FREIGHT FARMS

EDUCATION PROGRAM GUIDE & CURRICULUM

for Schools, Universities & Nonprofits

Acknowledgments

Thank you to all the farmer-educators who provided meaningful insight on this guide during its early stages. We are in awe of the passion, ingenuity, care and dedication that went into building successful container farming programs from the ground up when no such guide existed, and are grateful for the willingness to share what you learned.

A special thank you to the following educators:

David Larsen, Mountain Vista High School

Lauren Utschig & Max Fontes, Boys & Girls Club of Metro South Boston

Saralyn Tartaglia, Support & Feed, Boys & Girls Club of Los Angeles

Dr. Daniel Wells, Auburn University

Andrew Guay & Shane Jones, Durham College

Table of Contents

Acknowledgments **2**
Table of Contents **3**
Introduction **4**
Welcome! 5
How This Guide Came to Be 5
Guiding Principles 7
How It Works 9

Setting Yourself Up for Success **11**
Know Your Priorities 12
Build an All-Star Team 13
Lead Farmer 13
Hierarchy & Support 15
Setting Up Your Space 17
Physical Location 17
Workspace Tools & Mods 17
Calibrate Expectations & Start Simple 20

Teaching Foundations & Resources **22**
Overview - K – 12 Schools 24
Relevance by Age for K – 12 Schools 25
Overview - Nonprofits 25
Overview - Universities 27
Class Configuration & Group Sizes 29
Clean As You Go 30
Core Farm Activities **33**
Farm Field Trips & Tours 34
Seeding 39
Transplanting 43
Harvesting 47

Activities: Young Children (Grades 3–8) **51**
Activity: Food Steps Exercise 52
Activity: 5 Senses Exploration 55
Activity: Farm Fresh Salad with Green Goddess Dressing 57
Worksheet: Crop Arithmetic 60
Additional Activity Ideas for Younger Children 61
Activities: Older Children (Grades 9–12) **63**
Activity: Crop Trial & Yield Data Analysis 64
Activity: Mixing Solutions & Calibrating 69
Activity: Evaluating Farmhand® Datasets & Graphs 72
Worksheet: Cultivation Irrigation Flow Rate 75
Additional Activity Ideas for Older Children 77
Activities: University **78**

In Conclusion: YOU GOT THIS! **81**
About the Author 84
Additional Resources **86**

Introduction

Welcome!

Congratulations on taking the first steps to bringing a state-of-the-art educational platform to your school or organization!

You are now part of an international network of hundreds of Freight Farmers united by the mission to revolutionize farming. Across the globe, educators and community members are using the Freight Farms as a cutting edge tool for STEM education and workforce development. Together, this segment of the Freight Farms community is working to revitalize agricultural education and prepare the new generation of farmers and scientists for the dynamic challenges our world faces.

While the hydroponic growing method is an ancient solution that dates back thousands of years, container farming is a brand-new feat of human innovation – and you are on the forefront of bringing this solution to the education and service-driven space.

There exist limitless possibilities for how to use your farm and how to maximize its impact. Our education & nonprofit customers span a variety of school and community settings, each using their farm in a uniquely tailored way, and yet there's one thing they all have in common - students and kitchens love it! The high-tech learning environment of the Freight Farm captivates young minds in a way that the traditional classroom can't, the hyper fresh produce takes cafeteria offerings to the next level, and modern technology of the farm serves as an incomparable public engagement tool to recruit new students, volunteers, funders, and more. We are so excited to see how your organization or school chooses to use the farm to make classrooms richer, cafeteria trays fuller, and communities brighter.

How This Guide Came to Be

There are a growing number of customers in the public sector, as educators and community groups worldwide are awakening to the utility of hydroponic systems to teach hands-on science that empowers local food systems. The movement to develop educational resources around hydroponic systems and indoor agriculture is growing, but it doesn't always apply specifically to the unique spatial environment of vertical container gardening, let alone an industry-leading, densely outfitted, high-tech product like a Freight Farm. No clear evidence base existed on how to teach hydroponics to different ages across different types of institutions.

Unique considerations arise when adding a farm to a school, university, or community setting as opposed to a typical small business or for-profit operation. The first and most obvious is that you are teaching! This requires extra time in and of itself. Training any new students in farming means that the actual farming will take longer than it would if an independent grower were doing it themself. You're also adding a Freight Farm to an existing institution — already full of many people, moving parts, and responsibilities. Integrating a commercial farming operation into an existing school or nonprofit structure requires lots of teamwork, coordination, collaboration, and communication that you likely wouldn't see at such scale among a small team of entrepreneurial farmers.

A larger roadmap was needed to merge basic teaching elements with the nitty-gritty of implementing a commercial-scale growing operation into an existing school or nonprofit setting. We wanted to take the guesswork out of the equation and offer some tried and true solutions to some of the most valuable, albeit time- and resource-constrained, members of society: teachers

and nonprofit employees. We tapped into our network of farmers already doing the work of growing and teaching and compiled their years of learnings into an evidence-based, practical user guide that will set you up for success. In other words, we did the research so you don't have to!

There are a growing number of customers in the public sector, as educators and community groups worldwide are awakening to the utility of hydroponic systems to teach hands-on science that empowers local food systems. The movement to develop educational resources around hydroponic systems and indoor agriculture is growing, but it doesn't always apply specifically to the unique spatial environment of vertical container gardening, let alone an industry-leading, densely outfitted, high-tech product like a Freight

If you haven't seen them yet, check out our Grow Food *Here* case studies, featuring our education & nonprofit customers including Boys & Girls Clubs of Metro South, Mountain Vista High School, Auburn University and Lotus House.

Guiding Principles

Practicality

If you want to have a successful, self-sustaining educational farm program, most of your time will be spent farming. For this reason, we structured this guide around the foundational tasks of seeding, transplanting, harvesting, routine maintenance, and technical problem-solving. This is based on the practical need to fulfill farm labor but also on real, repeated feedback from teachers operating Freight Farms, who do not follow a step-by-step lesson plan each time they're inside the farm but rather respond flexibly to farm needs on a given day or week to grow produce and generate revenue.

There are a lot of lesson plans out there teaching plant science to K–12 students. We didn't want to reinvent the wheel and give you a stack of materials that are going to sit in the back of your classroom collecting dust. Instead, our intention was to thoughtfully design activities that directly support production needs and teach students how to actually farm. In addition to the core farming activities of seeding, transplanting, and harvesting, we provided sample lesson plans to give you some (non-exhaustive!) ideas of other types of learning that are possible with a Freight Farm. You can also view the Additional Resources section at the end of this Guide to see other publicly available plant science and gardening education curricula that we love!

Hands-On Learning

There is a pressing need for innovative learning that not only teaches students academic STEM concepts but also engages them in stimulating, hands-on activities with real-world impact. All lesson plans in this guide are crafted around a backward design framework in which the primary outcome is to operate a commercial farm and support food production needs. Students will learn the ins and outs of vertical farming while simultaneously developing real-world skills like critical thinking, problem-solving, and decision-making — without ever realizing they're being taught. Because there is such a heavy emphasis on learning by performing the core farming tasks, this "curriculum" may not look like other typical curricula you've seen. For teenagers and college students, this model teaches valuable life skills and workforce readiness. And for younger students in grades 3–8, it provides a welcome break from the sometimes rigid structure of school instruction in a setting unlike anywhere else in their school building.

Social Emotional Development & Social Empowerment

Having a container farm onsite at an educational or community outreach facility provides an extraordinary opportunity to bring densely nutritious produce to underserved areas (food apartheid, anyone?), empower local communities with real workforce readiness opportunities, and train the next generation of farmers in technological systems that create local solutions to global problems. The novel growing environment and year-round production capabilities create the opportunity to reach learners and community members who might not otherwise be interested in agriculture or gardening, lowering the barrier of entry to the industry. The nature of working side-by-side in a container farm opens space for therapeutic conversations about food, farming, and life to organically arise, adding a social-emotional element to this type of learning. Throughout this guide, you'll find Social-Emotional Learning discussion points so students can explore their life experiences and growth through the journey of a plant.

Impact

Robust research evidence demonstrates that combined gardening and health education intervention, including the use of indoor agriculture, create greater potential for positive behavioral change. Using such hyperlocal production teaches students about distributed farming that is led by community, not corporate, interests, turning typical agriculture career technology education on its head. A container farm is a microcosm of the food system as a whole — from seed-to-plate — and there are infinite opportunities for cross-curricular learning and community involvement suited to your region.

Customization

Freight Farms has customers on almost every continent, in nonprofit and for-profit settings, in K–12 schools and universities, and on corporate campuses and research headquarters. Across all these settings, farms are being used to teach young minds and train local workers. There are endless permutations for peer education across age groups, cross-curricular learning, and paid and volunteer hours. It would be impossible for us to create a single guide that describes the exact nature of every single one of these programs. Thankfully, that's precisely what is so beautiful and exciting about Freight Farming — the endless possibilities for creating positive change in communities worldwide.

It all depends on your goals as a farmer, your particular institution, and the community in which it is set. We opted for breadth and customization, rather than depth and singularity, to reflect our vibrant customer base. This guide will give you all the tools you need to get started on the right foot, and it's up to you to take the initiative to suit it best to your specific setting. Trust yourself, be creative, try new things, commit to learning alongside your students, and always hold in mind the vision of wild success in your chosen field.

Lie, W. Y., Wei, S. S., & Yu, S. F. (2019). Promoting STEM learning using hydroponic farming: A design-based research approach. International Journal of STEM Education, 6(1), 1-15

Meiklejohn, S.; Ryan, L.; & Palermo, C. (2016). A Systematic Review of the Impact of Multi-Strategy Nutrition Education Programs on Health and Nutrition of Adolescents. Journal of Nutrition Education and Behavior, Vol. 48 (No. 9), pp. 631-646.

Jarpe-Ratner, E., Folkens, S., Sharma, S., Daro, D., & Edens, N.K. (2016). An Experiential Cooking and Nutrition Education Program Increases Cooking Self-Efficacy and Vegetable Consumption in Children in Grades 3-8. Journal of Nutrition Education and Behavior, Vol. 48 (No. 10), pp. 697-705.

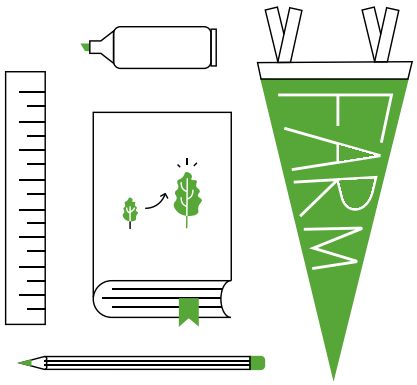
How It Works

This guide is broken into two sections. **The first section covers how to set yourself up for success before education starts. The second section goes into core farming activities and sample lesson plans for you to customize.** Throughout, you will find external links to additional step-by-step guides hosted on our farmhand® Community Knowledge Base (detailed below).

This guide covers all types of educational programming, including schools, universities, and nonprofits. You'll find detailed information about university and nonprofit farm programs, and specifics about how farm learning opportunities progress as kids age, in the second section.

What this guide is:

- Roadmap for all things education inside and around your Freight Farm.
- Practical guide for how to structure an educational container farm program, with teaching directions broken down by age level and subject area.
- Tips for how to get the most out of your program by mixing and matching various teaching elements.



What this guide is not (but other Freight Farms resources that will be helpful!)

In addition to this Guide, you will receive lifetime access to a wealth of digital resources and ongoing technical support. You'll receive login credentials for these via your assigned Customer Success rep once your sale agreement is finalized. Here's an overview of what will be your new best friends throughout your Freight Farming journey:

ASSET	DESCRIPTION	HOW TO ACCESS
Farmhand®	Our proprietary software that you will use to control the farm. This web-based application was built by the Freight Farms team and can be used to control the farm both remotely and in person. It can also be used to coordinate work across your students and interns. There is lots of educational value embedded in the app — which we will touch on throughout this guide!	Our Customer Success team will enable your subscription once your farm is delivered and connected to wifi.
Farmhand® Academy	A self-paced, online course and basic orientation for Freight Farming that covers everything from farm components, launch, and maintenance to pest management and food safety. Start here if you're a new operator!!	Farmers will be invited by the Customer Sucess Team during onboarding.
Farmhand® Community	Access to our global network of farmers via discussion boards and groups, in tandem with our online database of articles! The Community and the Knowledge Base are integrated so that farmers can search their questions to find answers from both their farming peers and the Freight Farms team at the same time.	Farmers will be invited by the Customer Success Team during onboarding.
Farmhand® Shop	Online store to purchase key supplies for your farm, including our custom nutrient blend, growing media, replacement parts, tools & accessories, and more.	Farmers can create their own account at any point during the onboarding process.
New Freight Farmer Guide	Everything to expect once you've purchased your farm, from your onboarding call to your first harvest. We provide the details on every step you'll take and how our team will support you to ensure a successful start.	Scan to view guide
Greenery™ S Owners Manual	A comprehensive technical user guide to set you up for success in farm operations — much like the owner's manual you would receive with the purchase of a new car or appliance!	Scan to view guide

Setting Yourself Up for Success

Know Your Priorities

The first step is to prioritize what's most important in your program, keeping in mind goals and key deliverables for your organization and funders.

Ask yourself: What is your #1 goal with the farm? To engage young minds in innovative, hands-on learning? To conduct research or train college students in new sustainable technologies? To grow food for your institution? To distribute food to your community?

Identify the single thing that's most important to you, and build your program from there. It can be easy to get lost in the flurry of excitement and grand visions for how your farm can be used, but the best approach is to pick a clear target and start small. **Remember: a grand vision is only as useful as its action plan and key deliverables.** Some farmers in the education and nonprofit space even recommend making a three-year plan for the farm — including all staffing, consumables, and incidentals.

Most importantly, ask yourself: What will you do with your produce? While your Freight Farm is certainly a tool for learning, community building, and educating, keep in mind that it is first and foremost a farm (and a very productive one, at that.) Regardless of whether or not produce is your endgame, you're going to have a lot of food on your hands! Again, it's best to plan before your first seeding where your crops will go when they are fully mature. There are various channels for this, such as keeping produce onsite for a commercial kitchen, donating to a food pantry, selling at a discount to wholesale partners, or using direct-to-consumer sales channels to generate revenue. Your assigned Customer Success Specialist will work with you to review these goals after purchase.

Start Small

It's recommended for new farmers to start small: Pick one crop that is most important to your needs, and keep your distribution plan simple for the first year of operations. If all goes well after that window of time, reevaluate how you want to expand or adapt moving forward.

We'll talk later about how this start-small approach ties into funding requests.

If you are distributing your food to consumers, you may want to consider pursuing Good Agricultural Practices (GAP) audit and certification early on. Even if you don't distribute your food, this still might be a good idea. The GAP certification process codifies important maintenance procedures leading to food safety and food chain transparency, and allows you to broaden your reach.

After signing your agreement and submitting your first deposit, you'll be connected with a dedicated Customer Success Specialist, who will help you design and execute a project plan to meet your goals. In addition to basic logistics like site prep and electrical hook-up (covered in our aforementioned New Freight Farmer Guide), your Customer Success Specialist will help you connect the dots between the big picture and actionable first steps. They'll onboard you and your team with our suite of digital resources like farmhand® Academy and farmhand Community, and sign you up for Farm Camp or onsite training. Who may be attending Farm Camp, you ask? Great question, which leads us to our next section: Building an All-Star Team.

See page 13 for Onboarding Journey Timeline

Step One

Starting the Journey

- Submit Downpayment
- Introduce Customer Success Specialist
- Begin Onboarding

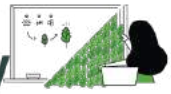
Step Two

Defining your Path

- Farm Prep & Readiness
- Vinyl Wrap Submission (if applicable)
- Program Development & Deliverables
- Crop Plan Creation

Step Three

Training & Delivery



- Confirm Site Readiness
- Enroll in Farm Camp Training
- Book Farm Shipment

Step Four

Farm Arrival & Activation

- Farm Delivery!
- Activate Farm
- Post-Delivery Inspection
- Book Onsite Training (if applicable)
- Order Supplies

Step Five

First Harvest & Beyond

- Begin Farming!
- Seed, Transplant, Harvest
- Integrate Programming
- Rinse and Repeat!

Build an All-Star Team

Farms at schools and nonprofits differ from a typical commercial farm in many ways, but most relevant here is that there are many stakeholders involved and many moving parts. This is more of a benefit than a hindrance, because you have many resources to tap into and less to build from scratch. For a sophisticated, high-tech product like the Greenery™ S, teamwork really does make the dream work. Ensuring you have the right team in place will almost certainly guarantee the success of your farm — both in establishing its operation in the first year and in keeping it running smoothly when the unexpected arises.

Lead Farmer

The best thing you can do to ensure the success of your farm is to hire a full-time lead farmer.

You probably have a large network of decentralized labor that you can tap into, such as volunteers or students, and that's fantastic. However, organizations that rely solely on this decentralized network to cover all their farm labor needs have historically been unsuccessful. Volunteers are often inconsistent; high school and college students are notoriously busy balancing school, work, and life (and are usually flaky unless they're getting paid or receiving some form of credit). Not to mention

that every time a new volunteer or student comes in, someone will have to take the time to train them on each task. With so many people involved, at least one person needs to act as the glue holding everything together, coordinate all the different people passing through, and take the time to get to know your specific farm intimately enough to create a thread of continuity across all the various stakeholders.

You may find, later on, that a full 40 hours is not needed for this lead farmer. Our team estimates a typical farm week requires 25 hours of labor. However, there's a big learning curve before farmers catch their groove; things can take longer for about the first year. For example, the first time you plant a tray of seeds may take 45 minutes. Two years later, it may only take 15 minutes. Plus, additional time will always be required to teach young students or train new interns and volunteers — more so in the first year. If a full-time lead farmer is not feasible, two people working part-time for a combined 40 hours works too, as long as someone is taking charge and serving as the primary point of contact for anyone involved in farm operations.

