

Candice Chow
January 13, 2009
ENV 307
Research Paper Cover Letter

- What arguments are you presenting in this essay and why?
My argument is that having a school garden can greatly add to the learning experiences in classrooms and that they have significant benefits for students from grades K-12. Additionally, integrated curriculum can relate gardens to school lunches and promote healthy eating habits beyond school life. These arguments are meant to bolster the reasons for implementing school gardens in the Hopewell Valley school district and ease the process of initiating these curriculum changes at these schools.
- What key issues did you address?
I am addressing health, education, and environmental issues through the argument for establishing school gardens in the Hopewell Valley school district. With the grant money already secured, Real Food for Thought has opportunity to engage students in designing their own school garden, which will greatly add to their learning experiences. Curriculum that is guided toward environmental awareness and healthy eating habits are also issues that I addressed.
- What are you most proud of in the writing of this paper?
I think that I was able to provide helpful key steps as the process to build a school garden at one of the elementary schools unfolds, and I am proud that my efforts have produced real-world recommendations that will hopefully benefit Real Food for Thought and the Hopewell Valley School District.
- What have you learned in writing this paper?
I am very glad that I got the chance to work on a CBLI project, especially one that is so exciting for me to learn about. I learned a lot about the challenges with Farm-to-School logistics, as well as trying to change curriculum in public schools. However, I was mostly inspired by the success stories that have really encouraged kids to become excited about working in a garden.
- What one piece of feedback would you find most helpful?
I would be interested to hear feedback about the organization of the paper. I realized that there were so many things that I wanted to help with and that I may have put too much information together without really focusing on any one thing. That said, I was really aiming to guide Real Food for Thought with several different topics in case they were already knowledgeable about one of them.

Introducing Garden-based Learning Programs to the Hopewell Valley School District

*A Community-Based Learning Initiative Paper for
Real Food For Thought*

Candice Chow
January 13, 2009
ENV 307
Professor X. Morin

This work represents my own in accordance with University regulations.

Abstract:

Prepared for a local organization advocating healthy eating options and school gardens in the Hopewell Valley School District, this paper seeks to advance the proposals of building school gardens in the district and providing more nutritious foods at school meals. Using examples of successful school gardens from across the nation as models, I argue that having school gardens can transform the learning experiences of students from grades K-12 and help to develop lifelong healthy lifestyles.

Research studies of the impact of school gardens on students have shown significant benefits related to academic achievement, environmental attitudes, socialization, and health. In addition to these results, garden-based learning programs are becoming more widely available and readily able to be integrated into existing curriculum. Efforts to improve school lunches can also work in conjunction with these garden programs, as both will help to reinforce healthy eating habits. The collected evidence provides a convincing argument in support of creating school gardens and improved school meals in the Hopewell Valley School District.

Consequently, best practices and lesson plans are provided in this paper to help initiate these programs and gather the needed support to ensure a smooth transition and a sustainable program.

After outlining the expected steps and challenges of introducing a new program, this paper concludes with recommendations for immediate implementation. Suggestions cover ways to include students in the planning process of the garden and small steps to take in the lunchroom to incorporate lunchtimes as part of a student's daily learning experience.

Introduction:

In a recent New York Times article, school gardens are being hailed as a new method of education that not only teaches about food systems, but is also being used to teach math, science, language arts, and public service¹. Neighboring school gardens to Hopewell Valley, including the Princeton Schools Garden Cooperative, provide a useful foundation to establish gardens within New Jersey, while other gardens across the nation also offer important models to follow. This paper is meant to provide a review of the latest evaluations of school garden and lunch programs that have been integrated into class curriculum to promote healthy eating habits among students from kindergarten to the 12th grade. With the integration of garden-based learning (GBL) and school lunchtimes into nutrition and other disciplines, schools have the potential to offer a more hands-on learning system which leads to increases in mental and physical health.

An outdoor curriculum can consist of growing produce, composting, and then consuming the grown plants. Classroom education can be enhanced by an outdoor curriculum that is integrated with NJ education standards, while incorporating dining periods into curriculum can also become an education experience. Virtually all types of subjects can be incorporated in a garden or lunchtime program. Some to highlight aside from the ones typically associated with gardening (nutrition, health, and science) include: math, cultural studies, English, arts, and marketing.

With successful school gardens already in place in neighboring school districts, Real Food for Thought can learn from these models and bring this same transformative experience to the Hopewell Valley School District. As Real Food for Thought prepares to build a school garden, this report will help provide reasons to move forward with garden construction by

¹ Jacqueline Mroz, "Sowing the Seeds of Gardening," *The New York Times*, 5 December 2008, <http://www.nytimes.com/2008/12/07/nyregion/new-jersey/07Rgarden.html?_r=1>

sharing successful evaluations of other programs around the country and potential plans to follow. Additionally, recommendations for immediate actions will be outlined. While approval of new curriculum and garden construction by the school board may be challenging, the promising results and their positive externalities will be worth the efforts.

Evaluation of Successful School Garden Programs

This section identifies the benefits seen by schools with garden programs that have incorporated garden components into school curriculum, with a specific evaluation of one of the leading school gardens in the nation, The Edible Schoolyard.

