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Creating a horticultural curriculum addressing environmental concerns

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CREATING A HORTICULTURAL CURRICULUM ADDRESSING ENVIRONMENTAL CONCERNS

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This thesis is dedicated to my niece Miss Natalie Caroline Becnel.

I hope to foster a love of learning and nature in her as she grows.

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Abstract

Research indicates that the average age of the American farmer is 57 years old. There is a need for new programs to be developed to encourage youth to pursue careers in agriculture. This study developed and implemented a horticultural curriculum at a summer camp targeting participants aged 9-12. A treatment group consisted of campers that signed up for the Victory Garden camp track and a control group consisted of randomly selected campers from a different camp track. A pre-test and post-test were given to both student groups. The test consisted of 16 general horticultural knowledge multiple choice questions and four questions pertaining to the campers' environmental stewardship. During the second year of the study, pre-tests and post-tests had minor adjustments but also included a short answer question targeting in-depth knowledge of flower pollination. Lesson topics included propagation, Victory Gardens, soil, recycling, plant parts, pollination, photosynthesis, and insects. Lessons were developed with several teaching methods using the three basic learning styles: visual, auditory, and kinesthetic.

Statistical analysis of variance using PROC GLIMMIX at the 0.05 level found that participants in the treatment group had a significant improvement of general horticulture knowledge from pre-test to post-test responses. Post-test scores of treatment participants were significantly higher than control participants in both years of the study. Treatment students were significantly more confident that they could explain to others how to grow a plant, and that they could grow more than one type of plant. Analysis of the second year of data found that treatment students were significantly more likely to feel confident that they could plant a seed that would grow into a plant. Although demographic data was taken for each participant including gender, age, and ethnicity, no significant differences were found for any of these groups. Analysis of the

short answer portion of the exam found that students from the treatment group were more likely to respond with multiple correct answers.

Chapter 1 Introduction

Introduction

Sedentary lifestyles have led to an obesity trend in youth throughout the United States. Obesity in the U.S. is also caused by eating highly processed foods rather than fresh fruits and vegetables. The average age of the American farmer is 57, implying many youth are losing interest in agriculture. Creating programs designed to encourage youth to exercise, eat healthier, and gain an interest in agriculture is an important step in resolving this obesity epidemic. This thesis project created a series of garden-based, hands-on activities to teach students about growing vegetable gardens. The campers focused on specific horticulture topics including propagation, pollination, insects, soils, recycling, and photosynthesis. This project contributes to school garden research by studying the effects of garden based education on student science knowledge and garden confidence levels.

History of Agriculture Education

Agricultural practices around the world have traditionally been passed down through generations of families. Although in many third world countries farmers are still using the tools and techniques of their ancestors, agriculture in the developed world has quickly advanced in the past 100 years. In the United States the establishment of land grant universities by the Morrill Acts of 1862 and 1890, created a formal agriculture education system. These land grant universities provided access to higher education for the general public. Though agricultural subjects had been developed for many years, these disciplines were already in practice in other areas of study (Barrick, 1989). As an example, before the creation of a formal agriculture program, plant pathology and animal science would have fallen under the discipline of biology. It was only with the development of formal agriculture education that these courses were offered together in one curriculum. Currently Louisiana State University offers nine different curricula

with a total of 45 concentrations within the College of Agriculture. There are four types of agriculture education: college education, general education, vocational education, and pre-college education. College agriculture education varies by program and trains students in research and education. Many universities such as Louisiana State University and Purdue University have entire colleges within their university system dedicated to agriculture and its sub-disciplines. General agriculture education is best suited for presenting information to the general public on agricultural products and techniques. Programs such as Master Gardeners fall under this designation. Vocational agriculture pertains to teaching students skills required in manufacturing, marketing, environmental conservation. This type of education is usually associated with associate degrees offered by community and junior colleges. Baton Rouge Community College offers two year degrees in Coastal Environment Science, Environmental Management Systems, Natural Resource Management, and Landscape Management. Pre-college agriculture education is offered in public schools. This type of education is generally associated with organizations such as Future Farmers of America and 4-H.

