crops, the most common are legumes and grasses. Legumes like peas, clover, and vetch are popular because they have the ability to pull nitrogen from the air and release it into soil through a symbiotic relationship with soil bacteria. This process is called nitrogen fixation. Grasses like rye, oats, and sorghum are popular because they provide a large amount of organic matter that can be chopped down and used as mulch, or can be tilled into the soil and left to decompose in place. You can plant one or multiple types of cover crop in growing plots.



Cover crops improve soil in growing plots that would otherwise be left fallow.

Cover crops can be planted anytime a growing location is fallow, weather during the growing season or when the growing season ends in the fall. Some cover crops are winter hardy, meaning they will survive freezing temperature and regrow in the spring. The advantage of using winter-hardy cover crops is that you'll have plant life starting as soon as possible when the weather begins to heat up; however, some winter-hardy cover crops can be hard to control without specialized machinery, so be sure to do research before seeding.

Crimson clover used to amend soil at the QBG Farm, a partnership of the Queens Botanical Garden and NYC Department of Sanitation.

For small gardens, it is best to only plant cover crops that will die during freezing temperatures. This means that seeds need to be sown in the fall so the cover crops grow as much as possible—and in turn, improving the soil as much as possible—before they die when it freezes. Come spring, you'll have a nice layer of mulch!

POPULAR COVER CROPS

Here are some commonly used cover crops. Many other plants are well-suited to be used as cover crops as well. Ask gardeners and farmers you know about their favorites!

Legumes: White Dutch Clover, Mammoth Red Clover, Crimson Clover, Peas, Vetch, Alfalfa

Grasses: Rye, Oats, Sorghum

LEAF MOLD

Imagine a top layer of soil deep in a forest where leaves have fallen and then decomposed for years and years. That forest topsoil—made almost entirely by decomposed leaves—is dark, crumbly, and has a distinctly earthy smell. This is ***leaf mold***!

We can make leaf mold ourselves in NYC using fallen leaves from trees and shrubs. Leaf mold doesn't have the same biological diversity as finished compost made from a diverse assortment of organic waste; however, it remains a useful soil conditioner. Leaf mold adds fugally dominant organic matter, which improves soil structure, aids in water absorption and retention, and gives refuge to many of our invertebrate friends when it's applied as mulch. Being dark in color, it retains heat in the spring and fall and acts as a soil insulator in winter.

Making leaf mold is easy and requires little attention. In the fall, rake up leaves and pile them in a wire bin or large plastic bag. Turn the pile several times throughout the year to add oxygen, and monitor for moisture—you want the pile of leaves damp, like a wrung out sponge. Because leaves are strictly carbon, they take usually between six and 12 months to decompose. To speed decomposition, you could shred the leaves with a lawn mower before making the pile. After the leaves have decomposed into a dark and crumbly material, you've got yourself some leaf mold!

You can apply leaf mold anywhere in the garden. Just remember that leaf mold is acidic, so you should apply it to soil used to grow plants that desire more acidic conditions. Some examples are blueberries, potatoes, ferns, and hydrangeas.

LARGE GROUP ACTIVITY:

INTERVIEW A COMMUNITY GARDENER OR URBAN FARMER

Visit a community garden or urban farm to interview a site manager or active gardener/farmer about their soil care methods.

- Do they use compost? How?
- Do they use compost teas or soil drenches? How?
- Do they use mulch? How
- Do they use cover crops? How?
- Do they use leaf mold? How?

ACTIVITY 5-1

HOW TO MAKE COMPOST TEA

WHAT IS COMPOST TEA?

Compost tea is a liquid brew created from finished compost. When applied to the soil or plant surfaces, compost tea adds microorganisms (such as bacteria, protozoa or nematodes, and fungi) as well as nutrients, which may help prevent pests and disease.

A traditional method of making 'tea' involves suspending a burlap bag of compost or aged manure in water, letting it steep for seven to fourteen days, and then using this fermented liquid extract as a fertilizer for plants. The preferred technique is to maintain and increase the population of beneficial microorganisms by aerating the water with a pump and adding a food source such as molasses, kelp powder, or fish hydrolosate to encourage specific beneficial microorganisms to reproduce.

NOTE: Compost tea should not be confused with compost leachate, the dark colored liquid that may drain from the bottom of the compost pile.