General Findings:

Garden-based learning (GBL) and emphasis on nutrition in the lunchroom has been found to produce significant results on children's health and academic achievement around the nation. In a compilation of research studies by the National Gardening Association, quantitative data has shown that GBL positively affects nutritional attitudes and behaviors (i.e. increased preferences towards fruits and vegetables), self-esteem, environmental awareness, and achievement in reading, reading comprehension, spelling, and written expression². The National Gardening Association's Adopt a Garden Program has also seen improvements across varying schools and grades across the U.S. as a result of garden involvement³. These improvements include: volunteerism, community spirit, exercise, enthusiasm for learning, leadership skills, social skills, self-confidence, and attendance.

Furthermore, GBL has the potential to teach key life science concepts and science inquiry skills. For example, in one 1999 study, the California Department of Education witnessed that "77 percent of students in environment-based education programs scored higher than their peers

² Eve Pranis, "School Gardens Measure Up: What Research Tells Us," *National Gardening Association*, 2008, 4 January 2009 < <http://www.kidsgardening.com/Dig/digdetail.taf?Type=Art&id=952>>

³ <http://assoc.garden.org/ag/asg/index.php?q=detail&n=programSummaries>

across all standardized tests and had higher grade point averages⁴.” More specifically, in 2006, the National Science Teachers Association reported on several studies that showed higher science achievement test scores from students who participated in school gardening activities than those who just received classroom-based science instruction⁵.

One response to the overwhelming evidence of improved achievement due to GBL is the California Department of Education launch of the *Garden in Every School* Initiative, which has built 3000 school gardens. The use of these gardens has enhanced the education and health of California public school students, while also advancing the Farm to School movement among these schools.

Evaluation of the Edible Schoolyard (ESY):

Introduction: Alice Waters, chef and author, founded The Edible Schoolyard at the Martin Luther King Jr. Middle School in Berkeley, California in the late 1990s, which is a one-acre organic school garden. The garden is wholly integrated into the school’s curriculum and lunch program, including garden classes and kitchen classes that teach the origins of food and food preparation. The Edible Schoolyard has since gained recognition as a model school garden program around the nation.

Nature of the Evaluation: The Center of Ecoliteracy (CEL), one of the core funders of the Edible Schoolyard and advocates of food systems-based learning, commissioned an evaluation study of The Edible Schoolyard and reported on its preliminary findings in 2003⁶. Until this report, benefits of the school garden primarily consisted of anecdotal evidence, and the CEL wanted to

⁴“School Garden Program Overview,” California Department of Education, 4 January 2009
<http://www.cde.ca.gov/LS/nu/he/gardenoverview.asp#ref7>

⁵ These studies were published in the American Society for Horticultural Science’s publication, *HortTechnology*. The link to these studies is posted in the NSTA report found at
 <<http://www.nsta.org/publications/news/story.aspx?id=51432>>

⁶ J.M. Murphy. “Findings from the Evaluation Study of the Edible Schoolyard,” Center for Ecoliteracy, Berkeley, California, April 2003. Accessed 2 January 2009. Online at
<http://www.ecoliteracy.org/publications/pdf/ESYFindings-DrMurphy.pdf>

quantify the results of garden-based education, particularly in a middle school setting, since programs such as The Edible Schoolyard are scarcer in middle schools. Data collected from the 2001-2002 school year consisted of surveys and interviews with students, school leaders, teachers, and parents, as well as school records used to assess grades, test scores, and attendance⁷.

Preliminary Findings:

- Increase in academic achievement of ESY students – significant gains in overall GPA, and particularly math and science grades.
- Greater gains in overall ecological literacy (i.e. understanding garden cycles and sustainable agriculture)
- Significant psychosocial adjustment improvements on a standardized student report questionnaire for ESY students than for students at the control school.
- Teachers from ESY rated their school as more conducive to learning than did control school teachers.
- Significant improvements in eating behavior (i.e. servings of fruits and vegetables)

Hence, quantitative data adds to the bounty of anecdotal evidence from other student evaluations collected by ESY director Chealsea Chapman, which point to improved student-teacher relationships, increased sense of community among the students, and excitement about and ease of learning due to new sensory experiences⁸.

Overall, as Murphy concludes in his report, the ESY program has encouraged student enthusiasm about attending school, making better grades, eating healthier foods, and becoming more knowledgeable about natural processes. These are just a few results from the great body of resources garden-based learning supporters have found to further vouch for the many benefits offered through these types of programs. This evidence can help motivate teachers and

⁷ More on Methodology: A total of 165 sixth graders, half from the King Middle School and half from another middle school in the Berkeley Unified School District (the control) were surveyed for this study, both at the beginning and the end of the school year. Sixty-four teachers from the two schools filled out surveys about the educational climate, and twenty-six ESY teachers contributed information about the subjects and students they taught. Student assessment included identification of fruits, vegetables and their parts, the garden-cycle, ecological concepts, sense of place, and relationship to the environment.

⁸ Ann Cooper and Lisa M. Holmes. *Lunch Lessons: Changing the Way We Feed Our Children*. Collins: NY. 2006.

volunteers to further incorporate garden-based learning programs into their established curriculum.

Garden Curriculum:

Basis for GBL: New Jersey Education Standards and Experiential Learning

In New Jersey, there are certain standards for the nine content areas that are taught in school with which local school districts must align their curriculum and instructional programs⁹. These content areas include: Visual and Performing Arts, Comprehensive Health and Physical Education, Language Arts Literacy, Mathematics, Science, Social Studies, World Languages, Technological Literacy, Career Education and Consumer, Family, and Life Skills. Additionally, New Jersey's revised science and social studies core curriculum content standards include an environmental studies standard in science and a geography/environmental standard in social studies, both for grades K-12¹⁰.