History of Education Standards

Educational standards have existed for over 200 years. During the 1840's educators felt education should be equal for all students, including the large influx of immigrants to the United States. This equality pertained to the availability of quality educational experiences as well as the development of textbook standards. University admission programs developed coursework requirements for students wishing to pursue higher education. In 1892 the National Education Association appointed a taskforce of scholars and high school principals, The Committee of Ten, to develop a uniform high school curriculum and requirements for college admission. With the beginning of the Cold War, the National Defense Education Act supported programs that

developed skills in math, science and foreign languages. These government-funded programs were designed to combat advances by Russian scientists. During the 1970's standardized tests were administered to determine if funding had increased student knowledge. Benchmarks for science literacy were created and released in 1993 to develop minimum knowledge targets for 2nd, 5th, 8th, and 12th grades. In 1995, national curriculum criteria were developed for science. Louisiana created standards that were based on the national criteria in 1997. The Louisiana Grade Level Expectations (LaGLE's), created in 2004, and categorize educational standards into specific criteria. The LaGLE's provide outlines for teachers to create curriculum and are categorized by grade and subject.

History of School Gardens

Although the first American school garden was established in 1891, the first recorded school garden was grown in Europe in 1811 (Subramaniam, 2002). The popularity of school gardens rose with the beginning of World War One with Victory Gardens and the United States School Garden Army (USSGA). The USSGA was an initiative of the U.S. government. Its goal was to incorporate agriculture curriculum into public school education. Schools grew relief gardens during the Great Depression that were used to raise the spirits of the local citizens and nourish students and their families. A second Victory Garden initiative arose with the beginning of the Second World War. The Green Revolutions of the 1970's and 1990's led to school garden initiatives. These revolutions saw the introduction of new varieties of crops that had higher yields, new farm management techniques, and new synthetic fertilizers and pesticides.

Recently, California approved legislation to sponsor school gardening. One example is the "A Garden in Every School" program (Kitchen, 2011). In Louisiana there are several programs advocating the use of gardens in schools. The Seeds of Service and the U.S.

Environmental Protection Agency (EPA) Growing a Garden 101 program provide the funding and technical advice needed to start school gardens. Currently the LSU AgCenter is sponsoring a school garden initiative to promote healthy living in Louisiana's youth (LSU AgCenter, 2012)

History of 4-H Program

4-H began in the late 1800's after university researchers realized that the farming community was resistant to new agricultural techniques. Research found the younger generation was more receptive to new ideas and practices. The first 4-H club, called the Tomato or Corn Growing Club, began in 1902 in Ohio. Early agricultural clubs were also established in Minnesota. In Avoyelles Parish, Louisiana a local boy's corn growers club was formed in 1908. By 1912 the clubs were renamed 4-H Clubs. As the program grew, additional organization was needed to extend the program to new members. Louisiana State University entered into a formal agreement with United States Department of Agriculture to operate 4-H as a unit within the university system. The U.S. Smith-Lever Act of 1914 created the Cooperative Extension System (CES) to combine support from local, state, and federal governments. This support allows the CES to interpret and present research-based information to the public allowing them to make informed decisions and live healthy lifestyles. The 4-H Youth Development Program continues to expand and currently consists of more than 175,000 youth in Louisiana. Seven million youth in 70 countries are 4-H members. Although the 4-H organization was created to offer new agricultural techniques to young farmers, it has evolved into a program allowing youth to develop important life skills such as leadership, public speaking and computer skills.

4-H Camp Grant Walker

The 4-H slogan is "learn by doing". Therefore the 4-H summer camp is the perfect arena to encourage youth to become better students. Camp Grant Walker, the location of Louisiana 4-H

summer camp and a major component of the Louisiana 4-H program, was founded in 1922.4-H Summer Camp is comprised of nine week-long sessions. All Louisiana youth ages 9-12 are encouraged to participate. Seven tracks were available to campers. A track is a nine hour period of instruction divided into three-hour sessions over three consecutive days.

Available tracks were Food and Fitness, Dramatic Arts, Science Engineering and Technology, Wetlands, Outdoor Adventures, Hunter Safety and the Victory Garden, the track used for this study,. Each week, a new set of campers arrived. On the first day of camp, participants chose one track to attend during the morning hours. Every afternoon, campers would rotate through several summer camp recreational activities such as arts and crafts, canoeing, archery, sports, and swimming.