The role of the lead farmer may vary depending on your program needs and institution. In some cases, they may do most of the labor on their own during the workday, with only a few hours per week spent with children (as is the case at Los Angeles Boys & Girls Club's Support & Feed program). Alternatively, they may oversee all the labor done by large groups of high school students during the school day and that's it (as at Mountain Vista High School). Or, they may have a hybrid of adult student labor with young student engagement (as at Lotus House or Boys & Girls Clubs of Metro South).

The farm should not be added to the plate of someone who already has a full-time teaching courseload or administrative duties. It is possible to be a full-time teacher and run a thriving Freight Farm program, but teachers who have achieved this are often extraordinary individuals who are willing to commit their personal time outside of school hours (unpaid!) to tie up loose ends and cover maintenance needs.

We recommend giving your lead farmer at least three months at the beginning of the job, post-farm delivery, to learn all the tasks themself. Although they will likely go to Farm Camp, which serves as an orientation, there is no substitute for learning through repetition, trial, and error in the first three to six months of farming. If they are allowed this time and space to learn on their own, they will be far better equipped to teach and engage students and develop additional connections for learning and enrichment within your institution.

Knowledge Base Links:

Lead Farmer Job Description

Connecting with resources & engaging the community

Hierarchy & Support

Our most successful farmers are those working within a well-established and well-structured organization with staffing hierarchy, collaborative work culture, and reliable support. Once you've secured your lead farmer, there are a few other people you'll want to connect with in order to ensure their success. After all, you want your farmer to be able to focus on the goals of your program - teaching people and growing food for the community.

- First, there needs to be a designated leader with budgetary and decision-making power within the organization who will prioritize and advocate for the farm program's needs. We like to call this the "champion."
- Then, you'll need people with technical know-how for specialized support when issues arise: facilities management, with general electrical-mechanical knowledge; and IT services, with software and connectivity troubleshooting knowledge. These latter two roles could theoretically be one person, but most likely it will be two.

To understand the need for specialized facilities personnel, see our list of recommended tools to have on hand for as-needed parts maintenance and replacement.

This trifecta — a lead farmer, a champion, and facilities/IT support — ensures that the lead farmer can focus on doing what it is they were hired to do: grow, teach, and train. It ensures that the first year of operations goes as smoothly as possible and that the lead farmer has the ability to get help and solve problems quickly if needed. And, it ensures that your farm program can weather the tides of change, such as staff turnover or, say, a global pandemic. When it comes time for training, these three to four people are the ones to send to Farm Camp, so that they have a shared understanding of how the farm works, what's needed, and how to best work together.

Some other roles that may be helpful but are not required:

- Administrative staff member who handles data management, purchasing, attendance tracking, and accounting.
- Marketing or outreach team that can publicize the program and help you recruit and track more students and funders.

As an added benefit, a structured, coordinated, intention-aligned staff is more likely to perform at or above expectations and therefore continually bring in new funding for a financially sustainable program. This will ultimately help the program expand and grow over time into the grand vision that you likely had in mind when purchasing your farm (including scaling your program by adding multiple farms).

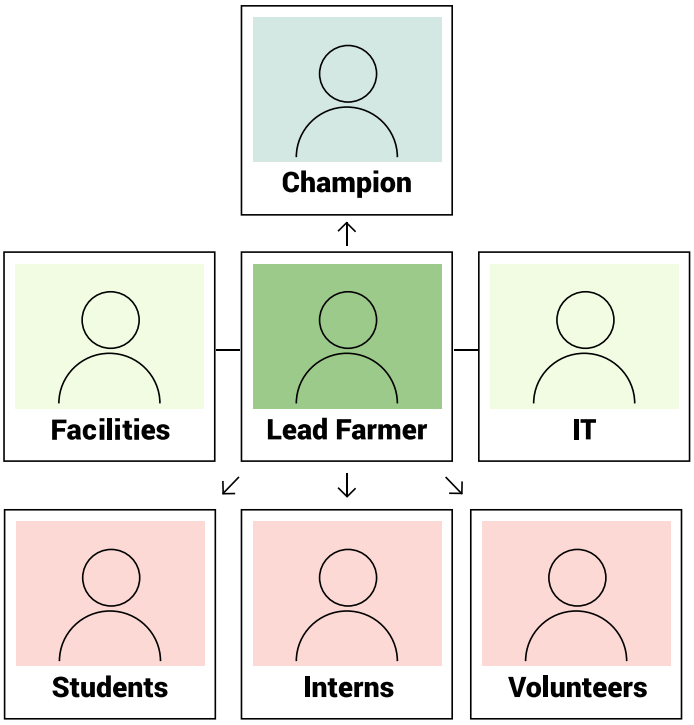
A Word of Caution - Too Many Cooks in the Kitchen

Again, it can be easy to run wild thinking of all the possible collaborators and ways to embed a Freight Farm in your community. Think critically (in advance of your Farm delivery) about whether or not a partner is essential to performing the core responsibilities of your operation. Are they receiving or distributing your produce? Are they supplying a steady stream of volunteers or teaching assistants? A surplus of collaborators could mean complicating things from the start by adding too many program variables that interfere with core farming, a greater number of stakeholder expectations to manage, and an unclear division of responsibilities in which tasks ironically fall through the cracks. Start with your 3-4 designated personnel, then allow yourself the space for community connections to grow organically over time in a way that complements your established operation.

HIGH LEVEL

MIDDLE LEVEL

LOW LEVEL



Knowledge Base Resources:
Head to the Additional Resources section to see how to create an SSO login for everyone in your organization.

Setting Up Your Space

Physical Location

Keeping your program priorities in mind, it's important to select a farm location that is convenient for whoever will be accessing it most. **Proximity and ease of access are paramount to minimize time spent in transit and maximize farming. It should take less than five minutes — ideally less than two, and absolutely no more than 10 — to walk your students to the farm.** Many high school teachers have their farm just outside their classroom, near a hallway with a door to outside, so that they can move back and forth as needed. Others have it situated close to their commercial kitchen, which makes sense if that's where your produce is going. It's also important to ensure a strong WiFi connection for your farm site so you can get the most out of teaching with our farmhand® software. Your Customer Success Specialist will help you identify a farm location early on to align with your program goals and overcome any logistical hurdles. Check out our Site Preparation & Delivery Guide here for all the important details.

If you plan to work with **large groups**, it's even more important to have the farm close to a cleared space with tables and chairs. This could be a classroom, a warehouse, an empty cafeteria, or an outdoor concrete pad with picnic tables and chairs (if regional weather permits year-round work in this area). With large groups, especially of younger children, tasks like harvesting can get messy, so having a space outside the container is helpful.

Shout out to **Support & Feed at Los Angeles Boys & Girls Club** for recommending this!

Many organizations already have some type of soil gardening operation to which they are adding their container farm. There are many benefits to this — it offers a more holistic, dynamic view of sustainable agriculture, enables students to compare and contrast traditional versus hydroponic growing systems, and gives more recreational space to learn and play for younger kids. However, if this is the case for your farm, it is critical that everyone that works in your farm is exceptionally mindful of the increased contamination risk. One of the beautiful things about a container farm is that it has the potential to be a closed environment that is virtually free of pests and disease. However, this can only be true if you make it so. Always separate the days that you're working in either garden, and never go immediately back and forth between the two within a single day, lest you bring in pests or soil samples and the abundant microbes that come with them. See an overview of environmental considerations — including multiple types of agriculture — for the location of your farm in our Food Safety Certification Guide.

Workspace Tools & Mods

Using farmhand Software to Enhance Student Learning

The farmhand software not only allows you to monitor and control your farm functions remotely and enter a "Task Mode" while working, but also to track the amount harvested over time, create a visual map of what's planted where, and create task alerts for what needs to be done when, effectively mapping your crop plan among instruction days. Farmhand software interfaces through a desktop computer or smartphone; for teaching purposes, **we recommend keeping a tablet or laptop in your farm that is automatically logged into the account.** This is a highly valuable medium through which you can engage your students in data visualization and software programming. Other teachers prefer to have a printed binder with visual aids in which students or interns leave detailed notes for each other. Ultimately, it depends on your teaching style and how you like to keep track of key information.

For teenage, college, or adult interns and students, you may want to implement materials that help standardize operations with instructional manuals and visual aids. These can be printed directly from farmhand Academy and Knowledge Base, and eventually refined and replaced according to anything you've changed or developed after your first year of farming. Any important logs for tracking who comes in and out of the farm; what was harvested, how much and when; and maintenance and food safety protocols should be kept here. Other successful farmers in educational institutions have created their own set of posters and visual guides based on their unique setting and procedures, printed and posted in the farm once established after years of operating. See the Additional Resources at the end of this guide for sample logs and other recommended resources to include.

Environmental Enrichment

The Greenery™ S and other Freight Farms models are a high tech laboratory environment designed for optimal plant production. They are designed from a plant science and engineering perspective — not a teaching psychology perspective. While the lights and stainless steel may be flashy, modern and exciting to some, it may feel cold and sterile to others. If working with younger students, you may want some environmental modifications to make your farm child-friendly, enriching, warm, and welcoming.

Tips to Make Your Greenery Child-Friendly

- Provide benches or foldable step stools so kids can easily access the work area
- Post educational posters and visual aids above the table and nutrient tanks
- Provide child-size disposable gloves in addition to adult gloves
- Purchase pelleted seeds whenever possible so children can more easily handle them
- Use colorful tape to separate the Nursery Area from the Cultivation Area, and instruct that children can only cross the tape with adult permission (prevents them from causing damage to plants, lights, or tank in the Cultivation Area)
- Add soft pads to any sharp edges in the Nursery Area
- Store all nutrients and chemicals safely away underneath the seedling troughs

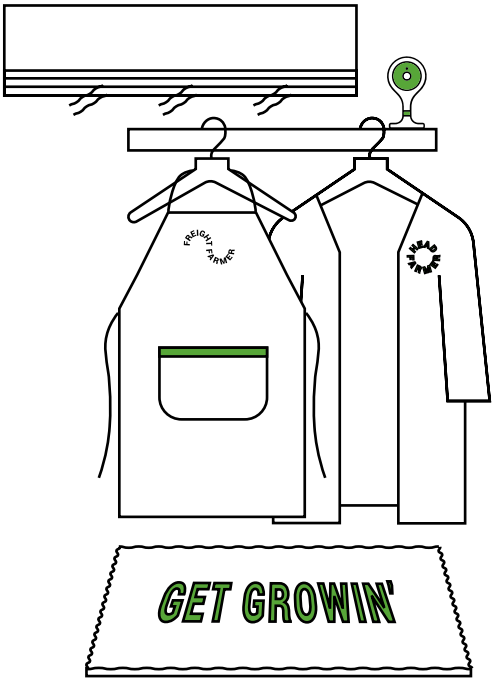
Modularity is the name of the game in container farming, and almost all our farmers, regardless of business model or setting, implement some form of workspace modification to customize their space — whether it be an additional rack for microgreens, a tv screen for demonstrations, or a shoe rack on the back of the door. You can see a list of possible add-ons on farmhand Knowledge Base. The nature of a school or nonprofit means you have lots of people coming in and out of the farm on a regular basis with relatively unfettered access. With this in mind, we recommend the following environmental and personnel controls:

- Air curtain (a common tool used in commercial kitchens) to create a wall of air inside the doorway that keeps pests out.
- Welcome mat or boot scraper for large groups to wipe shoes of debris before entering the farm.
- Adhesive coat rack or wall hooks for jackets and aprons, to keep your day clothes clean from any farming debris and stay warm while working

The farm is typically set to 65ºF to keep the plants happy!

- Ring camera or combination lock system for personnel control — this is only if your farm is in a public setting where unauthorized kiddos trampling in is a concern. Our farms have built-in cameras to monitor crops, but not to monitor attendance!

Hardcore farmers (such as ours at HQ) will remove their shoes upon entry and/or wear booties and shoe covers. This will definitely help with cleanliness, but can be time-consuming when you're working with multiple students and groups on a tight schedule. This step can be foregone in favor of more stringent cleaning and maintenance protocols (covered in the Clean As You Go section).



Calibrate Expectations & Start Simple

To Recap Section I:

Set expectations for everyone involved over what's needed to start this project. Start small, and build from there. The first year of farming serves as a launch pad, from which you will only continue to grow (pun intended). Use this recap below to guide your funding requests and deliverables agreements for the first year.

- Hire a lead farmer. Send them to Farm Camp along with your facilities/IT and "champion."
- Select a farm site that is most conveniently accessible for those you intend to engage the most in your program.
    - Set aside a small portion of the budget for any incidentals to set up your farm workspace. Purchase some incidentals (like an iPad) upfront to use during teaching. Save some to purchase after a year of running programming, when you have a better understanding of supplies needs and what tools would work for you.
- Choose a single recipient or point of distribution for your produce. Pursue GAP/food safety certification ahead of time if needed.
    - Identify means of packaging and distribution and build this into your budget.
- Choose a single crop to start with (check out our beginner crop recommendations on farmhand Knowledge Base for help).
    - For most people, this is lettuce. But for some, it may be herbs or flowers. Starting with a single crop achieves a few objectives:
        1. Accustoms you to the workflow and how to build a crop plan (one of the hardest things about farming!)
        2. Makes it easier to detect and diagnose any crop health issues or parts malfunction that might arise in the first year of operating.
        3. Builds confidence! If after six months, that one crop feels like a total breeze, then great! Choose another and incorporate it into your crop plan and workflow.
- Allow your lead farmer three months (as a practical note, you won't have your first harvest until eight weeks into farming) to learn everything on their own before involving students. Follow Freight Farms-recommended grow guides and maintenance procedures to a T here and throughout the first 12 months.

NOTE | Exact maintenance recommendations vary with farm model. Be sure to check Knowledge Base to access the appropriate guide.

    - Very similar to starting simple with a single crop, doing so:
        1. Creates comfort with and intimate understanding of farm operations, better equipping the lead farmer to teach others.
        2. Provides a better sense of time and labor needed for packaging and distribution.
        3. Builds relationships with the recipient of your produce, or allows your institution time to adapt their purchasing as needed
    - Build this buffer time into attendance- and engagement-related deliverables.
    - Build this buffer time into harvest- and distribution-related deliverables.
    - Trust our maintenance recommendations! A lot of time and experience went into writing them. If you don't follow them, be warned of learning the hard way and how that might disrupt your growing (pest infestations, mold, parts malfunction — oh my!)
- After three months, start teaching students or training interns using the subsequent sections of this guide.
- After one year, adapt these materials according to what works best for your institution. Take a red pen to any maintenance SOPs or lesson plans. Compile all these findings into something shareable — can be a cloud-based drive or a physical binder that lives in your farm.
- Decide how you want to expand, and what your goals are for your second year of farming!

Teaching Foundations & Resources

General Overview

Now that you're set up for success organizationally, let's get to learning! Having a lead farmer opens up a lot of space to involve as many people as possible in your farm operation. The lead farmer can collaborate with other teachers and staff to bring in students of different school classes and ages on a regular basis.

This next half of the guide covers all the core farming tasks and how they fit into different age groups and settings, as well as some sample lesson plans for each age band and further directions for learning. We've also included general overviews for each type of educational setting — K–12 schools, nonprofits, and universities — so you can skip to whichever is most relevant for you.

We understand the constraints on time and resources of working in a school or nonprofit and accordingly have done our best to make all the following processes and lessons as efficient as possible so that everyone can learn and have fun. A big emphasis in this section is incorporating routine maintenance and cleaning into the tasks you do with your older students, along with other time and labor-saving hacks, both so your students can get the full picture of what it means to run a farm, and so you can do as much of the day-to-day tasks as possible with your students rather than tying up loose ends after the fact.

ACTIVITIES	AGE	GROUP SIZE	LEARNING CONCEPTS
Farm Field Trip & Tour	All	<10 at a time	Hydroponics & CEA
Seedling	All	Small	Core Farming & Plant Science
Transplanting	Grades 9+	Large	Core Farming & Plant Science
Harvesting	Grade 6+	Large	Core Farming & Plant Science
5 Senses Expoloration	Grades 3-5	<10	SEL
Food Miles Exercise	Grades 3-5	Large	Food Systems & Sustainablity
Salad Prep	Grades 3-8	Large	Healthy Eating
Crop Trials & Yield Data	Grades 9-12	Small	Plant Science and Data
Mixing Solutioins & Calibrating	Grades 9-12	Large	Chemistry & Software
Evaluating farmhand Software & Graphs	Grades 9-12	Large	Math & Data Analysis

See each of the following age group sections for further activity ideas!

Throughout the discussion sections of each of these activities, you'll find different icons denoting a directive for teachers or a query for discussion. Look out for → for directives and 💬 for questions. Sample scripts for teachers are denoted with 🎙.

Overview - K–12 Schools

This section is intended to show how K–12 students of different ages can participate directly in farm tasks in a way that supports the overall production of the farm. We have focused on practical learning by doing, rather than prescriptive lesson plans that are only tangentially related to farming activities. K–12 and nonprofit instructors are likely competing with many other subjects and programs with their own lesson plans and attendance quotas, so we want to be realistic in what types of farm lessons are actually useful for lead farmers, teachers, and students alike. Field trips to and tours of the farm fit nicely into existing units of many different STEM subjects; accordingly, "Advanced Connections" have been added to each farm task. Farming tasks will likely take the entirety of a class period, about 45 minutes.

The technical sophistication and spatial limitations of a Freight Farm are ideal for small groups of older students (high school and up), however, there are still many ways to successfully engage children of younger ages. In general, we recommend doing the bulk of your farming with older folks — high schoolers, college students, or adults — and saving smaller amounts of work for slower, more individualized, exploratory learning with younger students.