Garden-based learning is a specific method of project-based learning, a teaching strategy which can be used to achieve these education standards by means of connecting different disciplines together. Knowledge from each discipline becomes integrated and applied to a real-world context, which provides for a more coherent learning experience that produces greater understanding.

Important steps to create an outdoor curriculum:

A Center for Ecoliteracy interview¹¹ with Michele Lawrence, the superintendent of the Berkeley Unified School District, presents some key points in developing a critical mass of

⁹ <http://www.nj.gov/education/cccs/cccs.pdf>

¹⁰ Taken from the National Environmental Education Advancement Project 50 State Survey by the Campaign for Environmental Literacy, 2007, 2 January 2009, <http://www.fundee.org/campaigns/nclb/brief5b.htm>

¹¹ Zenobia Barlow, "Rethinking School Lunch Guide" Chapter on Curriculum Integration, *The Center for Ecoliteracy*, 14 November 2008. <http://www.ecoliteracy.org/programs/rsl-guide.html>

teachers and administrators who support the school garden and who will work to ensure that it thrives even when they depart. Below are some summarized suggestions:

- ☐ Develop a mission statement for the garden laying out practical aims for development and defining what you want students to learn about (See Appendix I)
- ☐ Identify a pilot group of interested principals and teachers, and include the food service director.
- ☐ Study the state education standards to see how much of what you want to teach is already required by the state.
- ☐ Propose other methods of including elements that you want students to learn but cannot find a place within curriculum for them. These include student assemblies, lunch period integration, essay and reading assignments, field trips, and information sent to parents.
- ☐ Share the proposal widely with teachers and principals and alter the proposed curriculum.
- ☐ Present the proposed curriculum and implementation plan to the district board of education.
- ☐ Include ways of how to assess your goals. What do these methods of evaluation look like? How do quantifiably test the knowledge of students?

Curriculum Integration:

Esther Cook, the kitchen teacher and manager of The Edible Schoolyard's kitchen, said that at first teachers looked at the kitchen garden and sessions as "time away from the curriculum. Now they're seeing ways to make the lessons part of the curriculum¹²." As elaborated by Michele Lawrence, curriculum is not difficult to change, but it is incredibly time consuming. Adding GBL to the school day will not increase the number of school hours in the day, but it will require complex integration into subjects. Lawrence estimates that about 3 years of hard work are needed to transition: from the initiation, to the rollout, to the training. Additionally, she identifies that a critical mass of about a third of people who will finally be engaged in the process are needed to begin this curriculum, and these people consist of teachers, principals, parents, and community members who are committed to a sustained effort.

While the Princeton Garden Cooperative has developed garden-based curriculum that meet New Jersey standards of education, Real Food for Thought seeks to build off of this foundation for the beginning of the Hopewell Valley school gardens and include lesson plans for

¹² <http://www.ecoliteracy.org/publications/edibleyard.html>

grade levels K-12 and potentially for all subjects required by the state to present to Hopewell Valley school teachers. A complete curriculum guide for all grade levels is beyond the scope of this paper, however I have compiled a complete set of lessons or lesson ideas for each subject for a single grade for when the garden is installed (Appendix II). These lessons can be tailored to meet the standards of other grade levels.

Because the Hopewell Valley school gardens have not been constructed yet, there is a unique opportunity for students of all grade levels to prepare in the planning and implementation as soon as possible. Planning can begin at the earliest grade levels, but older students have a particularly robust opportunity to integrate garden planning into their curriculum, due to the specialized subjects offered by the high school. For instance, Hopewell Valley Central High School's department of business education and practical arts have classes related to architecture, marketing, culinary arts, and construction, which can directly involve high school students with the planning of a school garden. Moreover, this curriculum can be extended to more traditional curriculum departments, such as math and science. Specifically, a sample series of lessons provided in Appendix III use geometry and computer software to design a garden, while students studying field ecology and biology determine what to grow in the garden and where. A hands-on project like this encourages students who are studying multiple disciplines to learn how they can be used together and applied to the real world.

Because the first school garden will be implemented at one of the elementary schools, this cross-curricular approach will also bring the Hopewell Valley community closer together as students will be able to collaborate with students of all grade levels. Furthermore, including students in the garden designs will give them a sense of ownership and responsibility, bolstering even more support for widely using the gardens as a new learning environment. Garden

curriculum lessons continue to grow as school gardens continue to pop up across the country, and there are many resources that provide lessons which meet education standards (a few are provided in Appendix IV). One last suggestion has to do with what to do with the garden's produce. If food service policies prevent the use of eating garden produce for school lunches, there are still many different ways to put the food to good use. Some schools have opted to donate their vegetables to the local food bank, and students learn about how to be civically engaged through serving the community. There is also potential to run a mini-farmer's market, with funds going to the upkeep of the school garden, and this could be a good way of teaching students about money management. Encouraging students to think creatively about how to use the garden will help them become more and more invested in its success.

