A photograph of a greenhouse interior. The structure is made of metal frames and translucent panels. In the foreground, there are several black trays filled with small potted plants, likely seedlings, each with a small white label. The background shows the greenhouse's interior structure and a bright light source, possibly the sun, creating a lens flare effect. A central blue rectangular box contains the title text.

GREENHOUSE TO SCHOOLHOUSE

A CLEDA Publication



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COVER LETTER

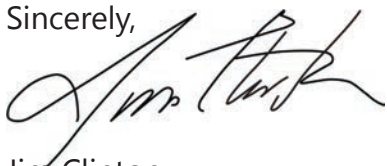
A LETTER FROM OUR PRESIDENT

Local foods are rarely seen on a regular basis in Central Louisiana public school cafeterias. This is unfortunate since the availability of local produce in school cafeterias has been proven to increase healthy eating among children and youth. Because school procurement systems are unable to easily access local food, this Greenhouse to Schoolhouse start-up toolkit has been developed to demonstrate how local food can be incorporated into central Louisiana Schools in ways that engage STEM education and vibrant classroom and greenhouse activities.

The Greenhouse to Schoolhouse toolkit addresses the most common barriers, including logistics, costs, storage and processing, as well as offering examples of best practices and tips for program success. Food grown in controlled environments (like greenhouses and high tunnels), and on school grounds, can help lower costs (yields can be higher and growing seasons longer) for procuring fresh, healthy local food for local schools. This start-up toolkit includes practices recommended by the Centers for Disease Control and Prevention (CDC) both in their obesity prevention guidelines and their guide to increasing consumption of healthy fruits and vegetables. Growing evidence indicates that increasing local food within school cafeterias leads to healthier eating, and this toolkit is just one way that CLEDA is supporting vibrant rural communities in central Louisiana.

CLEDA's Fresh Central, with Live Lively LaSalle and LaSalle Parish School Child Nutrition, have developed an economically sustainable greenhouse-to-schoolhouse start-up toolkit to improve community health outcomes, encourage healthy eating, support multi-faceted STEM education and create communities of choice across the region.

Sincerely,



Jim Clinton
CEO and President
Central Louisiana Economic Development Alliance

GREENHOUSE TO SCHOOLHOUSE TOOLKIT

A CLEDA Publication

This guide was inspired by the successful hydroponic greenhouse program at Rayville High, in north-central Louisiana. The information here is intended to help you jumpstart a Greenhouse to Schoolhouse program at your school.

CLEDA

The Central Louisiana Economic Development Alliance (CLEDA) is an organization which consists of the economic development entities from the parishes (counties) of Allen, Avoyelles, Catahoula, Concordia, Grant, LaSalle, Natchitoches, Rapides, Vernon and Winn.

The mission of the Central Louisiana Economic Development Alliance is to help people prosper in vibrant, thriving communities.

Visit us online or call Bahia Nightengale at 318-441-3408 | FreshCentral.org/GreenhouseToSchoolhouse





LAUNCHING A GREENHOUSE PROJECT

A **Greenhouse to Schoolhouse** program is a significant undertaking which requires a community of people from in and around the school, to start it and to maintain it. Begin by discussing the idea with a few people you know will be interested and together create a basic plan for what the project could be. Think of this as the seed of an idea, that will grow and change as more people get involved and the reality of your school and situation shapes what is possible. Once you have a core group and the seed of an idea, begin reaching out to key people in your school and local community, asking for support and help. The more that people have a chance to help shape the project, the more those individuals will be invested in ensuring the program becomes successful.

MANAGING THE PROGRAM

Schools are administratively complex, with management levels ranging from a single teacher to the principle to the school board. A greenhouse project can be administered from any one of many different levels, depending on the program goals. It may help to clarify this early in the process. Often, a high level of administrative support translates into a larger impact, but on the other hand, may be more complex to manage.

Organized by and for one or several **Teachers**: Common for a small teaching garden or in a science classroom, curriculum driven and limited to just one or a few classes

Embraced by the whole **School** and championed by the **Principle**: Large scale, involves multiple classes and grades, can be curriculum driven and/or provide healthy food for students.

Driven by the **Child Nutrition** program or the **School Board**:

May support projects at multiple schools and focus on vegetable production, with goals to provide fresh produce in school meals or cultivate healthy eating habits for students. Curriculum and educational goals can be supported by sharing greenhouse management and access with interested teachers.