Connecting Garden Lessons to 4-H

A grant titled Miss Lou: Connecting Kids and Communities was awarded jointly by The U.S. Department of Defense and the United States Department of Agriculture. The purpose of this grant was to provide funding for programs to benefit military youth and families, as well as non-military individuals. The grant was funded to support programs in health literacy, basic meal preparation, gardening, youth citizenship and other supportive programs. The intent of the grant was to provide community resources and support to military and non-military youth and families, and to enrich the lives of the youth. The objectives of the grant were to increase participation in afterschool programs by youth with parents or guardians in the military and to establish programs in rural and urban communities. The LSU AgCenter received a portion of this grant funding to create a “Victory Garden” at a centrally located area of the state near several military bases. The intent was to provide military and non-military families with a fun and educational outlet to learn about gardening. Tanya Giroir, the grant PI at the LSU AgCenter contacted the

School of Plant Environmental and Soil Sciences for assistance in creating the garden and developing a curriculum to be used with the garden. The curriculum would be used to teach an out-of-school program during summer camp and to hold monthly trainings for both military and non-military families living in the area. This thesis examines the summer camp portion of the Miss Lou: Connecting Kids and Communities grant. The camp track was termed the Victory Garden track to incorporate general garden practices with a military background meeting the terms set forth in the grant.

Chapter 2 Literature Review

Uses of School Gardens

Although school gardens have been in existence for many years, only recently has the trend re-emerged. Researchers found that the majority of school gardens in California were used for curriculum purposes with science being the most common subject area. Gardens were also utilized to instruct students on environmental issues and nutrition (Graham et al., 2005). Virginia elementary school teachers indicated that the two most important factors in successfully incorporating gardens into standard curriculum were when teachers and students took ownership of the garden, and when resources such as and faculty gardening skills, building materials, and plant materials were available (DeMarco and Relf, 1999). Florida teachers were polled to learn more about the use of gardens in instruction. They indicated that gardens were used to teach environmental lessons as well as used for experiential learning. Eighty-four percent of the teachers in this study indicated that garden activities related to the curriculum improved student learning (Skelly and Bradley, 2000).

Use of School Gardens to Improve Knowledge

Several studies found that incorporating gardens into alternative curricula improved scores in areas such as science and literature (Wagner, 1999; Smith and Motsenbocker, 2005; Klemmer et al., 2005a; Karsh et al., 2009; Pigg et al., 2006). Wagner (1999) found that a South Carolina Botanical Garden Program, Garden Explorations, used an inquiry-based learning method to teach their subjects. This method allowed students to investigate on their own rather than performing "cook book" type experiments. The goal of the South Carolina Botanical Garden was to increase science literacy in those that experienced the program. Other garden programs existed to engage student's interests and improve their science scores. Smith and Motsenbocker (2005) found that integrating the Junior Master Gardener Program into a 5th grade

traditional science classroom increased student science knowledge. Klemmer et al. (2005) found that when third through fifth grade students in Texas were given additional science instruction using garden activities they scored significantly higher on science achievement tests than students who received only conventional classroom instruction. This is important to my study because the Victory Garden track used a non-traditional setting to present these lessons.

Garden curriculum can also be used to instruct students about environmental stewardship. Karsh et al. (2009) presented garden and environmental lessons to middle schools students and found those that participated had improved scores in both scientific knowledge and environmental awareness. Pigg et al. (2006) found that garden curriculum had no significant effect on student's science scores over all, but that fourth graders did benefit academically from taking part in the school garden activities. Although many schools are using a garden-based curriculum, many are not measuring the educational value of gardens. In 2005 a science achievement test was developed to assess the effectiveness of a garden curriculum with a reliability score of 0.82. These tests were created using standards developed for the Texas Essential Knowledge and Skills (TEKS) (Klemmer et al., 2005b).