Evaluation of Reformed Lunchroom Practices

In order to prime students for garden-based learning, and eventually reinforce this type of learning, school meals and specially geared lunchroom practices can begin to nurture the idea of how school subjects and classroom behavior are closely linked. The benefits of choosing healthy foods at lunch were quantifiably documented at Appleton Central Alternative School in Wisconsin when they began to provide meal of non-chemically processed foods that are low in fat, salt, and sugar, as well as fruits and vegetables¹³. These improvements included: increased ability to concentrate in the school setting, increase cognitive development, fewer health complaints, reduced feeling of hunger in mid-morning and/or mid-afternoon, more calmness, and increased practice of good nutrition outside of school. Other programs that have introduced farm-to-school programs, perhaps beginning with a farm fresh salad bar, have witnessed very positive feedback from parents and students¹⁴ and an increase in participation rates¹⁵.

¹³ Ann Cooper and Lisa M. Holmes. *Lunch Lessons: Changing the Way We Feed Our Children*. Collins: NY. 2006.

¹⁴ Ibid

Call for Cafeteria Changes

Basis for Healthier Meals

According to a recent Reuters Health article, U.S. youth obesity rates have tripled since 1980, and the government says 32 percent of U.S. children are overweight and 16 percent are obese¹⁶. Because school lunches are a main source of caloric intake for students, this means that lunch options should all be healthy options and students should receive proper guidance in choosing foods that are good for them.

In 2007 New Jersey mandated that foods of minimal nutritional value be prohibited from being sold prior to the end of the school day¹⁷. These foods include candy, soda, and other high-fat foods (those containing more than 8 grams of fat). While this initiative seeks to cut out major causes of health risks, the school lunch time should also help foster lifelong healthy eating habits outside of the school. More and more, school districts realize that lunch is also a key learning experience of the student, and educators are learning to “assume the responsibility of the whole child—from the time the student arrives at school until the school day is over.”¹⁸

Ideas for the Cafeteria: Turning Lunchtime into a Learning Experience

While complete switches to local fresh foods poses its logistical problems, there are other ways to promote healthy choices in the cafeteria. The first way is to clearly identify healthier options that match the comprehension level of the students in the lunchroom (i.e. colored stickers for elementary school children) in addition to presenting them in an appealing way. Teachers

¹⁵ Janet M Wojcicki, Melvin B Heyman. "Healthier Choices and Increased Participation in a Middle School Lunch Program: Effects of Nutrition Policy Changes in San Francisco. " American Journal of Public Health 96.9 (2006): 1542-1547. Research Library Core. ProQuest. Princeton University, Princeton, NJ. 11 Jan. 2009 <<http://www.proquest.com/>>

¹⁶ Julie Steenhuysen. "Fast food + nearby schools = fat kids" *Reuters Health*. 24 December 2008. 1 January 2009. http://www.nlm.nih.gov/medlineplus/news/fullstory_73138.html

¹⁷ <http://www.nj.gov/agriculture/divisions/fn/childadult/PolicyQA.pdf>

¹⁸ Zenobia Barlow, "Rethinking School Lunch Guide" Chapter on Curriculum Integration, *The Center for Ecoliteracy*, 14 November 2008. <http://www.ecoliteracy.org/programs/rsl-guide.html>

could work with students to identify healthy options in the lunchroom and reward fruit and vegetable consumption when students bring these stickers back from lunchtimes. Moreover, creating ties with local farmers similar to the CookShop program in New York City schools¹⁹, can build up excitement when local produce is featured as part of a lunch meal. Local farmers can either write letters to classes or personally visit them and bring along some of their produce to stir up interest in these products.

Recommendations and Conclusion

Introducing garden-based learning programs and farm-to-school meals can be a challenging transition that occurs over a long period of time. As already identified in this paper, here are some of the steps that can be carried out immediately:

1. Check for interest in incorporating garden planning activities into the classroom. This primarily has to do with asking teachers if they would be willing to work with Real Food for Thought in coming up with student garden designs. There is great potential to work with older students who are already required to take part in a hands-on project.
2. Draft a mission statement with students to share your vision with the community.
3. Create cafeteria connections in the curriculum while planning out the garden.

There are also a number of different partnerships to form outside the school which can help with initiating or maintaining the school garden (i.e. Boy Scouts and Brownies, Master Gardeners), and getting these partnerships set up now can help with garden planning as well as long-term sustainability.

As school gardens become more common among public schools, garden-based learning and curriculum geared toward healthy living is providing students with many significant benefits. Hopewell Valley School District has the opportunity to establish these same resources and

¹⁹ Ann Cooper and Lisa M. Holmes. *Lunch Lessons: Changing the Way We Feed Our Children*. Collins: NY. 2006.

benefit from these initiatives as well, and the future looks promising for the efforts of those who wish to see their children thrive in this new environment.

Appendix I: Mission Statements

These are some examples of mission statements for a school garden and how to get students involved in garden planning²⁰.

MISSION STATEMENTS

OBJECTIVES OF A SCHOOL GARDEN PROJECT FOR FIVE SCHOOLS IN RURAL ECUADOR:

- Develop children's understanding of vegetable production;
- Raise children's interest in a more varied diet;
- Help children to learn to produce vegetables;
- Produce foods appreciated by the community and adapted to the local climate;
- Give opportunities for children to consume the vegetables they grow (at school breakfast);
- Encourage children to acquire attitudes of cooperation, responsibility, self-esteem and self-confidence, motivation and the value of work.(Source: Chauliac et al., 1996)



OBJECTIVES OF THE URBAN NUTRITION INITIATIVE in West Philadelphia (USA)

Our school gardens emphasize nutrition education, sustainable organic agriculture, youth entrepreneurship and neighbourhood beautification. We aim to:

- Create and sustain an interdisciplinary curriculum that focuses on improving community health
- Improve nutritional and health status by increasing fruit and vegetable consumption in low-income communities
- Improve the urban environment through school-based gardens
- Facilitate school-based community health promotion projects

Foster socio-economic development through an entrepreneurial curriculum that

²⁰ "Setting Up and Running a School Garden." Food and Agriculture Organization. 2005. 2 January 2009. <http://www.fao.org/docrep/009/a0218e/A0218E00.HTM>

includes business development activities (UNI, 2001).