EXAMPLES & IDEAS

www.nysunworks.org

The NY Sun Works' Greenhouse Project Initiative uses hydroponic farming technology to educate students and teachers about the science of sustainability for K-12 grade students in urban schools. info@nysunworks.org

www.fns.usda.gov/farmtoschool/farm-school

Excellent step-by-step guide for Farm to School programs

www.farmtoschool.org/Resources/SchoolGardensFactSheet.pdf

Two page fact sheet on starting school gardens, features Rayville greenhouses as model example.



INVOLVING THE WHOLE SCHOOL COMMUNITY

Regardless of who administers your greenhouse program, supporters, participants, allies and champions are all vital to your success and can be drawn from within the greater school community. Certain members of the school community are essential to a successful program. Invite anyone who is interested, to help plan and decide the purpose and goals of your greenhouse program. Particularly include anyone who will be directly a part of the project, including students, staff and teachers.

ADMINISTRATORS

Permission from the school Principle is of course necessary, but active support from within the administration of a school may be equally important. Starting and running a greenhouse to schoolhouse program is a complex endeavor requiring significant investment of money, resources and time. Without the security of a supportive school administration it will be difficult to launch and sustain.

STAFF

School staff can provide essential skills in the construction, set-up and operation of a greenhouse facility, particularly custodial and maintenance staff. Also, food service staff play a vital role in receiving and serving any fresh vegetables harvested from the greenhouse for the cafeteria.

STUDENTS

Students are the direct audience and beneficiaries of any school greenhouse project. Even before your program begins, let the students know it is coming, how they will be involved, and communicate the excitement of the project. Students can help plan or implement, and their excitement can encourage other teachers, parents and administrators to get involved.

TEACHERS

Whether academic achievement is your primary goal, or maybe increased access to nutritious food for your students, teachers are key to your success. At least one teacher should be engaged and committed although two is preferable and ideally all teachers should have some participation with the effort.

GUARDIANS

Parents are a source of potential knowledge, labor, supplies and funds, in addition to encouraging their kids to be excited participants. Parents can also petition the school on your behalf, by showing that they and their children find the greenhouse to schoolhouse project beneficial.

www.realschoolgardens.org

REAL School Gardens' primary focus is the use of school gardens as tools to help meet the academic needs of teachers and administrators. Research on their program shows that these gardens make a big impact on student academic achievement, when paired with extensive teacher training to improve teacher effectiveness and student engagement. REAL School Gardens provides professional development training nationwide to elementary schools or school districts, including standards-based lesson plans.



GREENHOUSE PROGRAM PURPOSE & GOALS

Farm to School projects come in many forms, employ diverse methods, with various intentions. Early in the process of starting a school greenhouse program, you and your team of supporters should map out the specific purpose and goals of your project. Common reasons for starting a school greenhouse program include food production, academic achievement and improved health or nutrition. These reasons are described in more detail below, although your particular program may be a combination of these or other reasons. A well formulated plan helps to clearly communicate with school staff, administrators, parents, community and donors.

HEALTH & NUTRITION

Growing and harvesting vegetables is a great entry point to increase student consumption of produce. Greater interest in, knowledge of, and willingness to try fresh vegetables can be generated through greenhouse and garden activities. Studies have shown that students who participate in school gardens are interested in eating the fruits of their labor, tend to choose more fresh and healthy meal options, and have more healthy lifestyles.

FOOD PRODUCTION

With a little knowledge, infrastructure and effort, large quantities of high-quality vegetables can be grown in a school setting. A successful food production system can provide one, two or several crops, and can be designed to provide daily or weekly harvest. For example, maybe you can supply all the salad for your school, or tomatoes for several schools. Food safety is extremely important when food is destined for the school cafeteria or student consumption, so plan to include training and development of a food safety plan for harvest and food storage. Expect to spend time daily on the management of a production focused greenhouse system.

ACADEMICS

When guided by teachers, students can meet specific learning objectives by participating in the activities of the greenhouse. There are many curriculum guides that link growing, planting and harvesting activities with standards-based educational outcomes. Subjects available to integrate with your greenhouse include biology, chemistry, entrepreneurship and math, plus many more academic topics. Implementing a curriculum can be as simple as purchasing the guide and following the lesson plans. However, evidence shows the most successful curriculums are paired with frequent training sessions for teachers, on how to use and apply the guides.

EXAMPLES & LINKS

www.fns.usda.gov/tn/fruits-vegetables-galore-helping-kids-eat-more

Fruits & Vegetables Galore is a tool for school foodservice professionals packed with tips on planning, purchasing, protecting, preparing, presenting and promoting fruits and vegetables. Use Fruits & Vegetables Galore to help rejuvenate your cafeteria with colorful fruits and vegetables.

www.sustainablefoodlab.org/wp-content/uploads/2016/02/GuideforFoodServiceProf.pdf

Changing the vocabulary of food purchasing: a guide for food service professionals from the sustainable food laboratory.