It can be a goal to see every student one to two times per year in grades K–12 using a "touchpoint" system as a means of garnering interest and recruiting for a high school-level agriculture or career tech class. The first touchpoint should be a general tour of the farm and lettuce tasting. The second touchpoint can be the age-appropriate farming activity — such as seeding (elementary school) or harvesting (middle school). Farm learning culminates in high school classes in which students complete the full range of farm tasks (including transplanting and some maintenance).

We envision K–12 school farming as centering on older students, who carry out the majority of farm work and form cross-curricular connections within their STEM subjects or career exploration programs (though ultimately it's not our vision — it's yours!). **If you are going to create a class specifically around your hydroponic farm, high school students would be the age to do it with.** Just be sure that, at least starting out, the Lead Farmer teaching this class has the time and space to learn farming by themself first, and doesn't have another courseload unrelated to farming. See Additional Resources for a sample weekly high school farm course schedule.

EXPERT	AGES	ACTIVITIES
College & Beyond ●●●●	18+	Students Independently Run Farm Research Opportunities
PROFICIENT	**AGES**	**ACTIVITIES**
Grade 9 - 12 ●●●	11-18	Transplanting Maintenance Crop Trials & Yield Data Mixing Solutions & Calibrating Sensors Evaluating Farmhand™ Software & Graphs
NOVICE	**AGES**	**ACTIVITIES**
Grade 3 - 8 ●●	8-11	Farm Field Trip & Tour Seeding Harvesting 5 Senses Exploration Food Steps Salad Prep
BEGINNER	**AGES**	**ACTIVITIES**
Pre-K - Grade 3 ●	5-8	Farm Field Trip & Tour 5 Senses Exploration

Relevance by Age for K–12 Schools

Pre-K-3rd Grade (Ages 5-8)

Farming with young ages is only possible in small groups. We do not recommend working with these ages in a K–12 setting. See the Nonprofit Overview section for more detail on how to engage these ages in after-school programs. Children younger than age five are not recommended for activities in the farm, unless touring with an adult or guardian.

3rd-8th Grade (Ages 8-11)

In a school setting, students of this age group are introduced to the farm through field trips, tours, and short engagements with teachers as part of a class. Seeding is recommended for third through fifth grades, with harvesting added for sixth through eighth. Additional activities for this age group focus on engaging with farm products through food prep classes and explorational sensory activities.

9th-12th Grade (Ages 15-18)

This is the best age group to do farm work with in a K–12 setting. If you are deciding on a location for your farm within a district that serves all age levels, choose the high school so that students of that age can most easily access it.

College and Beyond

See the following section. The farm is an excellent means of introducing different students across campus to food and agriculture through paid internships, building upon what they learned in primary school!

Overview - Nonprofits

Every nonprofit is unique, and different organizations work with different age groups and sources of labor. For example, Boys & Girls Clubs and YMCAs work primarily with younger children (ages 6–13) in after-school settings, but may also have large volunteer groups or high school workforce readiness programs. Other nonprofits, like shelters or adult community resource centers, focus on using their farms for paid work training for adults with disabilities or minimal education, who may otherwise be limited in their career options and for whom hydroponic farming represents a valuable opportunity to break into a new industry. Other nonprofits, like food pantries, may want to connect with nearby colleges and universities to operate their farms through a paid student internship program.

Younger Children (Pre-K-3, ages 5-10)

The previous section of this guide covered primary school activities starting for children in grades three and up (ages 8+). This is because large groups of younger children, as in elementary schools with class sizes of 20–30 students, are untenable for work in a container farm. With groups of this size and age, too much time and effort will be spent on group and behavior management, leaving minimal opportunity for actual farming.

It is still completely possible to successfully farm with young children, starting at age six, as long as they are engaged in small groups with individualized attention. Nonprofit after-school farmers usually bring no more than four to five children of this age in at a time. In these settings, it is still important to cover the bulk of your labor by either the lead farmer themself or some other form of reliable adult labor, like a formal volunteer or work training program. Children under the age of six should not be engaged in farm activities without an adult

individually assisting them. There is some variability, but generally, ages six through eight can plant seeds, ages eight and up can harvest, and ages 10 and up can transplant.

Behavioral Considerations

After-school programs or food justice youth organizations typically work with some proportion of students who qualify for free or reduced school lunch (i.e. the federal definition of low-income) or rank lower in standardized test scores. These same students may be struggling with trauma and adverse childhood experiences like homelessness, food insecurity, and domestic violence that affect their ability to focus and learn at the same pace as their peers. An abundance of patience is needed, as farming tasks will take longer with these groups, but the opportunity to farm in a quiet, therapeutic setting like a container farm is all the more valuable for these groups.

Group Size & Scheduling

Similarly, after-school programs and clubs lack the formal structure of a school setting (for example, some children may only be present a few days a week or even only partial hours of each day), with frequent turnover and inconsistent attendance. Children will primarily be looking to have fun and let loose outside of school hours, away from the authority of teachers and principals. Lead farmers will need to strike a balance of enrichment and discipline — emphasizing play and learning by doing, but clearly defining rules for what is and is not allowed inside the farm. Because of these behavioral factors, large groups do not work well in these settings. The smaller the group of students, the more liberty teachers have to create an individualized, nurturing, high-impact learning environment. A variety of ages can also be reached within these groups — for example, by empowering older students to help younger ones, developing a collaborative peer education model.

Existing after-school club lead farmers approach scheduling by rotating through small groups of students in 45–60 minute sessions, once or twice daily, on multiple days of each week while providing opportunities to cultivate deeper learning for those who express the greatest interest. It's important to keep in mind that youth clubs often have other programs with their own engagement goals, so each organization must adopt a schedule that does not conflict with the other groups and initiatives. See Additional Resources for a sample weekly schedule for after-school classes.

Administrative Barriers of Volunteer Programs with Small Children

Many such after-school programs require volunteers to complete a background check prior to participation. This is a necessary legal measure to prevent child abuse, but can create administrative burdens when managing a volunteer program. Rather than recruiting a large pool of individuals from the community, we recommend designating a longer-term, trained, pre-approved individual volunteer who can attend consistently on a part-time basis, as through AmeriCorps or similar state-based programs. .

Working with Adults in Community Resource Settings

You can also achieve the same outcome with paid adult interns from the community you serve. This might be the entire focus of the mission of some nonprofits without young children involved: creating work opportunities for those in need of new skills. This will look similar to a college paid internship program or some other training for high school students. Create a program that enlists adults in a set number of hours at a set rate. For example, at Lotus House Women's Shelter in Miami, adult residents are recruited through the Education & Employment Center for a paid apprenticeship with the

lead farmer for 80 hours. The internship is completed on a part-time basis of 20 hours a week, with two stipends paid for every 40 hours (two weeks) completed. Interns can work four hours a day for five days per week or develop a schedule that works best for them. They can work directly with the lead farmer, with the eventual goal of independent work and even involvement with children. Your organization can also set up a unified Single Sign-On (SSO) for web-based resources so that adult interns can complete farmhand® Academy and access Community and Knowledge Base resources during their tenure. At the end of this training course, grant them a Certificate of Completion (see Additional Resources) that they can list on their resume. You may also want to consider training them in a Food Handler or Food Safety course to open up additional opportunities in food service jobs.

A Freight Farm is a wonderful opportunity to engage new audiences in agriculture that might otherwise be excluded due to the physical demands of outdoor work. Many nonprofit farmers have successfully trained and employed people with a variety of physical, cognitive, and learning disabilities. That said, there is a degree of physical work to container farming, particularly when it comes to maintenance and farming tasks in the Cultivation Area (see our sample job description for details of physical requirements). Those with physical limitations should not be working entirely on their own, but rather in tandem with a lead farmer who can bend, climb, and stand for long periods of time as needed. If someone is physically limited, make sure they have access to a bar-height stool or folding chair for work at the Nursery Station, or access to a seating area to take breaks as needed.

While Freight Farms do not come with built-in wheelchair-accessible ramps, they can easily be added. See this Knowledge Base article for specifications on adding a ramp to your farm site.

Overview - Universities

The overall goal of this section is to create a program that empowers young adults to fully run all daily farm operations by themselves — including completing farming tasks from start to finish, performing maintenance, complying with food safety regulations, and handing off produce to dining services. In this setting, students gain the closest approximation to real-world farming experience. The farm is run like a business: Students are paid for regular shifts in the farm between classes, report to a supervisor (either a faculty member, graduate student, or dining/facilities manager — i.e. the lead farmer), and are responsible for delivering a high-quality product to campus food service.

Higher education is a scenario in which you will definitely want to pursue GAP and other local food safety certifications for your farm. These GAP standards should be incorporated into training materials for your students through the use of any visual aids and binders, in addition to any farmhand® content and software. Please see our Food Safety Certification Guide.

It's important to note that our university network farmers do not explicitly have a semester course for their Freight Farms. Professors acting as lead farmers may teach such courses as Intro to Hydroponics, Controlled Environment Agriculture, or Greenhouse Management, but use their Freight Farm as an accessory to these courses rather than a central feature.

While the farm serves as a unique model of alternative farming methods, it also provides an excellent opportunity to train students in life skills. Of course, student interns must be incentivized via course credit or paid work — ideally the latter. **You cannot rely on student volunteer groups to complete all your labor — the most successful student internship model is to have a budget**

supplied through campus dining to hire two to four part-time students.

How & Where to Recruit Student Interns

Student interns do not need to be limited to agricultural majors. Most of our higher education farm customers (like Auburn University, Stony Brook University, and Durham College) train students from a variety of schools and disciplines, from engineering and math majors to graphic design and photography. Students simply need to have an interest in working with plants and food in their free time. After all, the whole ethos behind Freight Farming is that anyone can do it! At the very beginning, you'll have to recruit a batch of brand-new students. But as time goes on, try to pair experienced students (with at least one semester of Freight Farm work under their belt) with new students to ease the faculty burden of onboarding and reduce time spent training.

Here are a few avenues to recruit students on campus:

- One of the best ways to recruit students is through in-person tours of your farm. Consider doing this at regular intervals, as part of campus orientation, student activity fairs, or weekly farm-to-table engagement opportunities.
- If you are a faculty member in Agricultural Sciences, present the work opportunity during class in the first two weeks of your semester course. You can use our 3D Farm Tour or other presentation materials of your own.
- For other areas of campus, post flyers or disseminate recruitment materials among professors and department heads within culinary, human ecology, nutrition and dietetics, sustainability, natural sciences, and engineering schools.
- Universities can also participate in federal or state government programs like AmeriCorps and FoodCorps (see Connecting with Local Resources).

Flexibility & Accountability

While the structure and professional accountability of a paid internship program are critical when working with college students, it's equally important to be flexible and adaptive to changes in their schedules. College students are learning, often for the first time in their lives, about balancing academics, work, personal relationships, and living independently. Inevitably, they will have weeks where big exams or other conflicts interfere with their ability to farm at their regular time. It is the lead farmer's job to meet them where they're at, shuffle schedules, and substitute other student interns as needed, while still ensuring interns are meeting the minimum work requirements that they committed to. It's best to err on the side of caution by recruiting more interns than you might need (four rather than two) to afford flexibility.

Suggested Work Schedules

Each student should complete two three- to four-hour farm shifts between classes each week. When hiring a student at the beginning of the semester, obtain their course schedule and ask them when their free periods are. We recommend scheduling farm shifts between or immediately before or after classes while they are still on campus; otherwise, they might not be as motivated to come. Work together to agree upon a schedule and be clear about expectations (e.g. being on time, completing a designated list of daily tasks, and updating the task list for the next intern).

PRO TIP | Put all your student interns in a group chat with the lead farmer to coordinate schedules and handoffs, quickly answer any questions, and substitute shifts as needed. The lead farmer should be present during each new intern's first two weeks of work while they get used to farming.

Class Configuration & Group Sizes

One of the chief benefits of container farming is that you can produce an abundance of food in a very small footprint. The obvious downside of this when it comes to teaching and community engagement is the spatial limitations on group size. Farmer-teachers in all types of educational settings have macgyvered solutions for both small and large class-size configurations, and there are benefits and drawbacks to each. See below for a breakdown and how to set up your space accordingly.

Small Groups (2-6 people)

Ideal for: After-school programs; small school classes (like gifted or special ed); paid interns (college or nonprofit); younger children (K–3)

How/where

- Inside the farm

Benefits:

- Intimate, quiet setting that allows individualized attention, room for discussion, and social-emotional learning
- In-depth learning experience that confers greater independence and self-reliance
- Better for young children, who have limited attention spans and may be distracted by other students or the novelty of the environment

Drawbacks:

- More upfront time investment in hands-on, step-by-step training
- Engage fewer people at a time, requiring rotation of students to maximally engage

Example Activities: Seeding

- See Additional Resources: sample schedules for rotating students in afterschool programs

Large Groups (up to 30 people)

Ideal for: Middle or high school classes; large volunteer groups

How/Where:

- Work outside the farm by transporting panels to a nearby workspace for harvesting or transplanting

Benefits:

- Plow through a lot of work in a short amount of time
- Engage more people in your program

Drawbacks:

- More time and energy spent on group management — clear instruction needed beforehand with lead farmer monitoring throughout to ensure correct technique
- Additional adult supervision may be needed
- Rigid food safety and sanitation protocols required to counteract increased exposure to potential contaminants

Example Activities: Transplanting; harvesting; deep clean of floors, tanks, walls, and fans; cleaning and replacing saturation strips; cleaning panels

Generally speaking, **whether you're teaching or giving a tour, you don't want to squeeze more than eight people inside the farm at any given time**, because you risk both damaging equipment or crops and introducing contaminants into the environment. With younger children especially, smaller groups are necessary because kids' rambunctiousness doesn't jive with the small space. Regardless of age, larger groups require more time spent on group- and behavior management and less time on teaching and farming.

Clean As You Go

A hydroponic container farm is much more like a kitchen or laboratory than a traditional garden. One of the perils of having multiple sources of labor at a school or nonprofit is an increased number of people moving through the farm and therefore increased chance of introducing pathogens that contaminate the growing environment. Because of this, **it is critical to follow Freight Farms' maintenance and cleaning protocols** — including regularly sanitizing the floors, turning over water in the tanks, and dosing organic sanitizing agents to regulate any algal, bacterial, or fungal growth. See farmhand® Academy and Knowledge Base to access our maintenance guides. We also recommend designating a few days each month, or even one per week, solely for maintenance without any teaching sessions or classes.

If you've ever worked in a restaurant or food service environment, you may have heard the phrase "clean as you go." Given the similarity between the sterile hydroponic laboratory environment and a commercial kitchen, this motto applies. "Clean as you go" refers to sanitizing between different types of food prep, like meat and vegetables, to prevent the spread of foodborne illness. In the context of Freight Farming, it extends to staying on top of food safety standards, minimizing time spent on maintenance outside of instruction time, and generally keeping your farm in tip-top shape. Some maintenance tasks simply can't be done in the presence of students — hence the need for a lead farmer to cover all the bases — but most are routine, straightforward practices that can be integrated into your workflow.

Let's use a handy analogy. You're cooking at home, and instead of washing dishes while you have a spare moment, you leave them piled up next to the sink until after you're done eating. Once you're done eating, and are full and lazy, those dishes start to look a lot more daunting. Next thing you know, three days have passed, food residue is crusted onto dishes, and pests are starting to catch wind of the snack.

It's the same with farming. If you put off cleaning all your panels until the end of the week, suddenly you have 22 panels for one person (the lead farmer) to clean, which could take hours. Instead, you could clean each panel immediately after its harvest, taking only a few minutes.

Here are some suggestions for how to incorporate maintenance into everyday farming tasks:

After harvesting (messiest; greatest need for additional cleaning), you and your students should:

- Thoroughly clean all panels:
    - Run your fingers between the foam, down the saturation strip, to remove any large chunks of plant matter
    - Check for algae or mold, especially on the very top and bottom of panels
    - Wipe off major plant debris with a towel or bristled brush
    - Spray with Zerotol
- Wipe down and sanitize drip emitters and gutters in the Cultivation Area where harvested panels are located

After transplanting (requires most precision; time-consuming), you and your students should:

- Wipe down and sanitize the section of Nursery trough where trays were located
- Thoroughly clean and sanitize seedling trays

After seeding (takes least amount of time and skill), you and your students should:

- Take the opportunity to do weekly deep clean and farm audit that you wouldn't otherwise have time for on harvesting and transplanting days
- Go through weekly checklists and recap understanding of the week

And here are some **bonus hacks** that can cut down on farming and maintenance time:

HACK

- Plant trim crops. These reduce transplanting and harvesting time by allowing you to "cut and come again." Recommended varieties are Coastal Star and Green Star lettuces.
- Grow microgreens and sprouts, which require no transplanting or labor-intensive harvesting.
- Pair farm tasks together — such as transplanting immediately after harvesting, which drives efficiency by reducing time spent hanging and cleaning panels at the end of each day.
- Quickly harvest full heads of lettuce by placing a panel in a kangaroo bag and pulling plants from top to bottom, then clean and sort produce outside of the farm (potentially in your classroom) later.