There are natural limits to all ambitions! Get advice and discuss what is feasible. Start small and improve your garden step by step. Each year a new feature can be introduced. Your ambitions can grow with the garden.



SUGGESTIONS FOR ACTION

- Decide the school garden's priority aims - provisionally.
- Draft a mission statement for the school garden, showing main aims and interests.
- Discuss the draft mission statement with pupils, parents, the head teacher, school staff, the garden group, the pupils and interested outsiders. Then revise it and make it public.
- Find out how organic gardening methods are regarded in your area.
- Make a preliminary decision about the size and scope of the garden (Remember: Start small!).

Outputs: finalized mission statement.

TIPS AND IDEAS

- Train children to explain the “Grow with the Garden” poster at the end of Part 1 to other children, parents and visitors.
- Get children to illustrate the finalized mission statement and display it in the school.



IN THE CLASSROOM

First Things First

Many lessons can be done before garden work begins. They can open up discussions with pupils about the aims and uses of gardens, give background information about plants, soil and gardening, introduce ideas of good gardening, and help children to set up a garden record

1. Shall we have a garden? *Pupils join the debate about whether to have a school garden.*

Objectives Pupils become aware of the uses of gardens and their positive aspects, recognize their own potential role, discuss reasons for having a school garden and feel motivated to start.

Activities Pupils discuss gardens they know, posting up words and pictures of the items discussed: what they produce, what happens to the crops, what other things are found in gardens (e.g. taps, fences) and what they are for. They describe gardening jobs they know (e.g. weeding, digging) and discuss what they would like to do in a school garden, recording their ideas on the displayed words or pictures.



2. What plants like *A key lesson for all aspects of horticulture and nature study.* **Objectives** Pupils become aware of plants' needs and identify the needs of particular plants.

Activities Pupils find ailing and healthy plants, describe them and note differences. They then imagine that they are plants, with roots (legs) and leaves (fingers) and answer questions:

- What do your roots like? Lots of space? Being squashed together? Being firmly fixed? Wet? Dry?
- What do your leaves like? Dark? Light? Open air? Blowing in the wind?
- What does your plant like? Lots of space? A lot of big weeds nearby? Good food every day? Bugs and insects (some are friends and some are enemies)?

Children speculate about why the sick plants are not well, then act out a mime or drama of young plants threatened by dangers and rescued by children.

3. Starting with soil *Children look closely at soil.*

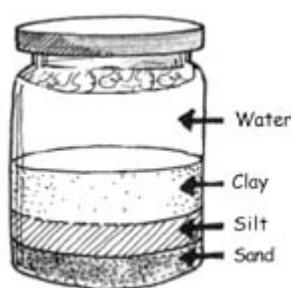
Objectives Pupils learn to distinguish topsoil and subsoil, recognize good soil by feel and sight, and become aware of all the components of soil.

Activities In the school grounds pupils dig a hole to observe topsoil and subsoil, then inspect samples of good and poor soil, answer questions about them and learn the slogan "*Good soil is damp, dark, crumbly and full of life*". On sheets of paper they sort soil components into four sets: things from plants, things from animals, live things and "other", and learn to approve of organic content. They also do experiments to establish that soil contains air (put a soil sample in water), and water (cover a sample with a plate and leave in the sun).

4. Soil quality *Simple experiments investigate soil quality and drainage.*

Objectives Pupils have a good understanding of soil structure and its importance.

Activities Students discuss which soil components contribute to: opening up the soil for air, water, roots; keeping the surface soft; providing essential food for plants; dissolving nutrients; holding soil in place; holding plants firm; allowing animals and bacteria to live; trapping water or helping it to drain. They identify the type of soil in the school garden (clay, silt, sand) by feel. Soil quality is tested by making a “mudshake” with soil and water and letting it stand for two days until the sand/silt/clay/organic matter settles out (ideal proportions are clay 4, silt 4, sand 2 and about 5 percent organic matter). They test drainage by digging a hole, filling it with water, letting it drain, filling it again and timing how fast it drains with a measuring stick (should be 6–10 cm per hour). Finally, they recognize that adding compost is the way to improve soil drainage.



(Experiments suggested by Guy *et al.*, 1996.)

5. Seeds and germination *This lesson combines science with healthy snacking.*

Objectives Pupils understand the nature of seeds and know how they germinate; they learn how to produce edible sprouts, and eat and savour them.

Activities Pupils inspect some seeds and discuss which plants they come from, then offer ideas about what seeds are (e.g. a plant egg, a food store, a sleeping plant). To make seed sprouts, they put suitable seeds (e.g. alfalfa, barley, broccoli, celery, lentils, beans, pumpkin, sunflower, wheat) to soak for a day, pour off the water, put in a glass jar, cover with a cloth and leave the jar on its side in a warm dim place in the classroom. Pupils predict what will happen. Twice a day they rinse the seeds with cool water, observe what is happening and compare it with predictions. After the seeds have sprouted, put them in the light for a day or two until they turn green, and then eat them - with ceremony! Pupils repeat the experiment at home and explain it to families.