BENEFITS OF COMPOST TEA

Applying compost tea to the soil provides nutrients and beneficial organisms directly to the area surrounding the roots, where plants can easily utilize them. Plants treated with compost tea may establish deeper roots, enabling them to be more stress and drought resistant.

The microorganisms in compost tea increase the biological activity in soil, which enhances overall soil structure, leading to greater moisture and nutrient retention.

Spraying compost tea directly on leaf surfaces can also help ward off common fungal and bacterial diseases by causing the beneficial organisms to outnumber the disease-causing ones.

When finished compost is in limited supply, brewing compost tea allows you to get more out of the initial finished compost as it increases the original population of organisms, and covers more ground than the compost would.

MATERIALS FOR MAKING "BUCKET-BUBBLER" COMPOST TEA

To make your own compost tea using the Bucket-Bubbler method, you must begin with the right materials.

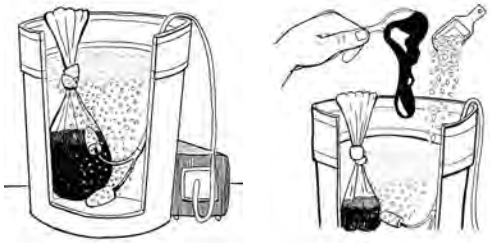
- 3 cups of good quality finished compost or vermicompost
- a 5-gallon bucket
- something to stir the mixture
- an aquarium air pump
- several feet of tubing
- a gang valve
- three bubblers (also called air stones)
- bag for compost (paint strainer bag or burlap bag)
- 1 ounce microbial food source (unsulfured molasses, kelp and/or fish powder)
- a watering can or a clean fertilizer sprayer

HOW TO BREW COMPOST TEA

One way to make your own compost tea is to use the Bucket-Bubbler method. This brewing process takes 1 day, so allow enough time for brewing and be ready to apply the mixture immediately after finishing.

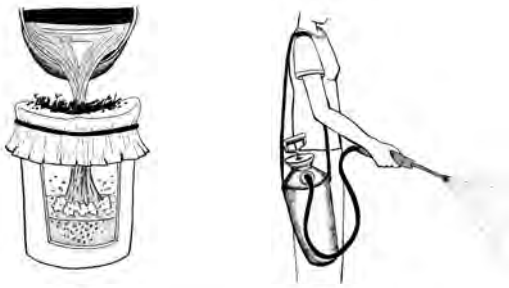
1. **Attach tubing, gang valve and bubblers to bucket.**
   Cut four lengths of tubing as tall as your five gallon bucket. Attach one length of tubing from your pump to the gang valve. Attach the three other pieces from the ports on the gang valve to your three bubblers or air stones. Secure the gang valve to the lip of the bucket and place the stones inside.

2. **Add water and compost to bucket.**
   Fill bucket three quarters full with water and aerate with a bubbler for one hour, or let sit for 24 hours to allow the chlorine present in city water to dissipate. Once you have chlorine-free water, add three cups of compost to your straining bag. Make sure the compost is loose in the bag for the bubblers to aerate properly. Don't let the bag sit against the bucket wall as this can support the formation of anaerobic microbes, which you don't want in your compost tea. Arranging the bubblers so they surround the bag will ensure maximum aeration.

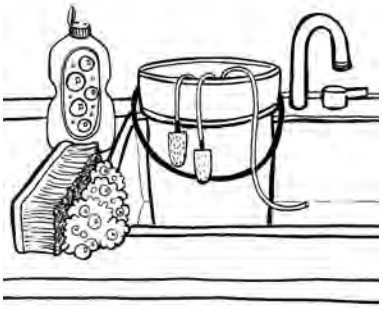


3. **Feed the microorganisms and stir.**
   Feed the microorganisms by adding one ounce of unsulfured molasses or one ounce kelp/fish powder to the bucket and stir. After stirring, you'll need to rearrange the bubblers so they are well-spaced.

4. **Remove equipment and apply compost tea**
   After 24 hours, turn off the pump, remove the equipment, and return the used compost to your compost pile. Use the compost tea immediately (within the hour, if possible), either as a soil drench or a foliar spray. As a soil drench, empty the tea into a watering can and pour gently on the soil near the plants. For use as a foliar spray, empty tea into a clean sprayer, and cover the leaf surfaces of the plants.



5. **Clean equipment well.**
   Using a soft brush and water, clean all surfaces of equipment and flush tubes repeatedly. If biofilm is difficult to remove, add a teaspoon of baking soda to cleaning solution and repeat.