Use of School Gardens to Improve Nutrition

School gardens have also been used to promote nutrition education with young students as well as improve vegetable intake (Morris and Zidenberg, 2002; Lineberger and Zajicek, 2000; Auld et al., 1998; McAleese and Rankin, 2007; O'Brien and Shoemaker, 2006; Koch et al., 2006; Lautenshlager and Smith, 2007; Parmer et al; 2009). Morris and Zidenberg (2002) found that the addition of a vegetable garden component to an existing garden program increased student consumption of nutritious vegetables. Lineberger and Zajicek (2000) developed a program to teach nutrition to students and investigate the willingness of students to incorporate

new fruits and vegetables into their diet. This study found that the students reacted more favorably towards fruits and vegetables after inclusion in the gardening program but vegetable intake did not increase. Auld et al. (1998) found that students were more likely to choose and eat healthy foods after learning from certified teachers and parents. McAleese and Rankin (2007) found that students presented with a gardening and nutrition curriculum are more likely to eat healthy fruits and vegetables than those who received only nutrition education or those that received no supplemental instruction.

A gardening curriculum does not have to be presented during school hours to be effective. O'Brien and Shoemaker (2006) investigated an eight week after school program consisting of hands-on lessons. Their study examined the effects the gardening program had on nutritional knowledge, food preferences, and attitudes towards gardening practices and consuming fruits and vegetables. This study found no significant differences in knowledge learned or student preferences for fruit and vegetables, however student knowledge and vegetable preference levels were high at the beginning of the program. Koch et al. (2006) studied a summer gardening program offered to second through fifth graders that assessed the knowledge participants gained about the nutritional value of fruits and vegetables, attitudes towards these foods, and if their eating habits changed in relation to these foods. Participants were given multiple choice exams and questionnaires and were interviewed to assess the effectiveness of the program. Although the students' knowledge improved and they reported eating more healthy foods, there were no significant differences in their attitudes towards fruits and vegetables. An out-of-school nutrition and gardening program based on the Junior Master Garden handbook found no difference in self efficacy, one's belief in one's ability to complete a task, in gardening or improvement in knowledge of third through fifth graders. This program had

a very low participation (thirty students total) and only eleven fourth graders participated in a fall program. The low number of students in the study may account for the neutral findings (Poston and Dzewaltowski, 2005).

The theory of planned behavior states that the combination of a one's attitude, belief in one's abilities, and societal cues shapes one's behaviors and intentions. Lautenshlager and Smith (2007) studied a program involving the theory of planned behavior and found that a garden program positively affected youths' vegetable and fruit consumption and strengthened healthy eating intentions in some students. Combining gardening and nutrition programs may improve the health of participating youth. Parmer et al. (2009) found by using questionnaires, taste-and-rate discussion and lunchroom visits, youth participating in this nutrition program were more likely to retain nutrition knowledge, enjoy the taste of fruits and vegetables, and freely choose to eat fruits and vegetables in a lunchroom setting.

Use of School Gardens to Improve Attitudes and Perceptions

Gardening programs not only positively affect the health of participants but also their attitudes (Waliczek et al., 2000; Kahtz, 1995; Dirks and Orvis, 2005; Skelly and Zajicek, 1998; Midden and Stoelzle, 2000; Taniguchi and Akamatsu, 2011; Lohr and Pearson-Mims, 2005; Rappe et al., 2006). Waliczek et al. (2000) administered a web survey for adults about gardening with children. Participants indicated they felt youth involved in gardening had lower stress levels and increased self-esteem. This study also found that parents and teachers have different concerns about youth gardening. Parents were more interested in student's learning food production whereas teachers were more concerned with students' opportunities to socialize and the increase of knowledge. Kahtz (1995) investigated the Missouri Botanical Garden programs "The Water Cycle: Making a Terrarium" and "The Tropical Rainforest" and found the programs

had no significant impact on participants' attitudes of the environment but the participants did gain knowledge from the programs. The Terrarium program had a positive effect on participant attitudes towards learning about plants. Dirks and Orvis (2005) explored the use of The Junior Master Gardener program in Indiana classrooms and found the curriculum had a significantly positive effect on students' attitudes towards gardening topics presented. This study also found that the schools that currently had a garden performed better in the tested areas. Skelly and Zajicek (1998) analyzed ProjectGREEN, a garden program, in an elementary school setting and found that the program positively impacted student's attitudes towards the environment. This program also indicated that the more outdoor activities the students participated in, the more their attitudes positively changed towards the environment.