6. Growing plants *This lesson provides an overview of the plant life cycle in relation to food plants.*

Objectives Pupils become aware of how plants are grown and the relation to the plant's life cycle

Activities Pupils speculate on what happens after seeds have sprouted. They look at plants in different stages of development (seedling, growing plant, flowering plant, fruiting plant and

seedhead), place them in order and find others in the school grounds to fit each category. They then apply these categories to crops they know well, or are planning to grow, deciding in each case if we harvest leaves, stems, roots, fruit or seeds.

7. Organic gardening *Organic gardening is healthier for children, for crops and for the environment.*

Objectives Pupils learn how to improve conditions for plants using natural methods.

Activities Pupils find a “sad plant”, name it, and discuss how to improve its life in answer to these questions: Has it got enough space and light? Is the earth very hard/too dry/too wet? Does it have rich soil to feed it? Is it being attacked or eaten? How can we go on helping it grow? They take appropriate action, label the plant with date, diagnosis and remedial action, and monitor it for the following two weeks. Older children follow up by researching questions about organic approaches (e.g. What is mulching and what is the point? Is it good to use fertiliser? What kind? What worms and insects are good for the garden? (see Organic gardening in the appendix Horticultural Notes).

8. The garden file *Recording the life of the garden reinforces learning and heightens motivation.*

Objectives Pupils are motivated to keep records of gardening events and activities, learn how to make a documentary record and become aware of its value.

Activities The teacher shows some well-known “garden documents” (e.g. photos, map, drawings). Pupils arrange them in chronological order, suggest titles, captions and dates for each and nominate writers to label the documents. The teacher shows how to file the documents in a “Garden File” and gets individuals to insert them one by one. The students discuss what they will put in the file (Best work? Photos? Visitors’ comments?) and where to keep it so it is accessible but safe. Finally they discuss what should go on the cover and front page and nominate class members to do the lettering, cover picture, etc. Volunteers undertake to explain and show the file to absent students.

Appendix II:
Lessons for Grade 6 covering the NJ Education Standard Subjects:

Social Studies:

Studying a particular region, such as the Middle East, a class could prepare Middle Eastern foods or discuss the role of the Fertile Crescent. Perhaps consider the history of where seeds grown in the United States come from.

World Languages:

Students prepare foods or construct a healthy foods menu in a foreign language. Teach kids foreign vocabulary in the school garden.

Mathematics:

Learn about the costs ingredients in a meal and how to budget when only buying organic foods, etc.

Visual and Performing Arts:

Drama class: Improv Iron chef/ cooking show

Art class: Outdoor Impressionism class in the garden

Comprehensive Health and Physical Education

Learn about nutrition in the cafeteria (which foods are healthy); healthy eating habits

Science

Field ecology; learning about ecosystems, plant life (what conditions plants can grow in), composting.

Language Arts Literacy

Journal writing in the garden, or reading novels geared toward nature appreciation.

Technological Literacy

Using computer software to create garden designs

Career Education and Consumer, Family, and Life Skills

Cooking classes, visiting a farm (CSA) to understand how farms are run as a business

Appendix III: Example Lessons focused on Garden Design

1. Garden Design using Math and Computers. Meets Louisiana Curriculum Standards.

Website: <http://www.lpb.org/education/classroom/ntti/lessons/html2004/9jcLand.html>

LAUNCHING LAUDABLE LANDSCAPES
JANET CUNDIFF, Grades 9-11, MATHEMATICS
Click here for [pdf](#) to download and print

TIME ALLOTMENT:

Ten 50-minute class periods shared by two team teachers.

OVERVIEW:

This unit is a culminating activity to a geometry unit involving triangles involving real world problem solving. In the final project students are asked to find or design their own garden plan. A problem to create a landscape design provides lots of opportunity to think creatively about determining the square feet of garden space and hardscape so that the proper number of plants and the correct number of bricks can be ordered. Students will be further excited by the project if the class is able to actually implement one or more of the designs in the school or community environment. Local PTSA volunteers, an environmental science teacher, or Master Gardener could assist in choosing plants appropriate for the area, considering the amount of sun, condition of the soil, and drainage properties, and (of course) based on the measurements given to them by the math class. Presenting their plans to the principal and to the expert class partners helps to make them more responsible for their work because others (outside of our class) will be involved and are depending on them to do a good job. The possibility that their plan may be accepted and implemented makes it more of a competition and a real life challenge.

It has been designed as a team project between the computer literacy teacher (or other computer related elective) and the geometry teacher. Specific tasks need to be divided between the two to the satisfaction of the two teachers involved.

SUBJECT MATTER:

Geometry, Technology/Computer Literacy

LEARNING OBJECTIVES:

The learner will:

- Solve a real life problem: Design a garden environment to suit the definition of “formal garden” using geometric figures.
- Measure accurately and draw the design to scale.
- Calculate area and perimeter of a variety of geometric figures.
- Create a presentation to “sell” their idea to the school administration and/or community volunteers.