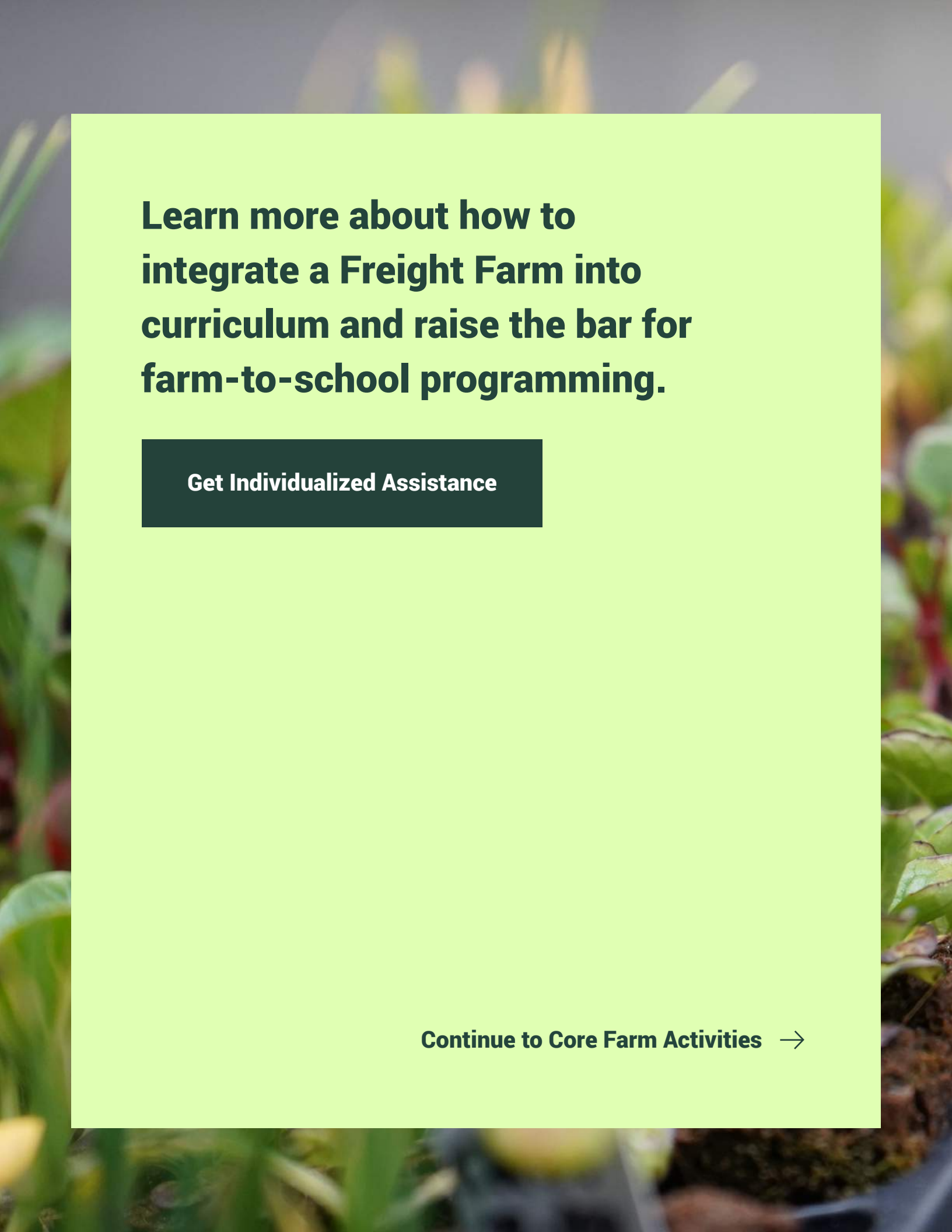
There's also a beautiful teaching opportunity here. Maintenance, while tedious and uninspiring, has wide-ranging real-life applications. Preventative maintenance is a big part of what we might popularly call "adulting." Like changing the oil in our cars, replacing the filter on our A/C, or scheduling routine checkups with a doctor.

It can be difficult to learn the importance of maintenance without seeing its real-world relevance, especially for teenagers who generally haven't had to face the consequences of aging or living independently. The farm is a fantastic opportunity to see how efficient maintenance keeps things running smoothly, and conversely, how things can go awry when maintenance is foregone. Your students can implement the preventative maintenance practices that they learn in the farm into their real lives, such as keeping a clean apartment or a well-running car. One high school teacher even spun off a Home & Apartment Repair course with his students!

Core Farm Activities

The following section covers the activities central to any container farming operation — seeding, transplanting, harvesting — and how to approach them with students. Each activity states learning outcomes for students of each age group, along with discussion points to guide the task. Activities also suggest how students can extend their learning through advanced discussion topics and explore how the plant journey relates to their own human experience through Social-Emotional Learning questions.

For each activity throughout this section, we've provided suggested scripts for how to lead your students. Students will naturally have questions during the process; these notes should cover anything that comes up, but be prepared for unexpected questions! Every setting is unique, and all teachers bring individual insights and experiences. We encourage you to put the lesson in your own words and leave space for student inquiry.



Learn more about how to integrate a Freight Farm into curriculum and raise the bar for farm-to-school programming.

Get Individualized Assistance

Continue to Core Farm Activities →

Core Farm Activities

LESSON PLAN

Farm Field Trip & Tours

Ages: All (5+)
Group Size: Small (<10 Students)

Providing short tours and oral overviews of your farm is an important component of any successful program — not only to introduce young students to the farm for the first time, but also to recruit interns or court potential funders. You can adapt the talking points and script from this activity for various age groups using our Media Kit, FAQ, and Blog. If for whatever reason you're unable to physically tour a group inside the farm, use our 3D virtual tour online.

If you are a Greenery™ S owner, check out our Owner's Manual for detailed diagrams and notes on farm components!

Learning Outcomes

- Explain the basic premise of hydroponics and Controlled Environmental Agriculture (CEA) and the benefits of Freight Farming
- Describe how plants receive water, nutrients, and light in the Nursery & Cultivation Areas
- Describe the role of farmhand® software and the processes it automates
- Describe the components of climate control
- Compare and contrast indoor and outdoor agriculture

Materials You Need

- Hand sanitizer
- Table outside of the farm for taste tests, if working with **large groups** (10-30 students)
- Compost bin or other receptacle for discarded taste test samples
- 5 Senses Exploration worksheet

Activity Overview:

Introduction

5-10 mins

Set ground rules before going into the farm. Give your students clear instructions of where they can and cannot be and what they can and cannot touch.

Walk to farm as a class.

Tour & Worksheet Activity

5-20 mins

Describe each component of the farm and how it relates to your organization's program outcomes. Leave plenty of time for questions!

Complete a taste test and fill out the 5 Senses Exploration worksheet.

Clean up & walk back to class

5-10 mins

Talking Points

Ages: All (5+)

Excite & Engage (Beginning Discussion):

What do you think of when you picture a farm? How about a farmer? What comes to mind and why?

Today we are going to be touring our Freight Farm. The Freight Farm is a hydroponic vertical container farm. Has anyone heard of any of the following terms before — hydroponics, vertical farming, container farming, or controlled environment agriculture? In what context have you heard about them?

The Freight Farm is a small space with delicate plants and expensive equipment, so let's lay some ground rules to make sure we respect the space. See suggested farm rules below the Script for Young Children.

Explain & Expand (Activity Discussion):

Identify each of the following interior farm components and their function. This is the time to flex your knowledge as a lead farmer! Exact components vary with farm models.

Nursery Station:

- Two troughs
- 16 slots for seedling trays
- Closed-loop water tank that fills troughs and drains back into tank
- Optical sensors for water fill level
- Riser with Bluetooth speakers, toolbelt, and light bar for crop spacing (Greenery™ S only)
- CO2 tank
- Dosing panel with hydro sensors, nutrient tanks, and peristaltic pumps controlled by dosing module and farmhand® software

Farm Exterior:

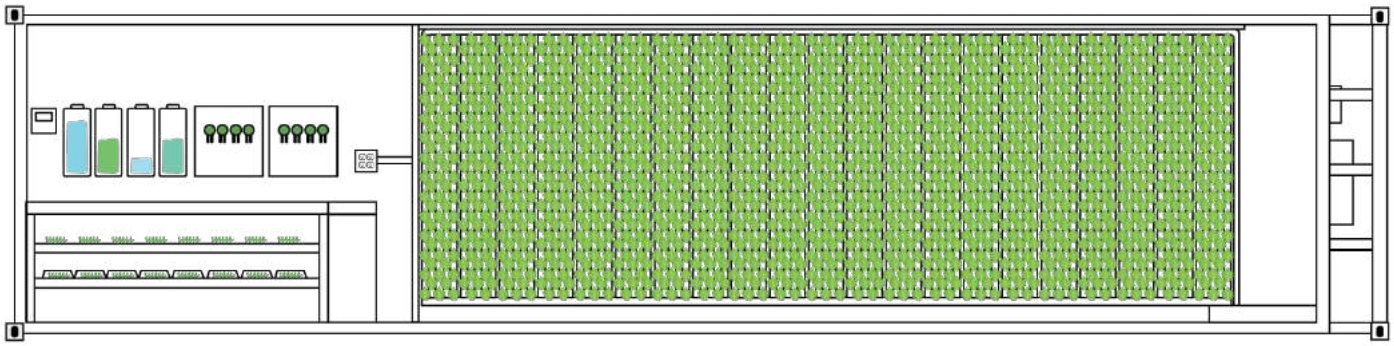
- HVAC unit (cooling, heating and dehumidification)
- Water & electrical hookups

Cultivation Area:

- Two double-sided mobile grow walls
- Four LED walls with cameras (Greenery S only)
- 88 total plant panels with five channels each, grow foam, and saturation strips
- Closed-loop irrigation that sends water via emitters down the panel, into the gutter, and back to the tank

Climate & Controls:

- Overhead fan, duct fans, floor vents, and more for optimal airflow
- Electrical box with CloudGate for internet and farmhand Hub controller or Agrowtek GrowControl — the brain of the farm!
- Climate sensor and module



Exit (Concluding Discussion):

- Check your understanding. How does everything work together? How do the internal systems of the farm mimic an outdoor growing environment? How does the technology improve upon traditional outdoor agriculture?
- How has your perspective or opinion of modern farming changed?
- In what ways is a Freight Farm more sustainable than an outdoor farm?
- What's your favorite thing that you saw in the farm today?
- Was the experience of tasting vegetables in the Freight Farm different from other vegetables you've tasted? How and why?

Social Emotional Learning (SEL) Connections:

- The farm has many different systems working together. What are the different systems of our lives and our bodies that work together? What happens if one of these systems goes out of whack?
- The farmhand software is all about maintaining a stable setting inside the farm. There's a similar premise in our bodies, called homeostasis, which makes sure we maintain the same body temperature even if we sweat, for example. How else are our bodies like a controlled environment? What are ways we can keep ourselves stable internally, both physically and emotionally?

Advanced Connections:

- How else could a hydroponic container system be designed? How could a hydroponic system be constructed outside of a freight container?

Script for Young Children:

Welcome to our Freight Farm! This farm is a hydroponic garden. Does anyone know what “hydroponic” means?

Hydroponics is a way of growing plants that uses water instead of soil. In most gardens, plants get their nutrients from the soil, but in hydroponics, we put everything plants need to grow big and strong into the water instead.

This hydroponic container farm is a form of controlled environment agriculture. Does anyone have a guess about what this means?

It’s exactly what it sounds like: We make our own growing conditions by controlling the area inside the farm. We get to decide the temperature, the humidity, even the conditions of the water! In controlled environment agriculture, we focus on keeping the outside environment out, and the inside environment stable so that the plants have the same perfect growing day, every day.

There are two types of controls in the farm: climate and water. The climate, or air, is controlled through a big HVAC unit (which stands for Humidity, Ventilation, and Air Conditioning) to maintain the perfect temperature and amount of water in the air, or humidity, for plants. The water is controlled through sensors that detect pH, temperature, and nutrient levels. These sensors send that info to the farmhand Hub (the brain of the farm!), which then commands the dosing panel to add the right amount of nutrients needed into the water.

There are two main areas of the farm: the Nursery Area and the Cultivation Area. Seedlings will spend three weeks here before being transplanted in the vertical panels for mature growth in the Cultivation Area walls. Each of these areas has its own water tank and sensors to control nutrients and pH.

The Nursery is where all our seedlings start. First, we fill these trays with our grow medium — called “plugs,” then plant a seed in each plug, then slide it into these tables (called the Nursery troughs) and cover with a humidity dome. Automatically, at a certain time each day (automated by the farmhand software), water is pumped from the Nursery tank and fills up the troughs, where the plugs soak up the water and nutrients and give them to the seedlings. After a week, when the seedlings are done germinating, the dome is removed, and they spend another two weeks growing before they’re ready for transplant.

Once the seedlings are transplanted into the Cultivation Area, they will spend up to five weeks until full growth. This varies a little bit on the type of plant, because some plants are harvested by trimming (or “cut and come again”) but others are fully harvested in one go. When we fully harvest, we clean the panel so that it’s ready for the next tray of seedlings. If they’re trimmed, they can usually stay there for another two weeks until the second trim, then another two weeks until it’s time to take them out completely. We don’t want to keep the plants in the wall too long, because their roots will get so big and strong that it will be difficult to remove the plant!

We cannot grow big woody plants like trees or shrubs. For example, we can't grow apples here, because apples grow on big trees in orchards! But, this container farm is perfect for small, delicate plants like leafy greens, herbs, some flowers, and small root vegetables … which is great, because these are the exact type of plants that wouldn't last very long if we were to grow them outside and deliver them over long distances in a truck. These plants are delicate and wilt (or go bad) fast once they're harvested, and they can be expensive! Growing them onsite here saves us money from having to buy them, allows them to stay fresher longer if we eat them close by, and prevents us from wasting them because they go bad too quickly after buying in a supermarket. Plus, we skip all the carbon dioxide emissions from the delivery truck.

One of the best things about hydroponic container farming is that, because it's a controlled indoor environment, we can grow and harvest every day of the year! So even if it's cold and snowy outside, or hot and tropical, we can have fresh, happy greens here regardless of outdoor climate. And, because we control the environment, and the outside is kept out, we don't have to worry about spraying harmful pesticides to kill bugs. This means the produce in our farm is organic, and is safe to eat straight off the wall! But we'll still wash it before serving it to anyone, just to be extra safe.

That brings us to the benefits and limitations of hydroponic farming. There are certain things that can't be grown in this environment. What plants do you think these might be? Everything we grow in here goes to [recipient of your produce] and is used for [destination/food service environment]. All the work is done by [your lead farmer or other primary source of labor] and YOU as student farmers!

How to approach field trips with large groups of young students:

If working with large groups of students, bring an extra teacher or chaperone. Divide the class into two to three groups, with no more than 10 in each group. Each group will spend five to 10 minutes on each task — one group touring the farm while the other group does a taste test, Food Steps Exercise, or another activity.

→ **Activity 1:**
Tour inside farm

→ **Activity 2:**
Lettuce tasting with table set up outside farm using the 5 Senses Worksheet

→ **Activity 3**:
Food Steps Exercise (Optional)

Suggested rules before going into the farm:

- Keep arms and hands to yourselves — explore with your eyes, ears, and noses only!
- Ask permission before entering the Cultivation Area, and stay off the Cultivation tank, please! (We recommend using colorful tape or a staff member as a barrier between Nursery Station and Cultivation Areas.)
- Raise your hand to ask questions and always use inside voices
- Don't yuck someone's yum
- Be curious! If you're not sure how something works, ask!
- Ask permission before using touchscreen or farmhand apps

LESSON PLAN

Seeding

Ages: All (5+)

Group Size: Small preferred; see below for working with large groups

Learning Outcomes

- **Teenagers and adults (grades 9 and up)** should be able to:
  - Prep workspace
  - Plug and seed full tray
  - Label and insert tray into slot in Nursery trough and cover with humidity dome
  - Clean up workspace, along with weekly "clean as you go" maintenance
  - Enter seeding data into Crops section of farmhand® with appropriate notes
- **Young children (grades K–8)** should be able to:
  - Plug and seed full tray
  - Label and insert tray into slot in Nursery trough and cover with humidity dome
  - Plug and seed full tray
  - Label and insert tray into slot in Nursery trough and cover with humidity dome

Materials You Need

- Trays, plugs, and seeds
- Hand sanitizer or gloves
- Tweezers and small cup of seeds for each student
- Benches for small children (if applicable)

Activity Overview:

Introduction

5-10 mins

Prep the workspace and set up all supplies. This can be done in advance by the lead farmer to maximize session time, which is particularly beneficial when working with young students or under time constraints.

Seeding

20-30 mins

Show seeding video or demonstrate the activity in your own words

Wrap-Up & Takeaways

10-15 mins

Label seedling trays with crop variety, planting date, and class number or student names.

Stow away all supplies, clean up, and sanitize workspace.

Pose advanced STEM connections and SEL discussions. These can also be assigned as homework or journal prompts.

Talking Points

Ages: all (5+)

Excite & Engage (Beginning Discussion):

- Who has planted seeds before? What kind and where? What did they look like?
- Today we will be planting seeds in our Freight Farm. Seeding is one of the most important tasks in our farm. If we don't plant them every week, we won't have anything to harvest eight weeks from now!

Explain & Expand (Activity Discussion):

- If we're not planting seeds in soil, then what are we planting them in? How many do we plant?
- What is contained within a seed? What do they need to grow and thrive? What happens next?

Exit (Concluding Discussion):

- → Check understanding and recap all the seeding steps with your students. Why do we do each?
- Compare seedling growth in a controlled environment to that of a traditional soil garden. What are the benefits of growing in our Freight Farm?
- What does our growing media look like and what does it do? How is this different from soil?
- Identify, compare, and contrast different seed types. Explain what a seed contains and what it needs to sprout and thrive.
- Identify all the different systems involved in seed germination in the Freight Farm — tray, media, seeds, dome, water, nutrients, lights — and explain how they work together to start a plant.