CHAPTER 6

REACHING & TEACHING OTHERS

LEARNING OBJECTIVES

- Conduct outreach and engage New Yorkers in composting
- Use learning tools and techniques to plan and facilitate a workshop

SUGGESTED ACTIVITIES

- How Do I Learn? (page 6-8)
- Create a Lesson Plan (page 6-9)
- Engage the Senses (page 6-12)
- Ask Open-Ended Questions (page 6-13)
- Independent & Group Work (page 6-14)
- Conduct a Compost Workshop (page 6-15)
- Outreach Role Play (page 6-18)

In this final chapter, we're going to discuss how you can share what you've learned in this course—and from the countless experiences with composting you're bound to have!—with your community and New Yorkers at large. We'll explain the difference between outreach and education (as defined by this course), and identify techniques you can use to teach others about composting.

OUTREACH

What we refer to as ***outreach*** is connecting with relatively large numbers of people during short periods of time. Outreach can occur in a number of ways. You can host information tables at public events like farmers markets, block parties, or festivals; distribute informational flyers at community meetings; post signs in the windows of local establishments: all are great ways to convey the importance of your cause to your community. You might want to contact event organizers to ask if there will be upcoming tabling opportunities available. Alternatively, you could plan an event of your own.

A family learns about composting with worms at a community event.

The people you talk with when you conduct outreach will have a range of knowledge about composting—some will be very familiar with it, and some will know next to nothing about it. Some people will be supportive and enthusiastic, while others might express skepticism or concern. Remember to treat everyone you talk to with respect.

When conducting outreach, you'll only have a few moments to capture people's attention. Try focusing on these three things:

1. **Change the way someone sees an apple core.** Instead of something to toss in the trash, you can help New Yorkers recognize food scraps as valuable resources that can benefit their community. To do this, you can explain the benefits of composting you discussed with your classmates during your orientation and throughout the Master Composter course. Let folks scoop up a handful of rich, finished compost. Explain how the compost they're holding can be used in their homes or neighborhood to improve soil and health.

2. **Provide information.** Master Composters can order or download educational materials for free online from the NYC Department of Sanitation's (DSNY) website at **nyc.gov/dsny**. If you are starting or promoting a compost site, create your own flyers that inform people of the site's location, contact information, operating hours, schedule for accepting food scraps, and any other important information.

Carol Hooper, from NYC Compost Project Hosted by Snug Harbor Cultural Center & Botanical Garden, conducts outreach at an event.

3. **Address concerns.** People will want to be sure composting is a positive endeavor for them and their community before offering their support. Try to address concerns the best you can. If you don't know the answer to a question or aren't in a position to respond to a particular issue, don't be afraid to say, "I don't know." In those cases, you can always connect people with NYC Compost Project staff or direct them to DSNY's website where they can contact the appropriate staff person for help.

LARGE GROUP ACTIVITY

OUTREACH ROLE-PLAY

Break students into groups. Assign each group one of the outreach scenarios on page 6-18 to act out. Students can decide on roles among themselves. Instructors can give students time to plan a skit, or ask them to improvise. Students present the skits to the class.

TIPS FOR TABLING

Post a sign or hang a banner that clearly states to passersby why you are there—and make sure it grabs their attention.

A bold chalkboard sign catches the attention of event attendees.

Make a fun sign using reclaimed materials, like making letters out of cardboard boxes.

Bring finished compost to show people exactly what it is. Let them feel it and sniff its earthy aroma.

Use strong visuals that will catch the eyes of your community members.

Provide educational materials to help people get started composting. Free materials are available to Master Composters for downloading or ordering at **nyc.gov/compostproject**.

Let people touch the objects on your display. When people see others are handling compost, tools, and bins, they will be intrigued to come check it out—and play for themselves! A great way to do this is by using a small sample worm bin to explain vermicomposting. Get people involved by handing them a trowel and have them search for worms themselves. Master Composters can borrow display worm bins from the NYC Compost Project.

Provide demonstrations to show people what the composting process involves or to explain how to build a compost system.

Play a game to get the crowd involved. For example, display a variety of materials that can be composted, recycled, or discarded in the trash. Test people's knowledge by having them place items in the correct bins.

A woman sniffs finished compost.

An illustration of worm anatomy in front of a worm bin table display.

Test people's composting knowledge by inviting them to play a game of Compost Jeopardy.