2. Gardening: A Math Adventures. Grade Level 4-6. Meets Michigan Curriculum Standards

Website: http://www.michigan.gov/textonly/0,2964,7-125-2961_2971-67123--,00.html

Approximate Length of Activity: Two class periods plus gardening time

Objectives:

Teacher:

1. Help students understand how math computations can be applied to a “real life” situation (planting a garden).
2. Help students learn about cooperation and teamwork by making decisions about their garden.

Students:

1. Apply math computation skills (addition and multiplication) to a real life situation.
2. Follow step-by-step directions to complete a class garden.
3. Use group decision-making skills to determine the kinds of items a garden will have.
4. Create graphs from groups of information.

Introduction:

Gardening is the cultivation of plants, usually in or near the home, as a hobby. Gardening is closely related to horticulture. Horticulture is the growth of fruits, vegetables, flowers, shrubs, grass, and trees. Plants are made up of roots, stems, and leaves. The roots help to anchor the plant in the soil. They also absorb water and minerals to promote plant growth. Stems of plants are various shapes and sizes. Twigs, branches, and trunks are all stems of plants. Some stems grow partially underground, but most stems grow above ground. Stems support the leaves and flowers of plants so they can receive an adequate amount of sunlight. Leaves have the job of providing food for the plant. The leaves need sunlight, which provides energy to combine carbon dioxide, water, and minerals to make food for the plant. This process is called photosynthesis.

Plants are important to all living things. They provide us with oxygen to breathe, food to eat and clothes to wear. Some plants also provide us with wood to build homes and many other things.

We get food from many different parts of the plant. Some foods, such as carrots and sweet potatoes, are actually the roots of the plant. Corn, soybeans, and wheat are seeds of the plant. These three types of seeds provide us with food that is used to make many foods and products. We eat the leaves of plants when we eat lettuce and celery. Broccoli and cauliflower are actually the flower buds of plants. Oranges, bananas, and apples are the fruits of plants.

Plants also provide us with clothing, wood, and medicine. Cotton plants provide us with cotton for many different types of cloth products such as clothing, sheets, and curtains. Trees provide us with lumber so we can make paper, furniture, and most importantly, houses. Wood is also used in various parts of the world for people to burn for heat to cook food and to keep their homes warm. Plants also provide us with medicines like quinine, digitalis, and cortisone, to help treat human diseases and conditions.

Your students can plan and plant a garden right on the school grounds. This project is an exciting way to teach math using addition, multiplication, bar graphs and line graphs. From the beginning lay-out to the bountiful harvest, fun math situations can be worked repeatedly. Your students will understand that math is needed in the “real” world, and it can be a lot of fun.

Types of Gardens to Plant:

1. Rainbow gardens: Identify flowers and other plants that will add color and interest to your garden.
2. Soup and salad gardens: Think about favorite soups and salads – then grow them! Vegetables may include lettuce, tomatoes, spinach, carrots, celery, radishes, onions, cucumbers, potatoes, peas, and corn.
3. Butterfly gardens: Choose varieties of plants that attract butterflies. A helpful book may be *Landscaping for Wildlife* by Carrol Henderson.

Materials Needed:

- Graph paper
- Colored pencils
- Pencil
- Paper
- Various seed packages (examples include pumpkin, corn, cantaloupe, carrots, onions, tomatoes, and green beans)

Activity Outline:

1. Have your students design a layout of a garden. First, they must decide what they would like to plant in their garden. For example, your students may choose pumpkin, corn, cantaloupe, carrots, onions, tomatoes, and green beans.
2. To design the layout of a garden, each student will construct a small model of a garden using colored pencils on graph paper. Each color will represent a different plant. (For example, a plant that spreads four feet will be four squares wide and four squares high.) Information included on seed packages will be helpful in planning the layout of the garden. **Do not let students begin this project until you have relayed all information in steps 1-5 of this activity outline. If they begin now, they will not have room for tilling.*
3. Here is a sample of the space used for various plants:

Pumpkin	4 feet
Corn	2 feet
Cantaloupe	5 feet
Carrots	1 foot
Onions	1 foot
Tomatoes	2 feet
<u>Green Beans</u>	<u>2 feet</u>
Total	17 feet
4. When coloring the area used for plants, three feet should be allotted between each row of plants for tilling. Since the sample garden (including the plants listed in #1) has seven different plants, there will need to be six tiller spaces between the rows. A three-foot border on each side of the garden is also needed for tilling space.
5. Here is a diagram showing the sample garden discussed above with 30-foot rows:

6. Ask your students to find the length and width of their gardens.
 - a. To find the length, either count the squares or add together the length of the rows and the tilling space on the borders. The length of the rows in the sample garden is 30 feet and the tilling space needed on the borders is six feet (three feet on each end), so the total length is 36 feet.
 - b. To find the width, either count the squares or add together the total feet of the rows, the tilling space between the rows, and the tilling space on the borders of the garden. In the sample garden, the total feet of the rows is 17 feet, the total tilling space between the rows is 18 feet, and the total tilling space needed on the sides of the garden is six feet, so the total width is 41 feet.
7. If possible, allow your students to plant a garden at your school using one of the graph paper models. The expenses for this project will include the cost of the seeds, fertilizer, and organic pesticides. The soil will need to be tilled or plowed prior to planting. The seed packages vary in price. One packet of seeds is sufficient for at least 60 feet of space. An average sack of fertilizer will cover 1,500 square feet. The sample garden discussed above is 1,476 square feet (36'x41'), so an average sack of fertilizer will be sufficient.
8. As the garden produces vegetables, the class can keep a record of the harvest. Plotting the daily result on a line or bar graph is an excellent way for students to learn how to display data and compare at a glance the production of the plant. Since the garden will be growing over the summer, your students may end up charting the harvest at the beginning of their school year and planting a garden at the end.