Social Emotional Learning (SEL) Connections:

- Seeds represent potential. What is inside a seed? What do they need to grow into large adult plants? How are seeds similar to or different from us humans?
- Discuss: "They thought they could bury us, but they didn't know we were seeds" - Dinos Christianopoulos

Advanced Connections:

Grades 3–5:
We mostly use pelleted seeds in our farms; this is a man-made adaptation (coating seeds in a layer of clay) to make seeds easier to handle and have better control of the number of seeds planted each time. What are other natural adaptations that seeds may have to ensure their survival success? Examples: Burrs to stick on animal fur, fluffy parachutes to float in the wind, hollow shells to float in water, yummy fruits for animals and humans to digest and excrete.

Grades 6–8:
How much nutrients do seedlings need compared to a whole plant? More or less?

Grades 9–12:
How does a coconut become a grow plug? Investigate the use of coconut husk and peat moss as raw materials for hydroponic growing medium. Compare their physical and chemical composition to that of soil. Research three other types of grow media. What are the advantages and disadvantages of each?

Here are some options for seeding inside your regular classroom if the group of students is too large to fit in the farm:

Option 1

- Divide class into two or three groups.
- While one group takes turns planting rows of seeds, the other group can do an activity from the Activities section of this guide (plug artwork activity, seedling dissection, etc.).
- Make sure that students wash their hands before seeding if they're coming from a separate activity.
- Teachers should always label the tray with class, hour, or student names (in addition to date and seed variety) as a form of praise and recognition.

Option 2

- Have a table with the tray of plugs at the front of the classroom.
- Pick one to two students at a time to plug and plant, doing one full row at once (each tray has 20 rows of 10–12, so roughly every student can plant one row).
- While students are taking turns doing this, discuss associated talking points or answer any questions that seated students have.

Seeding Script for Young children:

Seeds are planted inside a small pod, made of some combination of coconut husk, peat moss, and other binding agents. This makes them fluffy and spongy so that they can:

1. Provide a stable “place” for the plant throughout its journey in the farm, from seeding through harvest, and
2. Easily absorb all the water and nutrients in the tanks and deliver them straight to the plant’s roots.

We call these plugs because they get “plugged” into the tray. While we’re plugging, you might see some broken pieces. As long as a plug is at least two-thirds intact, we can still use it.

Each tray has either 200 or 288 spots. Try to put only one seed in each hole. It’s okay if you accidentally add more than one, but generally, each plant likes to have its own space to grow so that it doesn’t have to compete for resources with another plant. Just think — would you rather share a room with your sibling or have your own?

Every seed contains the following: an embryo, a nutrient reserve (or endosperm), and a seed coat. The embryo is the actual beginnings of a plant — much like a human embryo in the womb! The seed coat protects the embryo and keeps it “dormant,” or asleep, until activated — namely, when it gets watered for the first time. Repeated watering will open the seed coat, triggering the embryo to sprout, or “germinate.” The embryo will use the nutrients stored in the endosperm to emerge from its shell, but once the initial sprout forms, it will need outside nutrients to further develop. Seeds differ in the shapes and sizes of their seed coats, length of time before germinating, and nutrients inside, but they all have these three common components.

Our Freight Farm has software and sensors to make sure that seedlings receive the exact amount of nutrients they need. And because the plug soaks up all the water and nutrients, the roots don’t have to spend time and energy spreading out in search of nutrients like they usually would in soil, and instead focus their energy on growth and development in place. This is part of the reason that plants can grow much more quickly and efficiently in a hydroponic system.

Once the tray is planted, we slide it into the Nursery table and place a humidity dome on top. This dome adds extra moisture to help with germination. Every day, the farmhand software will automatically water the plants by filling up the Nursery trough and dose nutrients into the Nursery tank to maintain an ideal nutrient level.

It’s important to label our tray with today’s date and who planted it, so that we can use this information in a few weeks when it’s time to transplant. We can also enter this information in the Crops section of farmhand so that anyone using our farm can see what’s been planted by checking the app.

LESSON PLAN

Transplanting

Ages: High school and up (young children only in small-group settings)
Group Size: Large or small

Learning Outcomes

- **Teenagers and adults (grades 9+)** should be able to:
  - Sanitize and prepare the workspace: enter Task Mode in farmhand®, retrieve panels from Cultivation Area, arrange tray for transplanting
  - Sort mature and immature seedlings for transplanting
  - Space seedlings according to crop spacing guidelines
  - Properly insert plugs into panel according to farmhand Academy guidelines
  - Label panel with crop variety, planting and transplanting date, and class number or student name
  - Re-hang panel and restore farmhand to operational settings
  - Enter transplanting data into Crops section of farmhand
  - Complete "clean as you go" maintenance
- **Young children (small group, after-school settings only**) should be able to:
  - Arrange seedlings according to crop spacing guidelines
  - Properly insert plug into panel according to farmhand Academy guidelines

Materials You Need

- Tray of mature seedlings
- Tweezers
- Disposable gloves
- Prepared Zerotol spray solution

Activity Overview:

Introduction

2–5 mins

- Sanitize the workspace and set up all supplies. This can be done in advance by the lead farmer to maximize session time, which is particularly beneficial when under time constraints.
- For high school and older kids, show the Knowledge Base transplanting video. For younger kids (small group, after-school settings only), see the sample script below. Or, describe the activity in your own words.

Transplanting

30 mins

Wrap-Up & Takeaways

10 mins

- Label panels with variety, planting date, and class number or student names (you can preserve the same label from the seedling tray).
- Stow away all supplies, clean up and sanitize workspace, and complete associated "clean as you go" tasks.
- Pose advanced STEM connections and SEL discussions. These can also be assigned as homework or journal prompts.

Talking Points

Ages: all (5+)

Excite & Engage (Beginning Discussion):

- What is a seedling? How is it different from a seed or full plant?
- What does it mean to transplant? Has anyone ever transplanted anything before?
- Why do you think we have to transplant in a hydroponic environment? A soil environment?
- Show Academy video if using.

Explain & Expand (Activity Discussion):

- Why do we move the seedlings to the Cultivation Area? What role does transplanting play in growing edible crops?
- How do we know when our seedling is ready for transplanting? We are looking for the appearance of true leaves, rather than the cotyledon. (See the bottom of this seeding article for more detail!) What other ideal characteristics are we looking for? How big should the seedling be, and how should the roots look?
- Describe how crop spacing relates to the needs of the plant. Why do we spread the lettuce apart within each row and skip channels when transplanting? How would plants' growth be impacted if we placed them closer together?

Exit (Concluding Discussion):

- Why did we transplant in such a specific way (at a 45-degree angle)? What are the effects of how a plant is situated? See transplanting article for detail.
- What do roots need to mature? Why do they need more space than they have in the Nursery Area? What would happen if we left them in the seedling tray?

Advanced Discussion & Extensions:

- When would transplanting need to be done in other environments? Teacher can provide examples: palm trees in Miami, repotting houseplants, landscaping plugs.
- Explore seedling and young plant wholesale as a business model. How do traditional greenhouse nurseries make their money?
- When transplanting goes bad: How can long-distance plant trades exacerbate tree felling? How can tainted seedling trays quickly contaminate your whole farm?
- Experiment: Transplant seedling to a soil garden and compare growth after four weeks to seedlings in the Cultivation Area (in all four seasons).

Social Emotional Learning (SEL) Connections:

- Where are your "roots" in life? What kinds of things make your roots feel strong?
- What was a time you felt like you were transplanted? How did that affect your growth?

Transplanting Script for Working with Younger Children in a Nonprofit Setting:

As we get older, our needs change. We need to eat more food and drink more water; we need different sorts of schooling so that we continue to learn. We outgrow our clothes and need new ones, we outgrow our shoes, we need new beds — all of these things are a part of growing up. Plants are the same way. As they get older, their needs change as well. They need a higher concentration of nutrients in their water supply, they need water more frequently, they need more space to stretch out their leaves and roots so that they can reach their full maturity. In short, they outgrow the Nursery Area — so at that point, it's time for them to be moved to the Cultivation Area.

There are a few important differences between the Nursery Area and the Cultivation Area. Can anyone tell me what they are?

- Plants grow on the walls instead of in the trays.
- Plants grow bigger.
- Plants get their water in a different way.
- Plants get more nutrients.

That's right! All of these things together help the plant grow into its mature form. Today, we'll learn how to "transplant," or move, crops into the Cultivation Area in a way that makes sure they are set up to thrive.

First, let's think about how we'll know when it's time for a plant to move. What are we looking for?

- Strong roots: white roots that wrap all the way around the plug.
- A few sets of "true leaves" — different from the little baby sprout leaves (called cotyledons) that the plant started with.

For food safety purposes, it's important to make sure we're following sanitary practices. This includes cleaning and sanitizing our workstation and tools in addition to tying back hair. We will all be sanitizing our hands prior to putting our gloves on, and everyone will be asked to change gloves if they touch their hair, face, or skin.

Now, onto the transplanting process. To move the plants, we have to first take them out of the Nursery tray. Remember to be gentle — we don't want to damage their roots. To remove seedlings from the trays, we can use tweezers as a lever to pop them up and out.

After we take the seedlings out, we can put them in groups based on the way they will get spaced out later. Since we're planting lettuce in groups of 15, let's put our seedlings into groups of five. Let's all help take the seedlings out of the tray and group them into little packs of five.

Great job! Okay, now that we have our plants all taken out and grouped up, let's get a panel off of the wall. This will be the new home for these plants.

When we are transplanting, it is very important that we put the plants in the panel in a certain way so that they'll grow well. We are looking for three things when we put them in the panel:

- What position are they placed in?

- How deep are we putting them in the panel?
- Where in the panel are they going?

Let's go through these things one by one.

First, we want to make sure we put the plants into the panel at a 45-degree angle. (Show an example of what this looks like, either by using your arms to visualize or with a helpful picture.) Does anyone have a guess as to why this is the way we should put them in?

- Helps the plants fight gravity (and not fall out!)
- Makes sure the plant gets water directly at its roots

Awesome job, everyone. Now, let's talk about how deep we should put them in the panel. What would happen if I put the plant in so deep that you could barely see its leaves? (Show an example of a seedling buried in the panel.)

- Water might run over the top of the leaves, and make it hard for the plant to grow!

What would happen if we put the plant in so that it was barely touching the foam? (Show an example of a seedling sticking out almost entirely.)

- It might not get any water at all!

You got it! We want to make sure the plant is getting everything it needs to grow, so we want to make sure the bottom half of the seedling is in contact with the fabric and foam. When it's done right, it should have a little corner peeking out, forming a triangle.

Finally, where in the panel should the seedlings go? We can use tape on the table to tell us where along the panel to put the plants. We have 15 pieces of tape, so we know we want to put 15 plants in each channel. And, since these are lettuce plants, and lettuce doesn't play well with others, we want to give them plenty of space for radial growth — meaning we will only use three of the five channels (the two on the outside and the middle one). Those extra two spaces (channels two and four) will give the plants extra room to grow!

When we're putting the plants in, we want to make sure we are giving them plenty of space — nobody likes to get too crowded! So, let's make sure we are staggering the plants. Does anyone know what "staggering" means?

- It means the plants aren't all right next to each other. We want them to look like a checkerboard – not like stripes! (Use seedlings to demonstrate correct vs. incorrect spacing.)

Who's good at math, and can tell me what [3 channels x 15 plants] is?

45 plants — awesome! So this panel will have 45 plants in it when it's all ready. There will always be 45 plants in a panel when we are doing lettuce!

So, let's go ahead and place the plants in the panel with our gloved hands. When we're all done, we'll add a label so that we know who transplanted these plants, and when. I will come around and check out all the seedlings when we're done to make sure they're ready to go.

Finally, we're ready to put the panel back on the wall. This will let the plants get to know their new neighbors — howdy, neighbors! — and also makes sure they will receive light, water, and nutrients in the right amounts to help them grow. Let's all wish the plants good luck in their new home!

LESSON PLAN

Harvesting

Ages: Middle school and up for large groups; ages 8+ for small groups
Group Size: Large or small

Learning Outcomes

- **Teenagers and adults (grades 9+)** should be able to:
  - Prep work space and apply PPE with extra care for food safety
  - Correctly harvest full head and plug or trim plant, depending on the day's procedure
  - Thoroughly clean panel, per "clean as you go" maintenance instructions
  - Take harvest to kitchen (or wherever it is stored/processed)
  - Weigh and count harvest
  - Clean farm according to maintenance procedures (sweep workspace, under Nursery table) after harvesting
  - Package harvest, if applicable
  - Enter harvest data into Crops section of farmhand®
- **Young children** should be able to:
  - Put on gloves or use hand sanitizer
  - Correctly harvest full head and plug or trim plant, depending on the day's procedure
  - Thoroughly clean panel, per "clean as you go" maintenance instructions
  - Take harvest to kitchen (or wherever it is stored/processed)
  - Weigh and count harvest

Materials You Need

- Aprons and gloves
- Bins for harvest
- Prepared Zerotol spray solution
- Paper towels or rags for cleaning

Activity Overview:

Introduction

2–5 mins

Sanitize the workspace and set up all supplies, retrieving panels for harvest from the Cultivation Area. This can be done in advance by the lead farmer to maximize session time, which is particularly beneficial when working with young students or under time constraints.

For high school and older kids, show the Knowledge Base harvesting video. (If trimming, use the trim harvests video). For younger kids, see the sample script below. Or, describe the activity in your own words!

Harvesting

30 mins

Wrap-Up & Takeaways

10-15 mins

Label harvest bin with variety, date, and class number or student names and take to designated refrigeration or processing area.

Complete associated "clean as you go" tasks, clean up and sanitize workspace, and stow away all supplies.

Pose advanced STEM connections and SEL discussions. These can also be assigned as homework or journal prompts.

Talking Points

Ages: all (5+)

Excite & Engage (Beginning Discussion):

- What does the term “harvest” mean? Has anyone here ever harvested something before?
- Harvesting looks different across crops and settings. What do you think it will look like in our hydroponic container farm?
- Explain the importance of Personal Protective Equipment (PPE) and good sanitation practice for preparing finished agricultural products. Why do we need to wear gloves and aprons while harvesting?

Explain & Expand (Activity Discussion):

- What are the size and characteristics of a plant that is ready for harvest?
- Describe the edible and inedible parts of different plants. Which parts are fit for consumption? Which parts do we not want to eat?

Exit (Concluding Discussion):

- What would happen if we didn’t harvest on time? How would this affect the plants, and how would this affect the recipient of our produce?
- What resources went into producing this vegetable? What is contained in this head of lettuce?
- Harvesting is one of our messiest tasks in the farm. Why is it so important to clean afterward? (For each area — panels, gutters, emitters.)
- What else needs to happen before this food can be served? How far does it have to travel before it ends up on someone’s plate?

Advanced Discussion & Extensions:

- There are inedible or unsellable parts of each head of lettuce. What do we do with this extra plant matter? (Discuss the role of composting and how it relates to your other garden areas, if applicable.)
- What factors might increase the quantity of this “waste” or unusable produce? How does that affect our overall yields and potential revenue?
- Let’s consider again what resources and inputs went into this vegetable. Where do those go once it’s consumed? How do the water and nutrients in the plants affect the human body?

Social Emotional Learning (SEL) Connections:

- What are food deserts? What is food apartheid? What differentiates these two terms? Is one more all-encompassing than the other?
- Where is the closest place to buy fresh produce in your neighborhood? Where did it come from and how long did it take to get there?
- "Hunger" is a global issue that can mean different things — not getting enough nutrients in total, or not getting the right balance of the types of nutrients that our bodies need. (Caution: Be mindful when discussing this with your class, since there may be students experiencing hunger present.) How might someone feel if they were deprived of these? What is the sensation of hunger, and how does it impact your ability to play or learn or work?
- What does it feel like — emotionally, physically, or both — to eat something that you grew or was grown by someone you know? Does it change the sensory experience of eating?

Harvesting Script for Young Children:

After the plants have spent eight weeks in the farm, they are ready to be harvested and taken out! Can anyone tell me what the plants are doing for those eight weeks? Why does it take them eight weeks to grow up?

- 3 weeks in the Nursery Area
- 4–5 weeks in the Cultivation Area

What happens to the plants after they leave the farm?

- They get eaten
- They are taken to the cafeteria, pantry, store, etc. (wherever it is you bring your food)

Right — they get eaten and go to our bellies! And since it's very important that our food is clean and safe when we eat it, let's make sure we all put gloves on our hands to protect the plants. Can everyone take a moment to sanitize their hands and then put on gloves?

Great. Now that we know we are keeping the food safe, let's talk about how we will be harvesting it today. Since we are harvesting lettuce, we will be taking the whole entire plant out of the panel — including the roots!

Can everyone show me their pointer finger? Point at the lettuce panel!

Perfect. Now, let's turn that pointer finger into a hook. Can everyone show me their best hook?

Great job! We will use that hook to take the plants out of the panel. First, we'll use our pointer finger to reach down into the panel near the grow plug. Once we feel the plug, we'll use our hook to scoop the plant right out! Be careful — sometimes, they really pop right up!

When you have the whole plant out of the panel, turn it over so that the grow plug is sticking up into the air. Now, pick off any leaves that look brown, crunchy, or slimy; those aren't so good to eat. As a rule of thumb, if it looks like something you wouldn't want to eat, then take it off! We'll put all of those leaves into the compost bin so that they can eventually help grow new plants.

Once your lettuce plant is all pretty, it's ready to go to the kitchen! Put your lettuce plant in the bin so that it can be sent to the kitchen.

Then, we'll do the whole thing again!

How many lettuce plants do you think we can harvest from the farm today? I guess we'll see!

(At end) Thank you for all of your help in feeding our [shelter/school/community]!

Activities: Young Children (Grades 3–8)

ACTIVITY

Food Steps Exercise

Ages: Grades 3–8
Group Size: Large

Learning Outcomes

- Explain the steps involved in a food supply chain from farm to consumer
- Understand the benefits of local container farming for the environment
- Calculate the difference in food travel distance between locally farmed food and standard shipped food

Materials You Need

- Paper and pencil
- Packaged store-bought lettuce (a picture works fine too!)