GREENHOUSE PROGRAM PURPOSE & GOALS

ENCOURAGING FUTURE INNOVATION

Entrepreneurs drive America's economy, accounting for the majority of our nation's new job creation and innovations. Small businesses employ more than 50% of the private workforce, generate more than half of the nation's gross domestic product, and are the principal source of new jobs in the American economy. A 2010 Junior Achievement poll showed that 84% of U.S. teens surveyed said that entrepreneurial skills should be taught in schools; 51% said they would like to start their own business someday.

Greenhouses can be a consistent and productive source of income for school greenhouse programs. Produce grown year-round in a controlled environment can be sold to support the school program, and academic projects can be used to increase business and entrepreneurial attainment for students. Entrepreneurship education paired with hands-on learning opportunities (in a greenhouse) links academic deliverables to real-life scenarios and can show students an empowering model for self-directed success. Entrepreneurship education builds vital skills that supports successful start-up businesses and skills that employers look for in successful job candidates, including leadership, decision-making, and problem solving.

At its most basic, the greenhouse can be integrated into an entrepreneurship program and serve as an incubator for micro-enterprises. Students can learn to calculate variable and fixed costs, how to set prices, determine break-even points, and practice no-cost marketing strategies while planting, raising, and selling produce grown (and paired with STEM education) in the greenhouse for a profit.

EXAMPLES & LINKS

<https://www.udacity.com/course/how-to-build-a-startup--ep245>

How to Build a Startup - The Lean LaunchPad, an introductory course to help students learn how to rapidly develop and test ideas by gathering massive amounts of customer and marketplace feedback.

<http://gardens.slowfoodusa.org/contents/sdownload/2867/file/YFM-Handbook-Slow-Food-Denver.pdf>

Youth Farmers Market Handbook, a guide to starting a farmers market linked to school activities and educational programs.

<http://www.bemoneysmartusa.org/about-cm8a>

A fee based program developed to teach entrepreneurship, business and financial literacy education to youth ages 8 to adult.

<http://www.nfte.com/what>

Network for Teaching Entrepreneurship, inspires young people from low-income communities to find their paths to success.

<http://www.microsociety.org/>

Bringing Real Life to Learning, creating environments that motivate children to learn and succeed by engaging them in the connections between the classroom and the community, real life and the future.

<https://www.juniorachievement.org/documents/20009/36541/2010-Teens-and-Entrepreneurship-Survey.pdf/03a2f2fd-ff25-4a34-bdd7-def00da17bd5>

Junior Achievement's 2010 Teens and Entrepreneurship Survey, Empowering Entrepreneurship Success.



PARTICIPANT ACTIVITIES IN THE GREENHOUSE

A WHOLE SCHOOL APPROACH

In some cases, an entire school may be engaged around the hydroponic greenhouse, with classes or subject areas from many different grade levels developing some activity, exercise or assignment that is linked to the project. A greenhouse may be used daily for teaching or lessons, which can incorporate greenhouse operations such as managing the nutrient balance of the water, planting new seeds, harvesting the crop, keeping records, and tracking costs/income. Harvested produce can go to the school cafeteria and consumed by students, contributing to nutrition and healthy eating habits. Excess produce can be sold for income, which may present a compelling opportunity for student business and entrepreneurship training.

THE CLASSROOM APPROACH

In a more modest approach, individual teachers can make use of the greenhouse program to supplement or complement their specific curriculum. Teaching guides have been developed to link all the major and many minor subject areas to school gardens, including Entrepreneurship, Science, Language Arts, and Health, to name just a few. Teachers may include greenhouse-linked lessons on a monthly, weekly or daily basis.

STUDENT CLUBS OR AFTER SCHOOL PROGRAMS

Students may be involved outside of class in a club or after-school program that incorporates the greenhouse growing operation into its activities. 4-H, Jr Master Gardeners or a school "Garden Club" are common student organizations of this type. Students also can be engaged in the cafeteria, through eating the produce itself, nutrition education, or farm to school activities such as voting on a vegetable of the month or competing to develop a healthy food recipe using local ingredients.