Children use trowels and magnifying glasses to search for decomposer organisms.

A display of jars showing soil composition from several different locations.

Making decomposer organisms with children out of felt and other materials.

EDUCATION

Education for Master Composters means sharing relatively in-depth composting knowledge and skills. You can do this by teaching a school workshop on worm bin composting, hosting a tour of a compost site in your community, or training residents in your building to use the compost system you installed in the yard.

Jenny Blackwell, of the NYC Compost Project Hosted by Brooklyn Botanic Garden, teaches an outdoor workshop on composting.

Your focus will depend on your audience. Fourth graders will likely enjoy learning about worms and how they can turn banana peels and carrot tops into food for a flower. Residents in your building will need more specific information about how to use a compost bin: what greens and browns are acceptable and why, how to prevent pests, and how to identify and fix problems.

The NYC Compost Project and the New York Restoration Project team up to offer a sifter workshop, during which participants build their own sifters.

If you don't know what your audience is interested in, ask! Consider sending out a survey before you plan the content of your workshop, tour, or training to get a sense of what people already know and what they are interested in learning.

You can prepare for your own composting workshop by first joining one taught by the NYC Compost Project. The NYC Compost Project conducts indoor and outdoor workshops throughout the year at NYC's botanical gardens, community gardens, libraries, schools and other public spaces.

LOCATION

The location of your class, workshop, or training can be a helpful learning tool. First, consider the topics you're covering. Will it be helpful to conduct your workshop outdoors? And if it rains, what alternate space could you use? Is there a restroom nearby? If you're presenting how to manage a compost system, a compost site is an ideal location. Need indoor space? Consider a library, community center, school, church, or apartment building meeting rooms.

Jodie Colón, from the NYC Compost Project Hosted by The New York Botanical Garden, leads a workshop on building a compost bin.

LEARNING TOOLS & TECHNIQUES

Everyone learns in different ways. Some people learn by reading or absorbing visuals; some by doing; and others by listening. Many people learn best when a combination of learning styles is utilized. When you teach people about composting—or anything for that matter—plan to communicate information in a variety of ways and provide opportunities for students to practice the skills they are learning.

If you're teaching about composting, it's helpful to have some basic tools in your "teacher tool belt" that you can pull out and use when you need to plan a workshop or host an educational tour at a compost site. Let's review some of these tools and techniques you can use to engage a diversity of learning styles and create space for student practice.

Everyone learns in different ways. Let students explore a topic from multiple angles.

INDIVIDUAL ACTIVITY:
HOW DO I LEARN?

Instructors give students a few minutes to individually reflect on and write about how they learn. Afterward, instructors facilitate a group discussion about student reflections and record patterns gleaned from students' responses.

Some journal and/or discussion prompts include:

- How do you learn best?
- Where do you learn best?
- Who was your favorite teacher? Why?
- What are some barriers to learning you've encountered?
- Do you prefer group work or individual work, or a combination?

CREATE A LESSON PLAN

A lesson plan will be your guide for every workshop or course. There are many ways to approach creating a lesson plan. Here's just one way you could do it. At the end of this chapter, we've included sample lesson plans for you to use as guides.

1. **Start with the end in mind:** Create learning objectives. What do you want students to have learned by the end of your class? What have the participants identified that they want to learn? Make a list of these "learning objectives."

   Look to this manual as an example. At the beginning of each chapter, we've identified learning objectives—the skills we hope you'll have learned by the end of the Master Composter Course. Flip to the beginning of each chapter to review these learning objectives.

   Now, try creating your own. List two sample learning objectives for a composting workshop for high school students:

   1. _____

   _____

   _____

   _____

   2. _____

   _____

   _____

   _____

2. **Identify "avenues for learning."** Learning is a journey. What roads will students travel to get to the learning objectives you've identified? Take a learning objective we've identified for this chapter: "Use learning tools and techniques to plan a workshop." An avenue for learning we provided is this very set of guidelines for creating a lesson plan. Another is giving you space to practice using these guidelines by completing short exercises.

   List two potential avenues for learning the sample objectives you listed in step one:

1. _____

   _____

   _____

   _____

2. _____

   _____

   _____

   _____

3. **Determine how students will demonstrate their knowledge.** How will students demonstrate that they've successfully traveled the avenues for learning you've set out and met their learning objectives? Will they take a quiz? Play a trivia game like Jeopardy? Build a worm bin as a group? Come up with a way (or multiple ways) for participants to show you that they've learned something. If students struggle significantly with this step, it may indicate that your students had trouble comprehending the material and that you might need to restructure the activity, workshop, or course to encourage more effective learning.