Activity Overview:

Introduction

5–10 mins

Walking Activity

25 mins, including transit to/from classroom

Concluding Discussion

5-10 mins

Talking Points

Ages: Grades 3–8

Excite & Engage (Beginning Discussion):

What did you have for lunch today? Were there any vegetables on your plate? I hope so! I want you to make two guesses: How old are those vegetables, and how far did they have to travel before you were able to eat them?

The vegetables we buy in the grocery store are grown on farms. These farms take up a lot of space, so most of the time they are located far away from where people live and go to school — usually too far to walk. This means any food grown on farms has to travel some distance before it can be prepared to eat and eventually go to our plates.

There are four main steps to moving food from farms to our plates. All of these steps together are referred to as the "supply chain."

1. The first step is the grower or farmer. The farmer harvests their vegetables from the field then sorts, cleans, and packages them so that they look nice for whoever is buying them. This sorting and cleaning — or "processing" can take one or a few days. Depending on the size of the farm, this is done by hand by farm workers or by a special machine.
2. The second step is the distributor. This person picks up all the harvest from the farmer, then drives it in a refrigerated truck to the grocery store where it will be sold. Sometimes the distributors drive across many states — for example, from California to Missouri. This takes a lot of time. Have you ever driven that far? How long did it take? This step is important because trucks require gasoline to run. What happens when trucks drive on gasoline? They burn fossil fuels and release pollutants into the air. How will this impact the environment if a car is driving lettuce or other crops across many states?
3. Third is the grocery store. This is where people buy the food before taking it home. Sometimes the food can sit on the shelves for a few days before it is bought by someone.
4. Lastly, food makes it into our homes or schools. We wash it before eating (to get rid of all the germs from its travel) and chop or cook it before serving it on our plate.

This is a bag of lettuce I bought at the grocery store. The packaging says this is where the farm is located (for example, Castroville, CA). Based on Google Maps, this is how far away the farm is (for example, to New York City is 2,993 miles and 44 hours of driving).

So, if processing the crops in the fields takes a few days, then driving the produce to the grocery store takes 44 hours, then the crop sits on the shelves at the grocery store before being bought and again in our refrigerators, how many days old will the lettuce be before we actually eat it?

→ Break from the intro discussion and head to the farm. Make sure students bring their paper and writing utensils.

Explain & Expand (Activity Discussion):

Our farm here is different. We grow the vegetables here inside a big container. This allows us to control the weather so that we can grow the same vegetables every day of the year, no matter what season it is. The vegetables are also grown vertically inside the container. This way they don't need as much space to grow, so we can place our farm closer to where we will be eating. So close, in fact, that we can walk to the kitchen where it will be prepared and served.

Starting at the door of the farm, we're going to walk, heel to toe and one foot at a time, to the kitchen. Take your time, and start over if you need to. We can all walk in a line elbow-distance apart so that we can all do it at the same time.

→ Turn on an app like Map My Run as soon as students start walking, and end when they reach the destination. Or, if you know the exact distance, let them know.

Let's calculate how many steps it took and do some math. How many more times is the usual distance traveled for lettuce compared to our steps from farm to kitchen?

Exit (Concluding Discussion):

Why is it good that our food is grown here at the school? What about this farm makes us able to grow our food here in the first place? List one reason for each on your paper.

Age Adaptation:

- For younger children, do walking activity and count steps only
- For older children, use the following writing prompts.

Writing Prompts:

Question 1: What was your last meal, and what vegetables were included?

Question 2: How old were those veggies? How many days total across the supply chain? How many miles?

Question 3: How many steps did you take from farm to kitchen? How does this compare to the typical supply chain for lettuce?

Question 4: What are three reasons why having a farm onsite is good?

ACTIVITY

5 Senses Exploration

This activity is designed to accompany Farm Field Trips & Tours. See the appropriate section for learning outcomes, materials needed, activity overview, and talking points.
If you have a traditional outdoor garden space at your site in addition to your Freight Farm, we suggest adding a second column for “Outdoor Garden” so students can compare and contrast the sensory experience of different growing environments.

SENSE	FREIGHT FARM COMPONENT
Hearing	
Sight	
Smell	
Touch	
Taste	

If you’d like, to get students more in tune with their bodies before filling out this table, have them check in with each sense: blink twice (sight), rub fingers or hands together (touch), pat ears (hearing), smack their tongue (taste), sniff twice (smell). Instruct them to move through the farm silently so that they can attune to what’s around them. Be sure to restate any rules before going into the farm — specifically, not to touch the plants without permission.

Below are some examples of what kids might sense for each category in the farm. If they identify a sight or sound and it is their first time in the farm, they will likely have questions about what it is. Here are some explanations that the lead farmer can offer:

Hearing

- Running water: Recirculator pumps in both Nursery and Cultivation tank to keep water moving over the sensors.
- Fans: Overhand and duct fans, which keep air moving throughout the farm to simulate the outdoor environment in which plants are constantly being refreshed with air.
- Mechanical whirring of pumps: Send pumps in the Cultivation Area or Nursery Station, sending water from the tanks to the plants. Only happens at certain times of day and is controlled by software, so we humans don't have to manually water.

Smell

- Fresh: Plants generate oxygen through the process of photosynthesis. Because we have so many plants in such a small space, there's a lot of oxygen in here that makes the air feel and smell super fresh. If you live in a dense urban environment, this might be the freshest air available to you!
- Vinegar: Some people think Zerotol, our only cleaning agent in the farm, smells like vinegar. This is because it's an organic product with a similar chemical makeup.

Taste

- Save the taste test for last. Some students might not enjoy the taste of whatever they're trying and will have the urge to spit it out - encourage them to explore the experience of taste as a sense, and name it with adjectives of texture or flavor, rather than immediately jumping to "gross" or "yuck."

Sight

- Red and blue lights: Scientists figured out that these are the two wavelengths of light needed for plants to grow. They generate heat, but not as much as the sun. Can you feel the heat? The lights are on for ~18 hours a day, which is more than plants usually get outside, allowing them to grow faster and larger.
- Green: Chlorophyll in plants, which enables photosynthesis and allows plants to grow by making their own food.
- Gray/metal: Stainless steel, which makes our farm easy to clean and sanitize. Good for insulating to keep the cold air in and outside air out.
- The sights of the farm are arguably the most stimulating and a lot to take in. Students might have very specific questions about what they see!

Touch

- Cold: The farm is kept at ~65ºF. This is the temperature that plants enjoy and grow best in. The farm is a little bit like a big refrigerator! Wear a sweater/sweatshirt when you're working here if needed.
- Warm: Heat generated by lights. If we didn't have the A/C, the farm would heat up inside super fast while the lights are on.
- Make sure students know what they can or can't touch — plants and water tanks are off limits.

ACTIVITY

Farm Fresh Salad with Green Goddess Dressing

Ages: 8+
Group Size: Large

This particular food activity does not require any heat or cooking. Full cooking classes are an additional programmatic element that schools and organizations may want to forego because not every organization has access to the necessary equipment and resources, and not all lead farmers have a food education background in addition to their gardening education background. However, involving food prep will likely extend the impact of your Freight Farm by promoting positive health and nutrition behaviors among students and by closing the link from farm to plate. They're also a great opportunity to involve volunteers, as it always helps to have extra sets of adult hands around.

Alternatively, you can partner with a nutrition education group to facilitate cooking classes. See our guide on how to connect with these partners in your community. See also our recipe bank for other ways to use produce from your Freight Farm.

Learning Outcomes

- Describe the five main parts of plants: roots, stem, leaves, flowers, seeds
- Give edible examples of each of these plant parts
- Describe food safety best practices
- Perform basic culinary skills like cutting and chopping, measuring and mixing

Activity Overview

Handwashing & Prep 5 mins
- Sanitize tables and distribute cutting boards & child-safe knives (can be done in advance)
- Instruct every student to wash hands with soap and water

Opening Discussion 3 mins

Food Prep 20 mins
- Chop lettuce and radishes
- Measure and mix dressing
- Toss it all together

Dish Up & Eat 10–15 min

Materials You Need

- White board
- Cutting boards & child-safe knives for each student
- 2 large mixing bowls
- Food processor
- 1 cup measuring cup
- Measuring spoons
- Spatula
- Salad tossers or large tongs
- Bowls & utensils for serving

Ingredients

From the Farm:
- 5-8 heads of lettuce (farmer's choice!)
- 4-5 Crunchy King radishes
- 1 bunch parsley (about 1 cup)
- 1 bunch mixed dill, mint, cilantro, chives and/or tarragon (about 1 cup) - for dressing

From Elsewhere (for the dressing):
- 1 cup whole milk Greek yogurt
- 2 tbsp lemon juice
- 1 tbsp extra virgin olive oil
- 1 garlic clove

Serving Size: feeds five kids. Scale as needed to feed your group size.

Talking Points

Ages: 8+

Excite & Engage (Beginning Discussion):

Before we start any food prep, everyone needs to wash their hands for 20 seconds with soap and water. We'll all be sharing this meal together, and your germs aren't one of the ingredients! Be sure to cover your mouth with your elbow if you have to sneeze or cough, and refrain from touching anything other than the food in front of you while cooking.

Today we'll be preparing a fresh salad and green goddess dressing with lettuce and herbs from our farm!

Who here likes salad? If not, I want you to think about where these plants came from and how we explored all 5 senses during our Farm Tour. Remember all the steps that went into growing them from seed to harvest to table - how does that change your opinion of salad?

Explain & Expand (Activity Discussion):

The main ingredient in our salad is lettuce. Lettuce itself is a whole plant, but the parts that we eat are the leaves. The role of the leaf is to absorb sunlight — in the case of our Freight Farm, LED light — to photosynthesize food for the rest of the plant. The leaves are one of five plant parts, along with roots, stem, flower, seeds, and fruits.

What are some examples of foods we eat for each of these plant parts?

→ Demonstrate on the whiteboard with an illustration of a plant. Solicit answers from the class and write on the board.

First, remove the grow plug and roots from the head of lettuce by chopping with your knife. Then, cut the head of lettuce into one-inch strips. If you're new to cutting, try a technique called "rock and chop." Use your non-dominant hand as a bear claw to hold the lettuce in place while using your dominant hand to rock the knife back and forth through the produce on your cutting board. The knife shouldn't even leave the cutting board — just roll back and forth. Add the chopped lettuce to the mixing bowl on your table. Alternatively, leave the grow plug on and hold it in place while slicing the leaves from the other side. Stop chopping when you reach the grow plug and discard.'

Next are the radishes. Who's ever tried radishes before? Radishes are a special root vegetable with lots of nutrients and a spicy flavor. We're going to cut them into thin slices, which will add a nice crunch to our salad. Using your bear claw with one hand and a sawing motion with the knife with the other hand, slice the radish into ⅛-inch thick coins. The role of roots in a plant is to drink up water. In our Freight Farm, the roots absorb both nutrients and water through the saturation strips in the vertical panels in the Cultivation Area.

→ This is the end of chopping. Collect knives and cutting boards from students in a bin for washing.

Next, we're going to prepare our dressing. This is called a Green Goddess dressing because it contains lots of fresh herbs from the farm that will give it a rich green color. We're going to blend everything in our food processor. First, I need a volunteer to help me measure the first ingredient: Greek yogurt. We're using this instead of mayo or sour cream, which are usually the main ingredient in creamy dressings, because it has much more

protein. Protein is a nutrient that provides the building blocks for many different parts of our body — mostly strong muscles, but also healthy skin and hair and an alert brain! Scoop the yogurt into our 1-cup measuring cup, then use the spatula to add it to the food processor.

→ Continue selecting a student volunteer to add each of the remaining dressing ingredients to the food processor. Pulse to combine and use a spatula to pour over the salad. Toss, serve, and enjoy!

Exit (Concluding Discussion):

- Do we feel differently about salad now that we've made our own with greens grown here? Do we feel differently about salad now that we've made our own with greens grown here? Would you make this again?
- What did it taste like? Pick five words. Use descriptive adjectives like crunchy, tangy, or fresh, rather than terms of judgment or likes/dislikes.
- Everyone, give this recipe a quick rating with a show of hands — thumbs up, thumbs down, or thumbs in the middle.

Advanced Discussion & Extensions:

- The Greek yogurt provides protein that helps our body develop strong arms and legs. What nutrients do plant bodies use to grow strong stems and leaves? Do humans and plants use the same nutrient building blocks?

ACTIVITY

Worksheet: Crop Arithmetic

Ages: Grades 3-5

Ages: Grades 3–5

Advanced math directions and full crop planning schedule activities can be developed by referencing the Crop Planning Overview on farmhand® Community and the associated Farm Camp PowerPoint.

Seedling trays come in two sizes: 288-cell & 200-cell. For the purposes of this activity, we are using 288-cell.

Question 1:

- If we seed two 288-cell trays of lettuce each week with a germination rate of 98%, how many seedlings will we have for transplanting?
- 288 x 2 x .98 = _____ *(Answer: 282)*

Question 2:

- If lettuce is planted 15 plants per channel, in 3 channels of a panel, how many panels can we fill with our transplants from Question 1? Round up to the nearest whole number.
- 15 x 3 = _____ plants per panel *(Answer: 45)*
- [Answer from Question 1] ÷ [answer above] = _____ panels *(Answer: ~6 panels)*

Question 3:

- Let's work backward. Our farm contains 88 panels total in the Cultivation Area. These 88 panels are divided between 4 walls. How many panels are on each wall?
- 88 ÷ 4 = _____ *(Answer: 22)*

Question 4:

- If we wanted to fill a whole wall with lettuce (using the planting configuration in Question 2) to be harvested at once after 4 weeks in the Cultivation Area, how many plants will be in the wall total?
- 22 panels x [# of plants per panel (45)] = _____ *(Answer: 990)*

Question 5:

- Now that we know how many plants we need in our panels, how many trays of seeds do we need to plant for one wall of the Cultivation Area?
- [Answer from Question 4] ÷ [Answer from Question 1] = _____ *(Answer: 3.5)*

Bonus question: Leaves Galore!

- How many leaves are on a single head of lettuce? Pair students into groups of 3–5, each with a head of lettuce, and count the total number of leaves.
- How many leaves are harvested with a full wall of lettuce?
- [# of leaves] x [Answer from Question 4] = _____

Additional Activity Ideas for Young Children

Seedling Dissection

This activity requires a mature seedling for each student. Have each student dissect a seedling to observe its leaves, stem, and roots using tweezers or small scissors. Depending on how many students you plan to engage in this lesson over a week, have the lead farmer plan to seed an extra tray accordingly. If desired, the lead farmer can plant an extra tray each week dedicated solely for classroom lessons. Compost as much as possible after the lesson so you're not wasting supplies! If desired, you can also provide students with cross-section photos of a seedling or full head of lettuce and instruct them to label each part.

Farm Stand

Here's your students' chance to show what they know! Set up a table in the cafeteria during lunch hours, parent-teacher conferences, or any other public event or common space. Bring sample produce from your farm, and have one or a few students describe the crop characteristics and the process of growing it in their own words. Count foot traffic from the event toward your program deliverables, recording the number of people engaged and the number of samples distributed. (See Additional Resources for sample attendance sheets.)

Art Activities

Use your grow plugs as painting sponges! Instruct children to create an image of something they saw in the farm today — their favorite plant, a plant part, a component of the farm, or even an illustration of the plant life cycle as a whole. Similarly, try vegetable printing or leaf pressing with other fruits & veggies.

You can also try a Zoom In, Zoom Out art prompt: creating art by looking at different perspectives of crops, such as a whole wall in the Cultivation Area, a single panel, a single plant, a single part of a plant, all the way down to a close-up shot of leaf veins and root fibers.

Bonus points for using biodegradable, plant-based paints!

Germination Prep

Some seeds with tougher coats (like cilantro, for example) require soaking in advance of seeding to increase germination rate. Prepping such seeds can be a fun in-classroom activity so children can monitor germination over the course of the week. Simply soak seeds in a container of water or on a wet paper towel until shoots appear, then seed as usual.

Celery Stalk Demo

We all remember this classic plant science activity from our elementary school days! Demonstrate plant nutrient uptake by adding food coloring to a glass of water with cut plants. Over the course of a few days, the food coloring will be drawn

up through the xylem (the plant's veins!) to change the color of the stem and leaves. Ideal crops for this include celery, parsley, or similar plants with thick stalks and branched leaves.

More Food Activities

Craft herbal teas by harvesting and drying medicinal herbs or flowers like calendula, lemon balm, mint, and/or lavender.

Shout out to **Rasheeda at Boys & Girls Clubs of Metro South** for this one!

Dry herbs by laying them flat on a baking sheet and roasting in the oven for three to four hours at 150–200 ºF (low and slow!). Then, assemble a blend of your choice into loose-leaf tea bags and host a tea party in your classroom.

Other great recipes to explore with farm produce include kale chips, pesto with fresh basil, and guacamole or salsa with fresh cilantro. Should you choose to grow microgreens in your Nursery Area, radish and broccoli sprouts make for great tastings as well!

We developed a booklet of salad and entrée recipes in 2019. Check it out!

Farm Journals

Encourage your students to keep a journal to document each trip to the farm. Use this as a lab notebook of sorts to collect observations, sketch each stage of the plant life cycle, or make predictions and track patterns. What did each crop look like at the beginning, middle, and end of its journey? Where did it start, how far has it traveled, and where is it going (our bellies!)? A classic spiral-bound or composition notebook does the trick for this!