SEVERAL CURRICULUM EXAMPLES

www.4-hmall.org/Product/4-hcurriculum-gardening/gardening-level-d-growing-profits/4H1040.aspx

4-H Gardening Level D: Growing Profits. Plant genetics, plant diversity. Using garden-planning software, investigating the effects of pollution, hydroponic growing, and cultivar trials.

www.bvsd.org/curriculum/CTEC/CurriculumEssentialsDocuments/GreenhouseManagement.pdf

Curriculum guide to a "Greenhouse Management" two year set of courses. Designed to give students an introduction to plant science, propagation and greenhouse management.

GUIDES TO FINDING CURRICULUMS

www.kohalacenter.org/hisgn/hisgn-resources/school-garden-curriculum

Very thorough compilation of school garden resources, websites, curricula and organizations.

www.uffnp.org/wordpress1/wp-content/uploads/2015/09/FDACSFW_Grow-to-Learn_Book-LOW-RES.pdf

The Grow to Learn Guidebook for teachers and other school garden champions. University of Florida. Excellent list of available curricula on page 13.



DESIGNING A GREENHOUSE SYSTEM

THE GREENHOUSE

The goals of your project will help tell you how large and how many greenhouses are needed. Maybe your school already has a greenhouse that can be re-purposed or refurbished, if not you will need to build new. A greenhouse can be built from a kit or from scratch, and can cost \$10,000-\$30,000 for one that is 30ftx100ft, including construction costs and additional options such as floor, heating, tables, etc. In addition to providing water, cooling and heating, the key resource your greenhouse should provide is light. Choosing a high quality, warranted covering is the best way to ensure good light over many years, which can be supplemented with greenhouse grow-lights. UV protected polyethylene film or rigid polycarbonate panels are the two most common options. In your greenhouse, you will also need a growing system, such as hydroponics, aquaponics or soil-based.

A **Hydroponic System** uses water to grow vegetables, without soil. Two recommended types are the "floating raft" and "nutrient film". Nutrient film places plants in a trough, like a pvc pipe with holes, and runs the water/nutrient solution through the pipe and over the roots. A floating raft system employs a large, shallow pool of water/nutrient solution with floating styrofoam sheets suspending plants so their roots extend into the water. Hydroponics will require pumps, filters and reservoirs, and nutrients in the form of water-soluble elements and chemicals formulated for hydroponic systems.

Aquaponics is a variation of hydroponics that includes fish production in separate tanks, and uses the fish wastewater to fertilize the vegetable plants. This system provides both protein and produce. Can also be configured as a fish-only system, which are typically tilapia, carp or catfish.

Soil-based* Systems use growing trays or pots filled with potting soil and raised up on tables or "benches". As plants grow and are harvested, the soil becomes depleted of nutrients or harbors plant disease and must be discarded and replaced. Either irrigation (mist or drip) or hand-watering will be required. * If you prefer in-the-ground growing, consider a "High-tunnel" or a garden outdoors.

TECHNICAL GUIDES

www.extension.msstate.edu/sites/default/files/publications/publications/p1957.pdf

Detailed budget example for greenhouse in Mississippi.

www.attra.ncat.org/attra-pub/viewhtml.php?id=45

Organic Greenhouse Vegetable Production guide covers the basics and options for a successful greenhouse operation. ATTRA is a great organization and resource that provides information on many sustainable ag topics.

www.cornellcea.com/attachments/CornellCEALettuceHandbook.pdf

Hydroponic Lettuce Handbook, Cornell University Detailing commercial production of lettuce, and recommendations for greenhouse and hydroponic systems. Lighting, water monitoring, environmental monitoring and production are discussed.



MAINTAINING A GREENHOUSE SYSTEM

FOOD PRODUCTION

Common crops include lettuce, tomatoes, cucumbers, strawberries, other leafy greens and herbs, although there are many more options. You will need a space and system for germinating seeds and starting whatever crop you choose, before transferring seedlings to the growing system. Make a planting and harvest schedule for each crop. Also plan daily monitoring of your growing conditions and expect to adjust the water, light, temperature or fertility in your greenhouse on a daily basis. Factor in significant time to harvest and package your produce.

HARVEST

Particularly in a managed greenhouse system, your produce will need to be harvested several times a week, or even daily, depending on the crop and planting schedule. Timely harvest keeps the plants healthy and stimulates continuous production, helps reduce some plant diseases and provides a regular supply of fresh produce. Be sure to employ good harvest practices to ensure food safety and quality, and have a plan in place for packaging, storage or distribution, as appropriate.