   For example, to give you a chance to demonstrate your knowledge, at the end of this chapter we've suggested a group homework assignment in which you work with your classmates to develop your own composting workshop so you can put what you've learned into real-time action.

   Based on the learning objectives and avenues for learning you've listed above, list two ways students could demonstrate their knowledge:

1. _____

   _____

   _____

   _____

2. _____

   _____

   _____

   _____

ENGAGE THE SENSES

When planning a workshop or gathering display items for your table, think about how you can engage participants' senses—sight, sound, smell, taste, and touch.

List two ways you could teach people about composting by engaging them with each sense listed below. We've filled out the first one for you!

Sight	**1.** Show students photos of a variety of composting systems. **2.**
Sound	**1.** **2.**
Smell	**1.** **2.**
Taste	**1.** **2.**
Touch	**1.** **2.**

ASK OPEN-ENDED QUESTIONS

If you want to encourage discussion, try asking ***open-ended questions***, which are questions that provoke an answer beyond "yes" or "no," or a single word or phrase. Try to be aware of when you are asking a close-ended question when you mean to asking an open-ended one.

Here are some examples:

Closed-Ended Questions	Open-Ended Questions
Did you have a nice day?	How was your day?
Did you like the show?	What did you think about the show?
Have you ever composted before?	What's your experience with composting?

Try it yourself! Convert the closed-ended questions below into open-ended ones.

Closed-Ended Questions	Open-Ended Questions
Can I help you?	
Are you feeling better?	
Do you like gardening?	

INDEPENDENT & GROUP WORK

Integrating independent and group work into your lesson plan gives students a chance to practice solving problems on their own and work collaboratively.

List some benefits and challenges of working independently and working in groups. Consider these benefits and challenges as you create your lesson plan, so that you can determine how to best assign independent or group work.

Working Independently	
Benefits to Students	**Challenges for Students**

Working in Groups	
Benefits to Students	**Challenges for Students**

MAINTAIN ENERGY

Sitting in a chair for long periods of time can be tough. Even if the topic being discussed greatly interests you, it's natural to lose focus after a while. Give students opportunities to re-energize by incorporating breaks and short movement activities, such as a class stretch or a physically active game.

Here are some examples:

- **Human Mirror.** Assign participants a partner and have them face each other. One person takes the lead for a minute, moving in any which way they'd like, and the other person mirrors everything that person does. After a minute, switch leaders.
- **Animal Parade.** Ask participants to think of an animal in their heads (they should not announce their animal out loud). Then tell participants to act like the animal they are thinking of and arrange themselves into a single-file line from smallest to largest animal. Animal noises are okay, but no one is allowed to talk!

SMALL GROUP ACTIVITY:
CONDUCT A COMPOST WORKSHOP

Students break into groups and conduct a 5-10 minute workshop about an assigned composting topic, or a composting topic of their choice.

Students should create a short lesson plan (see page 6-9) that incorporates some or all of the learning techniques discussed in this chapter.

- Incorporates various learning styles
- Engages multiple senses
- Ask open-ended questions
- Assign group and/or independent work

TIPS FOR FACILITATING WORKSHOPS & COURSES

Know your participants. Every student will arrive at your workshop or course with his or her own set of experiences and expectations. Tailor activities and questions to your audience to improve the learning experience. Get to know your students (and allow them to get to know each other) by facilitating an icebreaker activity at the beginning of class. (A sample icebreaker activity, "Compost Bingo," is on Orientation, page O-14).

Consider sending an online survey a few weeks before the workshop begins to get a sense of students' prior knowledge about and experience with the subject, why they are taking the workshop, and what they are specifically interested in learning. Then construct your lesson plan accordingly.

Work with a partner. It's difficult to create a lesson plan, teach a workshop, hand out materials, and administer surveys all by yourself—especially if you are new to teaching. Working with others can make teaching more manageable for you, and therefore create a smoother workshop for participants.

Set up equipment before the course begins. Tech problems are common, so give yourself plenty of time to set up computers, projectors, and other equipment before the class begins. Know where you can get technology assistance if you encounter a problem.