Parts vs. Whole Activity

Divide your students into four to five groups and give them each a different piece of a plant (e.g. leaf, stem, root, plug, flower, seed). Completely separate each group by sending some students to the hallway or different sections of the room. Instruct each group to study their specimen in detail for five minutes, then talk about what they saw in front of the class. How was their perception of the plant altered by examining only one small part of it? How do all these radically different parts work together to form a healthy whole? And further, how do we give different parts of ourselves to others? How might this change their perception of us? Are we ever seeing all of somebody at one time?

Plant Parts and Body Parts

Take a brain break during class to talk about which parts of our bodies are like a plant (e.g. roots as feet and legs, stem or stalk as torso and spine, arms and hands like leaves, and so on). This can be explored through yoga movements or by simply stretching and shaking different parts of the body.

Activities: Older Children (Grades 9–12)

ACTIVITY

Crop Trial & Yield Data Analysis

Ages: 14+ (Grades 9+)

Learning Outcomes

- Identify representative samples
- Collect data on crop development in the Cultivation Area
- Construct a yield curve to quantify and analyze growth
- Calculate slope

Materials You Need

- Scale
- Ruler or measuring tape
- Google Sheets, Excel spreadsheet, or graph paper and pencil

Activity Outline:

This activity consists of collecting measurements on a weekly basis over the course of four weeks while plants are in the Cultivation Area. Conduct the beginning discussion in the first week and the exit discussion during the final week. Weeks two and three will require less time because they focus on data collection and entry only.

Beginning Discussion

5–10 mins

— Week 1 only

Data Collection & Entry

25 mins

Exit Discussion

15 mins

— Week 4 only

Talking Points

Ages: 14+ (Grades 9+)

Excite & Engage (Beginning Discussion):

- → After transplanting, assign a "rep," or representative sample, from each seedling tray. Discuss with your students what it means to select representative samples of crops.
- 💬 Which panel location within the Cultivation Area should we choose for our rep, and why? Near the end, towards the middle, or somewhere in between? What location of crop within a panel? The biggest one, the smallest one, the top, the bottom, the middle, or a mix of all three? (Hint: ***It's a mix of all three***.)

Explain & Expand (Activity Discussion):

- → Harvest a few plants from this rep sample and take some measurements, using the tables at the end of this page as a guide. First record the height and width using a ruler (include photo documentation if you'd like!). Record the total weight of the lettuce head, as well as the weight of the detached plug, and the "waste weight" of any inedible leaves removed during the harvesting process. Tissue weight is calculated as total head weight minus plug and waste weight (this can be automatically calculated within the spreadsheet by subtracting between columns).
- → For each of the four weeks that these plants are in the Cultivation Area, continue taking multiple samples from your rep panel, average the variable measurements across all rep heads for that week, and put the data into a line graph. The y-axis will be the dependent variable (e.g. weight) and the x-axis will be the independent variable (time). Students can do this by hand on graph paper or using a computer program.
- 💬 Which type of graph is most useful to represent this data? Bar graph, pie chart, or line graph? (Since we are looking for a curved trajectory of growth over time, we want to use a line graph.)
- 💬 There may come a time when something goes wrong with your rep panels or harvest. Unfortunately, the nature of the game in agriculture is that sometimes crops are lost. Maybe your pump fails and a round of crops misses a night of watering. Mark that time point on your graph and use such disruptions as teaching moments. How might the hiccup affect the growth curve?

Exit (Concluding Discussion)

- 💬 Ideally, at the end of the four weeks, this graph should represent a curve with an increasingly steep slope each week. Why is that? Discuss with your students and elicit hypotheses. (This happens because the more the leaves on the plants grow, the greater surface area they have for photosynthesis, and therefore the more energy they can dedicate to growth.)
- 💬 Identify the point at which the graphed line is steepest. What is the slope here? What is the slope between each week?
- 💬 What are some confounding variables (like additives, hydro changes, or climate changes) that could increase the growth slope? Decrease the slope?

- How does the final projected harvest value on your growth curve compare to the actual average of the rest of your harvest (i.e. the other, non-representative panels)? Why might your sample fail to be truly representative? What variables are involved? If the actual value fell short of the projected value, how might this impact a farmer's revenue?
- Which variable is most important to you as a farmer and why?
- What would the graph look like if we waited too long and didn't harvest the lettuce at the appropriate time? How would the size and quality of the plant decay, and would that be represented graphically?

WEEK 1				
Variable	Head 1	Head 2	Head 3	Average
Total Weight				
Plug Weight				
Waste Weight				
Tissue Height				
Height				
Diameter				

WEEK 2				
Variable	Head 1	Head 2	Head 3	Average
Total Weight				
Plug Weight				
Waste Weight				
Tissue Height				
Height				
Diameter				

WEEK 3				
Variable	Head 1	Head 2	Head 3	Average
Total Weight				
Plug Weight				
Waste Weight				
Tissue Height				
Height				
Diameter				

WEEK 4				
Variable	Head 1	Head 2	Head 3	Average
Total Weight				
Plug Weight				
Waste Weight				
Tissue Height				
Height				
Diameter				

ACTIVITY

Mixing Solutions & Calibrating

Ages: 14+ (Grades 9+)
Group Size: Small or large

Learning Outcomes

- Measure dry ingredients and prepare a solution
- Practice safe and sterile lab procedures
- Understand the role of nutrients as chemical ions

Materials You Need

- 5 lb. bag of farmhand® form & grow nutrient formulas
- Two 1-gallon jugs with sealable caps
- Hot (not boiling) water and room temperature water (distilled water recommended)

HACK | You can use an electric tea kettle for this!

- Scale to measure dry powder
- Paper bowl, weighing boat, or other taring object
- Funnel
- Disposable gloves
- For **large groups**: Beaker, hot plate, and stirrer (glass rod or magnetic) per lab table

Activity Outline:

Beginning Discussion

10 mins

- Prep lab table materials in advance if working in a **large group**
- Refer to the Nutrient Use Knowledge Base article or guide first if needed

Mixing & Dosing

20 mins

- Add hot water to vessel
- Add dry ingredients and combine
- Top off with room temperature water

Exit Discussion

5 mins

Calibration

10–15 mins (optional)

Talking Points

Ages: 14+ (Grades 9+)

Excite & Engage (Beginning Discussion):

If there's no soil, how are the plants getting their nutrients?

As you saw through the dosing panel in the farm, nutrients are dosed into the water as dictated by the farmhand software and delivered directly to plant roots.

So we know the plants are getting their nutrients from the water. But where is the water getting the nutrients from?

Today we're going to mix nutrients for our farm using the Freight Farms powdered nutrient system!

Mixing and refilling nutrients is part of routine maintenance in the farm. When operating as expected, our farm will go through one full tank (1 gallon) of nutrients in five to six days, so we mix nutrients every week.

Since we are adding powder to water, this is considered a stock solution. Preparing stock solutions is one of the most basic chemistry tasks and one you will perform often if working in any lab or industrial setting.

Explain & Expand (Activity Discussion):

→ Put on gloves. These nutrient powders will not cause any harm if we come into contact with them (it's actually not all that different from mixing Kool-Aid!), but we want to use good lab practice and prepare as if we're working with dangerous chemicals. Avoid touching anything other than the lab materials in front of you.

→ Weigh dry formula. We have two different types: form and grow. The form formula contains the basic elements needed for plant formation (like nitrogen, magnesium, and calcium). The grow formula contains other micro and macronutrients for vegetative, or leaf, growth. We need 1 lb. of each nutrient per gallon of stock solution. (Divide this by the number of lab tables in your class if conducting this activity in a **large-group** setting.) Place a coffee filter on the scale and tare, then measure 1 lb. of powder. Add this powder to your vessel (gallon jug for small group or beaker for lab class) using the funnel.

> NOTE | Each nutrient must be mixed separately. They should never come into contact with each other in their concentrated form, or solids may precipitate over time. If you'd like, you can sacrifice a small amount of each nutrient and mix them together to demonstrate the concept of precipitates to students.

Why would a precipitated solution be a problem in the farm?

→ Add the water. Next, we're going to fill our vessel (beaker or gallon jug) with a half-gallon of our hot water. Use the funnel if needed. (Use hot plates to heat a beaker of water — a half-gallon divided by the number of lab tables — at each table if working in a **large group setting**.)

Tap water is fine, but distilled is always recommended for stock solutions. Why might that be in this case? Why are we using hot water?

→ Mix the hot water and nutrients until all solids are dissolved. If working in a small group with a single gallon jug, simply close the cap and shake. If working in a **large group**, stir manually with a rod or magnetic stirrer.

→ Add the rest of the water. Now that our solid is dissolved, we can top off our solution with room-temperature water. (In a **large group** setting, have each group pour their individual mixed beaker solution into the one-gallon jug at the front of the class first, then top off with the remaining water.) Add water through the funnel into the jug to the one-gallon tick mark. Use this as an opportunity to talk about the meniscus!

What forces in the water are creating the curvature of the meniscus? Should our fill line be at the bottom or top of the meniscus?

→ Add nutrients to the dosing tank in the farm using a funnel.

Exit (Concluding Discussion):

Let's assume hypothetically that there are 400 grams of calcium in our nutrient powder blend. How many moles is this? What about for the same mass of nitrogen and magnesium? (Hint: ***Number of moles = mass of substance/ mass of one mole.***)

The level of nutrients in the water of each tank is detected by an electroconductivity, or "EC," sensor. As the name suggests, electroconductivity is the ability of a material — in this case, a fluid — to conduct electricity. Why is this type of sensor used for our nutrient solutions? (Hint: ***Nutrients contain elemental ions that each carry a charge and therefore the ability to conduct electricity.***)

Freight Farms previously used pre-mixed liquid nutrient solutions, but these are heavy, have more plastic packaging, and are therefore more expensive to ship. Research what it costs to purchase and ship other liquid nutrient solutions on the market. What is the total price difference over the course of six months?

What other types of products can we purchase cheaper and more sustainably by mixing ourselves? (Hint: ***Household cleaning tablets and powders, concentrated soap and detergents, beverage packets.***)

Optional Extension:

If you're working in a Greenery™ S, calibrate hydro sensors with your students! Calibrations are quicker and easier in S models than in previous farm generations due to software upgrades. Simply follow the steps in the Hydro Sensor Calibration guide. Discuss the interplay between each sensor. For example, how does pH affect nutrient uptake? Why might water temperature sensors always be calibrated at the same time as other sensors?

ACTIVITY

Evaluating farmhand® Datasets & Graphs

Ages: 14+ (Grades 9+)
Group Size: Large

Learning Outcomes

- Describe the measurements collected by each sensor
- Download and organize datasets
- Contemplate the role of technology in modern agriculture and the career opportunities it presents

Some resources that may be helpful for this activity:

- Knowledge Base: farmhand Dashboard
- Knowledge Base: farmhand Control
- Knowledge Base: Analysis & Comparison
- Day in the Life on farmhand Software

Materials You Need

- Projector
- Farmhand dashboard

Activity Overview:

Beginning Discussion

5-10 mins

- Video overview from farmhand dashboard and control Knowledge Base articles

Farmhand Exploration

15 mins

- View each sensor graph and discuss (2 mins each)

Concluding Discussion

5–10 mins

Talking Points

Ages: 14+ (Grades 9+)

Excite & Engage (Beginning Discussion):

- What is data? What types of data might be useful to us as farmers?
- What are some of the earliest forms of agricultural technology? Further, at what point is something considered technology? For example, how did the invention of the wheel or shovel improve agriculture?
- Today we're going to walk through the farmhand dashboard to see what types of data are collected by sensors inside the farm and how this helps us monitor the performance of the farm as a whole over time. What are the benefits of being able to view these metrics remotely?

Explain & Expand (Activity Discussion):

- The dashboard contains key indicators for the container, Nursery Area, and Cultivation Area. Think back to our farm tour. Why are these regions of the farm separate? (Hint: ***Because the container section shows climate settings throughout the farm as a whole, and the Nursery and Cultivation Areas each have their own respective water tank with separate sensors.***)
- → The container section shows climate readings: air temperature, humidity, and CO2. The Nursery and Cultivation Areas each show hydro readings: water temperature, pH, and nutrients. Click through each with your students and evaluate trends in the graphs displayed together. See the following two scripts as a sample.
- **Let's start with CO2.** What types of trends do you see in this graph? There is a series of small fluctuations in value over shorter periods of time, and then a large jump in value. What might be causing this? The sensors in our farm work by taking regular readings and adjusting around a designated value, or set point. When the value dips below this set point, the farm technology will turn on the CO2 regulator to add more gas into the air, until CO2 levels return to a value closer to the set point. If plants are constantly drinking up new CO2, this process will continue — up and back down repeatedly in short ripples. So then what is the large jump? What other sources of CO2 could be added to the farm?

  The extra CO2 is from us — people! Remember that we humans have a symbiotic relationship with plants: We breathe out CO2, and they breathe out oxygen. In this way, we depend on each other's waste or byproducts. (If you'd like, you can have your students breathe directly into the CO2 sensor when inside the farm and watch the graph spike within minutes! You can also read more about the role of CO2 in plant growth on farmhand Academy.)
- **Now let's look at humidity.** This metric will have similar short rises and falls in value but without the large jump that CO2 displays. What might cause these fluctuations in humidity? These are caused by transpiration — the process by which plants release water vapor into the air as water moves up from the roots and out through the surface area of the leaves. As this water vapor is released, it drives up humidity, which then triggers the dehumidifying function in the HVAC (i.e. air conditioning unit) to turn on, causing these ripples.
- → For each metric you analyze with your students, download a dataset from the Almanac function within farmhand. Choose Almanac in the left-hand panel, then navigate to library > datasets > view (metric of your choice) > download as CSV. Convert this file into a spreadsheet and create a graph using the insert function.

Exit (Concluding Discussion):

- What do you think is the single most useful metric within farmhand for understanding the state of the farm? If you could choose the most important thing to track over time, what would it be?
- What are some things happening in the farm that the software is not capturing? What kinds of measuring devices, equipment, or inputs could be used to capture this data?
- What are other ways that technology is incorporated into traditional agriculture? (Hint: ***GPS navigation on tractors, robotics in greenhouses***)
- Identify a company (besides Freight Farms) creating farming technology and data analytics (can be traditional soil or hydroponic). Go to the careers page on their website. What types of jobs do they have posted? Which interest you?

ACTIVITY

Worksheet: Cultivation Irrigation Flow Rate

Ages: 14+ (Grades 9+)

Choose a single emitter in the Cultivation Area, and hold a beaker under it during the watering cycle for 10 seconds. Repeat this five different times with different emitters.

Emitter volume #1 in mL: _____
Emitter volume #2 in mL: _____
Emitter volume #3 in mL: _____
Emitter volume #4 in mL: _____
Emitter volume #5 in mL: _____
Volume average in mL: _____

If there is large variation across the different emitters, why might that be? (Hint for teacher: ***Clogs, pressure loss across irrigation, broken emitter, human error, etc.***) What is the standard deviation from the average?

Question 1:

Flow rate = volume ÷ time. What is the average flow rate of your emitters in L/sec? (Hint: first convert your previous average to liters!)
[Volume average] x 1000 = _____ L/10 sec
[Above answer] ÷ 10 = _____ L/sec

Question 2:

There are 440 emitters in the farm (88 panels x 5 channels x 1 emitter per channel = 440). What is the total average flow rate throughout the farm per second?
[Answer from Question 1] x 440 = _____ L/sec

Question 3:

Part A:
If the pumps are running and water is coming out of all 440 emitters in the farm at once for a cycle of three minutes, what is the total volume of water flowing onto the plant panels?
[Answer from Question 2] x 180 seconds = _____ L

Part B:
The right and left sides of the farm run separately, with two pumps flowing through 220 emitters each. What is the total volume of water moving through each pump?
[Answer from Question 3A] ÷ 2 = _____ L

Question 4:

- For supplies in the United States, flow rate is typically measured in gallons per hour. Convert your flow rate measurement into gallons per hour for the average emitter (from Question 1). Hint: 1 liter = 0.264 gallons.

Question 5:

- Part A:
- The Cultivation tank capacity in the Greenery™ S is 85 gallons. Typically, the tank does not stay 100% full to prevent overflow. What is the minimum tank capacity needed, in terms of percentage, for a three-minute watering cycle?
- [Answer from Question 3A] ÷ 85 = _____ %

- Part B:
- What is the minimum tank capacity needed to run a single pump?
- [Answer from Question 5A] ÷ 2 = _____ %

Question 6:

- There are 440 emitters in the farm (88 panels x 5 channels x 1 emitter per channel = 440). What is the total average flow rate throughout the farm per second?
- [Answer from Question 1] x 440 = _____ L/sec

ACTIVITY

Additional Activity Ideas for Older Children

Seed Shopping Assignment

Have your students build a purchasing list for one or more categories of crop options (leafy greens, herbs, flowers, root vegetables, etc.). Some factors to consider while shopping include total capacity of the farm, final harvest size, type of harvest (e.g. whole head or trim), total time from seed to harvest, and required crop spacing. Calculate the number of seeds needed for three months and write a budget.

Algae & Unicellular vs. Multicellular Organisms

Unfortunately, algae is a fact of life in a hydroponic container farm because it needs the exact same things as plants to thrive (light + water = algae). Use the presence of algae as a launch pad to compare and contrast the differences between unicellular (algae) and multicellular (plant) organisms. You can even prepare samples of each and view them under a microscope! How might the presence of algae threaten crops? How can we control algae growth? (Hint: ***Zerotol, our go-to, plant-safe cleaning product, is specifically designed to target unicellular growth!***) This is also a great opportunity to connect students' learning to larger ecological implications like harmful algae blooms and red tide.

Challenge: Build a Prototype

One of our university farmers has created a demo tower to use for public engagement when in-farm tours are not possible. Use this concept as a starting point for your students to understand the basics of hydroponic systems and create a miniature setup of their own with the following components: pump for water, medium for plant growth, nutrients, and light system.