Discussion Questions:

1. Which vegetables will need the most space in our garden?
2. Which vegetables will need the least space?
3. If we doubled the size of our garden, what would its new area be?
4. How many bag of fertilizer will our new garden need?
5. Figure the average price of a package of seeds using the seeds we have purchased.
6. Create a bar graph displaying the cost of each package of seeds. Which seed cost the most? Which seeds cost the least?

3. PLANNING A SCHOOL GARDEN: Meets CA Standards

Website: <http://www.wccusd.k12.ca.us/stc/2000les/garden.htm>

By Mary Leursen

OUTCOMES: Students will learn how to plan a vegetable garden. Each student will take responsibility for growing one vegetable from seed, to transplanting the seedling into the soil, and providing the plant with light, moisture, temperature and healthy soil. Students will learn basic gardening vocabulary. They will demonstrate how to use garden tools and how to compost. At the end of the project (over a three to four month period) students will harvest their crops for take home as healthy food and for sale at a school "Farmers Market."

OUTCOME: Students will learn the conditions necessary to grow healthy plants from seed. They will map or draw a garden plot for an outdoor area in their school.

CLASSROOM ACTIVITIES:

1.) Teacher asks class to identify four concepts that are essential for growing vegetables. Students list these on overhead or large poster paper:

- Light
- Moisture
- Temperature
- Healthy soil

*(Healthy soil is a separate lesson on Composting.)

2.) Teacher and students then go outside and identify an area that meets all four essentials for a healthy garden. Once the area is identified, students take responsibility for measuring the plot and taking soil samples.

3.) In class, teacher asks students to identify what food plants they will plant. Students must consider:

- Season
- Space
- Irrigation
- Kind of soil

4.) Teacher breaks class into four large groups for each of the above items. Each group will be responsible for providing the entire class with research that will enable the class to integrate all four concepts in the planning of the vegetable garden.

Activities:

- Seeds/Plants - research what vegetables can be planted in particular season. Use Internet, Master Gardeners, Gardening Books, Botanical Gardens in the Bay Area. Bring in sample seed packets of vegetables that can grow in school's climate.
- Space - this group must determine how much space each crop will require and how to integrate it with the other crops
- Irrigation - How close will the garden be to a water faucet so that water is available to the plants. What plants require more/less water.

- Soil - What is the soil type? Clay, sandy, rocky? Is the space in a flat area? Will there be a drainage problem during heavy rainstorms?

5.) After groups have presented their findings, class must decide on three to four vegetable plants to grow based on the above conditions of their plot. Once the students have chosen the vegetables, they may begin mapping or drawing the plots for each vegetable in the garden area. Students may use the computer to "draw" their garden or they may use paper and pencil and color the vegetables they draw.

6.) The four groups now must each choose one vegetable and assume responsibility for:

- Reading the seed packets to find out if the plant must be started from seed indoors or if the seed can be put directly in the soil
- Assigning members of each group the responsibility for starting a seedling tray, i.e. use Styrofoam cups filled with potting soil to plant seed
- Starting a daily record for measuring growth, water needs
- For seeds ready to go directly in the soil, members of each group must take responsibility for preparing the soil, digging a row to the required specifications on seed packets.

7.) Gardening Tools and Equipment - Activities:

Vocabulary: Teacher asks students to list all the tools and equipment they need for gardening. Final list to be put on overhead for students to copy in their Journals should include: *Spades, rakes, hoes, watering cans, hoses/nozzles, trowels, twine/string, pruning shears/scissors, spading forks, shovels, stakes, clippers, wheelbarrows, compost bin, worm box.*

Safety training: Teacher establishes the rules for students using the tools. Stress safe tool use and model how to handle tools, how to clean them and how to safely hand them to another student.

CONDITIONS: This lesson extends over several days.

MATERIALS: Journals, tape measure, rulers, pencils, colored pencils, masking tape, poster paper, computer, gardening books, seed packets, sampling of garden tools.

METHOD OF ASSESSMENT: Vocabulary and measurement and mapping/drawing using the Academic Rubric. Group activities using the Life Skills Rubric.

MODIFICATIONS/ACCOMODATIONS: Use the "three minute pause" ask the students to turn to each other and tell what they just heard during the Safe Use of Tools Training.

STANDARDS ADDRESSED: Language Arts Word Analysis and Reading Comprehension, Mathematics, Social and Health Sciences, grade 9-10.

Appendix IV: More Resources for Curriculum

- National Environmental Education Week - http://www.eeweek.org/resources/garden_curricula.htm
- My Healthy Schools (School Gardens – Steps to Starting a Garden) - <http://www.myhealthyschool.com/gardens/planting.php>
- Real School Gardens - <http://www.realschoolgardens.org/en/resources.html>
- National Gardening Association - <http://www.kidsgardening.com/>

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Acknowledgements: I would like to thank Professor Morin, Pam Flory, Trisha Thorne, Tony Kowolak, and my CBLI partners, Ruthie Schwab, Henry Barmeier, and Holly McGarvie for their help and support.

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