Agree on classroom etiquette. Set classroom conduct and participation guidelines at the beginning of a workshop. Ask students to contribute their own guidelines as well. For example, a "step up, step back" guideline asks students to self-monitor how much they've been participating: if a student hasn't said anything in a while, they are encouraged to "step up"; if a student has had many chances to speak, they are encouraged to "step back."

Use a whiteboard or chart paper. Having space to write down key ideas or draw concepts can be very helpful.

Invite personal discussion. Build in some flexibility in your lesson plan to address and guide discussion based on students' personal interests and curiosities. Encourage students to share their thoughts, questions, concerns, and experiences. Let students learn from and teach one another. And remember, you can learn from students too!

Keep track of questions. Questions are often good—but sometimes, they can be off-topic or too time consuming to address in a particular moment. Instead of stopping class to address such questions, add it to the "bike rack"—a board or piece of chart paper where students can write down their questions and save them for later. Set aside time at the end of each class to review the questions compiled on the rack.

Don't be afraid to admit you don't know the answer. Participants will sometimes stump you with questions you can't answer. Use this opportunity to demonstrate how they can find the information on their own, or to defer the question to other participants to enhance their contribution to the workshop.

You can always contact your course instructors or the NYC Compost Project with any compost-related questions.

Whatever you do, don't make up an answer—that won't benefit anyone!

Observe the energy in the space. People will often show you whether they are enjoying an activity and understanding major concepts without even speaking—through their tone of voice, body language, or interactions with other audience members. These are all things that you need to watch out for—and respond by adjusting your lesson plan accordingly. Don't be afraid to stop, back up, or change gears entirely—just make sure that you are not challenging anyone or making them feel singled out.

Address difficult classroom dynamics. Sometimes, you may encounter disruptive behavior from students. For example, someone may ask a lot of questions and not allow a chance for others to speak, or two people may whisper to each other while someone else has the floor. Establishing "class etiquette rules" that both the students and instructors agree upon at the start lets everyone play a role in holding one another accountable for their behavior. Also, you can address the behavior yourself: if you notice some people are participating much more than others, ask the class if someone who hasn't yet spoken would like to participate.

Get feedback. At the end of the course, give students an evaluation form on which to provide constructive feedback. That way, you'll know what they liked and what could be improved about your course.

ACTIVITY 6-1

OUTREACH ROLE PLAY

INSTRUCTIONS

Break students into groups. Assign each group one of the outreach scenarios below to act out. Students can decide on roles among themselves. Instructors can give students time to plan a skit, or ask them to improvise. Students present the skits to the class.

- **Scenario 1:** At a community event, a group of children between the ages of five and ten notice a large poster of a worm next to a table that Master Composters are conducting outreach from. They pull their parents over to the table, hoping to check out some worms. Neither the children nor their parents know much about composting.
- **Scenario 2:** Master Composters are tabling at a block party in their neighborhood to promote a new community composting site. They are approached by a group of neighbors who are very concerned about the new compost site causing foul odors.
- **Scenario 3:** Neighbors in a large residential building have decided they want to build a compost site in their courtyard. They've invited Master Composters to host a meeting with residents who are interested in helping to come up with a plan for creating a site that works for them. Some residents are very knowledgeable about composting, while others are not.
- **Scenario 4:** Master Composters have set up a demonstration of a variety of compost bins at a sustainability event for teachers at a high school. They are approached by several teachers who have recently started a small educational farm on the school's property. The goal of the farm is to provide hands-on learning opportunities for students that focus on food—both food production and food waste. The teachers are curious about how setting up a compost site on the farm could help them do this.
- **Scenario 5:** A group of community compost site managers are invited to present about their project to their community board, which is very enthusiastic about their work. The site managers welcome the opportunity as they are planning to begin accepting food scraps from local residents. When they announce this at the meeting, however, a resident voices her concern that the food scraps will attract rodents.

NYC Compost Project programs are carried out by staff funded by the NYC Department of Sanitation at host sites in each borough.

Big Reuse
bigreuse.org/compost

Brooklyn Botanic Garden
bbg.org/compost

Earth Matter NY
earthmatter.org

Lower East Side Ecology Center
lesecologycenter.org/compost

Queens Botanical Garden
queensbotanical.org/compost

Snug Harbor Cultural Center & Botanical Garden
snug-harbor.org/compost

The New York Botanical Garden
nybg.org/compost

General Information

Web: nyc.gov/compostproject
Email: nyccompostproject@dsny.nyc.gov

NYC Compost Project
Funded by NYC sanitation