High School Arts Crossovers

If your school has a videography or media lab, team up for a short feature! Or enlist art students to paint murals on the farm or in nearby garden spaces. If you have a Culinary Arts career tech track, explore more advanced recipes (compared to the previous section for young children) using specialty crops.

Active vs. Sterile Hydroponics

Explore the possibility of using active hydroponic methods (i.e. beneficial organisms) in your farm. Discuss with your class the role of beneficial bacteria, both in agricultural systems, but also in our bodies and other food products (Kombucha! The gut microbiome!). How does this differ from a 100% sterile environment, and what are some of the pros and cons of each approach?


CLARK
UNIVERSITY
CLARK UNIVERSITY
FIAT LUX
MDCCCLXXXIX
CHALLENGE CONVENTION. CHANGE OUR WORLD.
sodexo
QUALITY OF LIFE SERVICES

University

ACTIVITY

University

While most colleges use their farms for the practical purpose of supplying food to dining halls, the farms can still be used to introduce college students to basic crop science research. Our own Plant Science Team here at Freight Farms conducts plant trials year-round in order to develop best practices and higher yields. Empower your students to do the same by designing a study or research project that utilizes the basic systems of the farm: light, water, nutrients, and climate. This works especially well if you have more than one farm — one farm can be used for controlled growing of your staple crop while the second farm is used for experimentation. Here are some suggestions for independent or collaborative student research projects:

Crafting Recipes

Take a detailed look at the "Recipes" section of farmhand®, which offers grow settings for different crops. What would your students change in a recipe based on what they've read about a given crop's needs? How would they measure the impact of that change on crop growth over time? If they were to craft recipes of their own from scratch based on crop research, what factors would they consider and how would they manipulate variables to manage outputs (both quantifiable and observed)? Include farming variables like seeding density, crop spacing, and full trim versus harvest.

Nutrient Analysis

Devise an experiment to create an ideal nutrient solution for the crop(s) of your choice. First identify the basic nutrients needed for that crop's growth, then create a matrix of all the nutrient solutions on the market, comparing their respective benefits and drawbacks. What is needed? How will that nutrient solution perform compared to a previous control?

Light Analysis

Within the Greenery™ S farmhand software, there are three energy modes that describe the power of LED lights: Eco (low energy), Standard, and Performance (high energy). Design a study to evaluate test groups (Eco and Performance) against control (Standard). Calculate the difference in yields and prepare a model, using the previous Crop Trials & Yield Data activity as a template.

Daily Light Integrals (DLI)

DLI is a measure of light intensity over a period of time. While maintaining a consistent total DLI, adjust the recipe settings within farmhand so that blue lights and red lights turn on at separate intervals each day, but for the same total amount of time. How does this affect yields? For a sample of existing research on DLI, see this HortScience article.

Rare Crops

What has and has not been done before in hydroponic or container farm environments? Conduct a literature review of which crops have been tested. Identify the comprehensive needs of this untested crop, including nutrients, light intervals, air temperature and circulation, etc., and devise a plan to test this crop in your farm from seeding through harvest. Based on this literature review, which crop(s) present the greatest opportunity for research?

Here are suggestions of crops that have yet to be validated at Freight Farms HQ:

- Hot peppers
- Berries: blueberries, cloudberries, strawberries
- Saffron
- Cannabis (in locations where legal)
- Wasabi
- Hops
- Ginseng
- Tomatoes
- Rare Herb and woody ayurvedic plants (suggestion: create cuttings and cultivate dwarf varieties)

Additional examples that have been investigated elsewhere include grains (wheat, amaranth), native and rare flowers, large nightshades (eggplant, beefsteak tomatoes) and vining crops (pumpkins, cucumbers).

Flower Blooms Per Yield

Many varieties of flowers grow easily and abundantly inside a Freight Farm, but it's difficult to give an exact number of how many flowers one can expect to grow, package, and sell. Prompt your student researchers to devise a framework or mathematical model to evaluate the number of blooms per yield for popular flower varieties, such as calendula, viola, borage, or zinnia.

Collaborate with the Entomology Department

Ladybugs are a common predator of aphids, and outdoor gardeners regularly release them into their plots as a means of organic pest control. But can ladybugs, pollinators, and other beneficial insects survive happily inside a container farm environment for extended periods of time? Team up with your resident bug researchers to find out!

Strawberry Profitability

Strawberries can successfully be grown in various hydroponic greenhouse environments and are sold by large companies internationally. But are they equally profitable within a container farming system? How does the size and growth of container-farmed strawberries compare to those grown in a hydroponic warehouse farm?

Here are some examples of research conducted by our customers in university settings:

- Auburn University — Controlled Environment Research Group
- University of Florida Institute for Food and Agricultural Sciences Extension

Here are some textbooks recommended by our network of university farmers:

- Plant Factory, edited by Kozai, Niu, and Takagaki
- Light Management in Controlled Environments, by Lopez and Runkle
- Greenhouse Horticulture: Technology for Optimal Crop Production, by Stanghellini, Van 't Ooster, and Heuvelink (textbook)
- Plant Empowerment: The Basic Principles, by Geelen, Voogt, and van Weel (textbook)

In Conclusion: YOU GOT THIS!

In Conclusion: YOU GOT THIS!

Phew, that was a lot! Thanks for sticking with us throughout every step of this guide. We hope you found it useful. Let's review some of the things we learned.

In the first section, we covered all the key elements to set your school's or organization's farm up for success — including staffing and organizational structure, choosing a physical location that is easily accessible for students, and modifying it into a visually appealing learning space that works for you. Pay special attention to the Calibrate Expectations & Start Simple section, which recaps all the most important steps in your first year of operations.

In the second section, we discussed in detail what each of the core farming activities looks like with different ages of students, then provided additional spinoff lesson plans to explore within your unique setting. For younger kids, this mostly looks like sensory exploration, tours, and food classes. For older kids, this looks like crop trials, mixing solutions, discussing farmhand® data, and calculating physical properties within the farm.

And, if your eyes glazed over and you skipped over a bunch of sections, here's a list of some of the most important nuggets that we bolded throughout the guide:

- Remember: a grand vision is only as useful as its action plan and key deliverables.
- Pick one crop that is most important to your needs, and keep your distribution plan simple for the first year of operations.
- The best thing you can do to ensure the success of your farm is to hire a full-time lead farmer.
- Our most successful farmers are those working within a well-established and well-structured organization with staffing hierarchy, collaborative work culture, and reliable support.
- When it comes time for training, these three to four people (lead farmer, "champion," and Facilities/IT) are the ones to send to Farm Camp.
- Proximity and ease of access are paramount to minimize time spent in transit and maximize farming. It should take less than five minutes — ideally less than two, and absolutely no more than 10 — to walk your students to the farm.
- If you have an outdoor garden educational space, always separate the days that you're working in either garden, and never go immediately back and forth between the two within a single day.
- We recommend keeping a tablet or laptop in your farm that is automatically logged into your farmhand® account.
- If you are going to create a K–12 class specifically around your hydroponic farm, high school students would be the age to do it with.
- In a university setting, you cannot rely on student volunteer groups to complete all your labor — the most successful student internship model is to have a budget supplied through campus dining to hire two to four part-time students.
- Whether you're teaching or giving a tour, you don't want to squeeze more than eight people inside the farm at any given time.
- A hydroponic container farm is much more like a kitchen or laboratory than a traditional garden.
- It is critical to follow Freight Farms' maintenance and cleaning protocols.

After reading this guide, you should be able to begin formulating answers to the following questions about your program before it launches:

- Where will your produce go?
- Where will the farm be located?
- Which crop will you start with?
- What is the primary age group you want to engage? What group sizes will you work with?
- What is the expected duration of teaching sessions and general schedule for programming?
- Based on this, what are attainable attendance targets for the first year of operation?
- Of the teaching directions provided, which interests you the most and what is the core subject you want to teach?

We know this guide was lengthy, and the granularity of starting your own educational program can feel dizzying. But we're here to assure you that ***you can absolutely do this!*** Not only do you now have all the tools for success outlined in this guide, but you also have an entire ecosystem of support available to you from Freight Farms as a company and digital community. While you build towards achieving numeric milestones of students taught, volunteers mobilized, and crops harvested, you will also experience the intangible, immeasurable joy of growing minds and food.

About the Author

Hey everyone — **Jackie Roth** here! Firstly, thank you for all that you do to (literally) help your community grow and thrive. You're a champ. Secondly, thank you for taking the time to read this whole guide. I hope you found it helpful! Finally, congratulations on making it this far in your journey to farming!

A little about me: I started my Freight Farming journey in 2019 at Lotus House Women's Shelter in Miami, Florida. At the time, I had ZERO experience with proper agriculture, let alone hydroponic container farming. But I brought a lifelong passion for all things food and cooking, as well as undergraduate research experience in school-based gardening and nutrition education. I came to Lotus House just as our grant funding and purchase agreement for the farm was finalized, but otherwise started from scratch in every sense. By the end of my three and a half years running the Lotus House farm program, we engaged 400 shelter residents annually in farming activities, led weekly plant-based cooking classes, furnished the daily salad bar at our in-house Culinary Center with 70 pounds of fresh veggies weekly, and created a thriving paid farm internship program for adult residents. I know firsthand what it takes to build and run one of these programs, and it has been one of the greatest joys of my life thus far.

I'm thrilled to collaborate with the Freight Farms team to share this guide with you. It is my labor of love, and a love letter to farmer-educators everywhere! Please know that I am personally invested in the success of your program, and have held your needs in mind through every step of the process.

I've obviously given you a lot to chew on throughout these 80+ pages of content, but wanted to impart you with some final words of wisdom before you embark on this journey. They are mostly directed at the lead farmer (i.e. my previous role!), but are good reminders for anyone involved in the program:

1. **Be patient**

   Software-enabled container farming is a totally new feat of human ingenuity, and there is a learning curve. You will inevitably flood your farm and lose some crops. Have grace with yourself, ask for help when needed, and trust that you will become an expert with time.

2. **Be curious**

   This type of farming is fun! There are infinite things to learn about and rabbit holes to go down. Give yourself — and your students — permission to take the time to deep dive into how all the moving parts work together.

3. **Be humble, be an open book, and learn alongside your students**

   I can't emphasize enough how any human error or mishap is a teaching opportunity. Instead of feeling frustrated about not doing things perfectly the first time, view all of your mistakes as valuable moments for insight. Every failure makes you a stronger farmer.

4. **Buy an air curtain and clean as you go!**

   This one's a little more practical. I learned the hard way by getting a fungus gnat infestation after six months of hundreds of kids moving in and out without any barrier for pests. If you're into organization, have strong attention to detail, and can't help but keep things clean all the time, this farm is perfect for you.

5. **Follow your passion and make it your own**

   My background is in nutrition education, so I got amped about using our farm for onsite cooking classes and lessons about plant-based eating. But maybe your thing is engineering or entrepreneurship,

and you want to tie your farm program into something more along those lines, instead. Find what lights your inner fire when it comes to Freight Farming and make that the heartbeat of your program.

In conclusion, I'm rooting for you 100%! Believe in yourself and stay connected with that inner fire. Ask for help when you need it, and we at Freight Farms will be here to answer!

Additional Resources

Page 7 — Guiding Principles: K–12 Plant Science, Food Education & Agricultural Technology Curricula That We Love

Tower Garden (free)
Edible Schoolyard Project NYC (free)
Seeds of Wonder (Cornell University Extension (free)
Ohio State Extension 4-H (free)
iCEV Agricultural Science Curriculum (paid)
Future Farmers of America (FFA) Educator Resources (free)

Page 13 — Building an All-Star Team: Creating an SSO Login for Your Organization

For some organizations, it makes the most sense to have one centralized farmhand® account for everyone to use. This especially applies to nonprofit organizations and schools that have many program participants coming in and out of the farms at any given time.

Creating a single sign-on (SSO) login will allow everyone at your organization to use one username and password for access to farmhand, Academy, and Community. This will reduce the headache of continually registering and confirming new accounts for each platform!

Step One: Make a centralized email account that everyone can use

In order to set up an SSO, you will first need to create one centralized email address that everybody can use. We recommend creating a Gmail account with the handle "farm@[yourorganization].com." (Example: farm@freightfarms.com).

This account should have a password that everyone knows — one that is posted somewhere that everyone can access. It's recommended to keep this password simple (try something like "Lettuc3Grow!" or a straightforward, organization-specific password).

Step Two: Register for all farmhand platforms

Next, register for all farmhand platforms using this email address and password. This includes the farmhand software itself, in addition to farmhand Community and farmhand Academy.

Use the same password for all of these accounts. (Better yet, use the same password that the email is set up with!).

Step Three: Share login credentials with all members of your team

Make sure that your entire team (including any reliable recurring volunteers!) has access to the login information for your organization. Remind them that they will sign into any digital assets with the farm email account, and not their designated staff email.

This will allow new volunteers and team members to be able to run through the Academy when they first start with your organization, as well as access our database of information in the Knowledge Base should they need it.

Caution

While having one centralized login can simplify things for many organizations, there is a risk associated with having one account that everyone can use.

It is very important to make sure that all team members that have access to this login are well-trained in farmhand and understand the implications of actions within the app — as farmhand is the software that operates your farm, make sure that new operators aren't fiddling around with the software and turning equipment or modes on and off.

Additionally, it is still critical to have one person (usually a lead farmer) that is responsible for the farm. This includes making sure that the farm and farmhand are operating normally.

Page 17 — Workspace Tools & Mods: Materials for Printed Binder

The following are suggested inclusions for printed and bound resources to keep in your farm for interns. This list is not exhaustive and we encourage you to peruse farmhand® Community and Knowledge Base for additional guides that are most useful to you.

Maintenance Schedule — LGM
Maintenance Schedule — Greenery™
Maintenance Schedule — Greenery S
Maintenance Log (see sample below)
Attendance Log (see sample below)
Hydro Calibration Instructions — LGM
Hydro Calibration Instructions — Greenery
Hydro Calibration Instructions — Greenery S
Climate Calibration Instructions — Greenery S
Tank Turnover Instructions — Greenery S
Tank Turnover Instructions — LGM, Greenery & Earlier Generations
How to Clean & Replace Drip Emitters
Whole Harvest Instructions
Trim Harvest Instructions
Transplanting Instructions
Seeding Instructions
Grow Guides for All of Your Staple Crops
Nutrient Mixing Instructions

Sample Maintenance Log

DATE	TASK	NOTES	FARMER/ STUDENT INITALS

Everyone likes to record their maintenance in a different way — we encourage you to adapt this in a spreadsheet format that works best for you!

See also our Scouting for Pests article on Knowledge Base for additional notes to document during daily or weekly walkthroughs of your farm.

Sample Attendance Log — Students or Volunteers

NAME	DATE	ACTIVITY	TOTAL SESSIONS TO DATE *

We recommend tracking the number of repeat attendees so that you can describe the number of returning students and the various activities in which they participated in grant reports. A successful program will have students and volunteers returning regularly!

Page 24 — Overview, K–12 Schools: Sample Weekly Schedule — High School Agriculture/Career Tech Class

MONDAY	TUESDAY	WEDNESDAY**	THURSDAY**	FRIDAY
Harvest	Harvest*	Transplant	Transplant	Seed

*Harvesting may be complete after a single session. If additional time remains, use it for packaging and business administration. Any extra days can be used as flex time for theory/textbook lessons of your other curriculum (e.g. entrepreneurship, sustainability, etc.).

**If your school works on a block schedule, combine these two days to transplant in a single day during a doubled class period.

Page 25 — Overview, Nonprofits: Sample Weekly Schedule With Hybrid Adult Labor & Classes With Young Children

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	WEEKENDS
Adult Intern Labor — harvesting & maintenance (4 hours) **Small Group # 1** (ages 6–8) — student activity (45 mins) **Small Group # 2** (ages 6–8) — student activity (45 mins)	**Adult Intern Labor** — harvesting & maintenance (4 hours) **Small Group # 1** (ages 9+) — student activity (45 mins) **Small Group # 2** (ages 9+) — student activity (45 mins)	**Adult Intern Labor** — transplanting & maintenance (4 hours)	**Adult Intern Labor** — transplanting & maintenance (4 hours) **Small Group # 1** (ages 6–8) — student activity (45 mins) **Small Group # 2** (ages 6–8) — student activity (45 mins)	**Adult Intern Labor** — maintenance (4 hours) **Small Group # 1** (ages 9+) — student activity (45 mins) **Small Group # 2** (ages 9+) — student activity (45 mins)	Optional — Community Engagement or Tours

Page 25 — Overview, Nonprofits: Certificate of Completion

You can create a Certificate of Completion for your farm internship program using any template from Canva, Google Docs, Apple Pages, or Microsoft Word using the following framework:

You can also view the following Farm Camp participant certification as a reference.

farmhand academy
certification of completion

Jane Doe

The bearer of this certification completed Farm Camp, an officially recognized and certified training program from Freight Farms.

Farm Camp is two-day training that takes place at Freight Farms headquarters. Participants learn the intricacies of Freight Farming through detailed presentations, hands-on lessons, interactive activities, and working directly with the team of Freight Farms experts. The curriculum covers: Areas of the Farm, farmhand® Software, How to Launch & Set Up Your Freight Farm, Sensor Calibration, Grow Cycle, Maintenance & Supplies, and Q & A with a Guest Farmer.

Each certificate holder progresses through all lessons and completes two recall activities at the end of the experience. This robust in-person training curriculum prepares future Freight Farmers for a successful journey into hydroponic vertical farming.

Certified on: 9/16/2022

FREIGHT FARMS

Alissa Kelly
Training Manager
Freight Farms

Learn more about how to integrate a Freight Farm into curriculum and raise the bar for farm-to-school programming.

Get Individualized Assistance

FREIGHT FARMS

FREIGHT FARMS

freightfarms.com