PLANT PEST & DISEASE CONTROL

Careful monitoring for plant disease or pest insects is crucial to maintaining a good growing environment. Because a greenhouse is a closed environment, when an outbreak occurs it can often spread rapidly and become very difficult to eradicate. Insects can often be controlled using an "Integrated Pest Management" approach (or IPM), which may call for releasing a beneficial insects to counter the pest, such as ladybugs or praying mantises. Try to avoid chemicals such as pesticides, to reduce risk of exposure to students and harvested food.

ADDITIONAL RESPONSIBILITIES

Maintenance of the system, care over weekends and holidays, and over summer break, all present a major demand of time and knowledge. It is critical that these responsibilities be made clear and that someone specific is assigned to keep the system running.

TECHNICAL GUIDES

www.aggie-horticulture.tamu.edu/greenhouse/hydroponics/

Hydroponic Vegetable Production guide from Texas A&M, with information on growing options and specifically on tomatoes, lettuce and cucumbers.

www.fns.usda.gov/sites/default/files/foodsafety_schoolgardens.pdf

Food Safety Tips for School Gardens

www.edibleschoolyard.org/resources-tools

Searchable database of resources for school gardens from the Edible Schoolyard organization.

www.attra.ncat.org/attra-pub/viewhtml.php?id=48#general

Integrated Pest Management for Greenhouse Crops is a detailed guide published online by ATTRA. Additional crop-specific guides are also available on their website.



GREENHOUSE PROGRAM FUNDING & EVALUATION

OUTCOMES

A CDC survey of research shows expected beneficial outcomes from school gardens to include increased willingness to try fresh fruits and vegetables, and increased consumption of fresh fruits and vegetables. Additional potential benefits include reduced obesity rates, improved nutrition, improved health-related knowledge and enhanced academic instruction.

FUNDING

Where do you find the money to build or refurbish a greenhouse, set up a hydroponic growing system and purchase all the supplies for a farm to school program? The best option is to have a school or school system budget line. If that is not possible, check with your administration about seeking donations or sponsorships from local businesses, reach out to parents and teachers for volunteers, and consider applying for grant funding (private, state and federal options).

Generate income by selling excess production to area restaurants during the summer months when students are not in school. Or if your greenhouses are very productive, you may be able to sell even during the school year (can be a great business or economics teaching opportunity as well).

Featured: USDA: Farm to School Grant Program

Planning Grants are for schools or school districts who are just starting some sort of farm to school program. Grantees participate in monthly webinars and a face-to-face conference. They spend their year focused on building a farm to school team, creating a vision and goals, taste testing and menu audits, exploring local procurement options, starting school gardens, and getting students, teachers, food service staff, parents, and communities excited about local food and agriculture, and healthy eating. If your school or district has already done many of these preliminary activities, then an Implementation grant is probably more appropriate.

www.farmentoschool.org/resources-main/evaluation-framework

The national farm to school network offers a framework to evaluate school programs, broken down among public health, community development, education and environment sectors.

www.fns.usda.gov/tn/team-nutrition

Team Nutrition is an initiative of the USDA Food and Nutrition Service to support the Child Nutrition Programs through training and technical assistance for foodservice, nutrition education for children and caregivers, and school and community support for healthy eating and physical activity.

www.fns.usda.gov/fy17-farm-school-grant

USDA: Farm to School Grant Program Four types of grants awarded. Planning grant awards range from \$20,000 - \$45,000 Implementation grants and Support Service grants from \$65,000 - \$100,000. Training grants from \$15,000-\$50,000 (as of 2017).

GREENHOUSE TO SCHOOLHOUSE PLANNING WORKSHEET

Use this worksheet as a beginning, a summary, a guide - to help you get organized and plan your greenhouse project. This worksheet follows the Greenhouse to Schoolhouse Toolkit. Expect your plans to change, maybe several times along the way, and consider filling in this worksheet multiple times to reflect changing goals, participation or resources. For some topics you will need a much more detailed plan, such as for crop planting, tending and harvesting, so do not limit yourself to just this worksheet.

Core Team Members	Position
1.	
2.	
3.	
4.	
5.	

Specific Goals
Health and Nutrition
Food Production
Academics

Crop	Growing Months	Purpose
1.		
2.		
3.		
4.		
5.		

Sources of Funding:

Purpose of Greenhouse Program:

Intended Level of Management:

Number & Size of Greenhouses:

Participants in the Greenhouse		
Grade/Class	Subject Areas	Clubs

Primary Growing System:

Who is Responsible?	
1.	Scheduling
2.	Growing
3.	Harvesting
4.	Maintenance
5.	Money

GREENHOUSE TO SCHOOLHOUSE PARTNERS & FUNDERS

SPONSORS



FUNDED BY





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