Gardens have also been used successfully with very young students. Midden and Stoelzle (2000) found that when a garden was built at a children's preschool, the garden was successfully and effortlessly added to the school's curriculum. In addition to benefitting students, the teachers were introduced to an educational tool. Countries outside the United States are also advocating the use of gardens in a school curriculum. Taniguchi and Akamatsu (2011) administered a questionnaire to over1000 fifth grade students about personal farming experiences and their opinions of locally grown food and the region in which they lived. The study found that children with farming experience were more likely to respond favorably to questions about eating local food and had a stronger attachment to the area in which they lived. Gardening and exposure to environmental concerns, such as recycling and pollution, can affect youth throughout their lives. Lohr and Pearson-Mims (2005) administered a nationwide survey to adults asking their opinions on urban trees, civic participation and childhood experiences. Adults with active childhood nature experiences such as gardening or visiting natural parks had more positive attitudes

towards urban trees and participated more in civic activities. Gardening programs are not only effective with youth participants. Rappe et al. (2006) studied the effect of visiting a "green environment" had on nursing home residents. They found that visiting such locations improved how the patients felt about their own health. Students were evaluated on whether a youth gardening program influenced their attitudes towards their environment and their ability to positively influence their own environment. Although no significant differences were found, both control and treatment groups showed high positive attitudes towards their environments when participants had previous gardening knowledge (Aguilar et al., 2008).

Use of School Gardens to Teach Life Skills

Gardening and horticulture experiences can also teach youth life skills that can be used from early childhood through adult life (McGuinn and Relf, 2001; Robinson and Zajicek, 2005). McGuinn and Relf (2001) studied a program involving six juvenile offenders and found that when they were given instruction on vocational horticulture skills, they increased their social bonds and were motivated to think about the future and their careers. Robinson and Zajicek (2005) observed students in a one year gardening program to evaluate the development of life skills pertaining to teamwork, decision making skills, and communication skills. There were no significant differences between the students in the gardening program and the control group. However pre-test scores were higher for the control group and students in the treatment group raised their life skill scores by 1.5 points after participating in the program.

These studies indicate that incorporating garden lessons into school curriculum can positively affect students' knowledge, environmental attitudes, and life skills. Many schools are beginning to establish gardens on their campuses. More research should be done to assess where

garden lessons are most effective: in a classroom, in correlation with an afterschool program, or during a summer camp.

Chapter 3 Materials and Methods

Victory Garden Track Lesson Plan Development

Camp lessons were developed using Louisiana Grade Level Expectations (LaGLEs) for 3rd -6th grades. LaGLEs are state mandated requirements that each student must meet before passing to the next grade. The LaGLEs were reviewed to identify knowledge students should possess as well new concepts that could be introduced through the gardening lessons (Table 1).

Lessons from the Texas Junior Master Gardener handbook as well as several internet sources were modified for time constraints and appropriate teaching methods. The major lesson topics used in the Victory Garden track were propagation, plant parts, pollination, soil science, gardening, and recycling. One lesson was written per topic using selected Grade Level Expectations. The lessons included hands-on activities to maintain student interest and to make lessons enjoyable as this was a summer camp setting.

The objectives of this research study were to develop a 4-H summer camp track to teach military and non-military youth gardening skills, and to measure changes in science knowledge and gardening self-confidence in participating and non-participating youth.

Location of Study

The 4-H Summer Camp Program, designed for all youth that have completed fourth, fifth, and sixth grades (aged 9-12) is held at the Grant Walker 4-H Educational Center, located near Pollock, Louisiana. Youth arrive at the camp Monday afternoon and depart Friday morning. Sessions for each track are held Tuesday through Thursday mornings and recreation sessions consisting of archery, canoeing, arts & crafts, etc. are held during the afternoons.

Table 1. Victory Garden Lessons Presented for the 2010 and 2011 4-H Summer Camp and Their Corresponding LaGLE's.

Lesson Title	Corresponding GLE
Lesson 1: Propagation	4: GLE-46 Describe how some plants can be grown from a plant part instead of a seed. (LS-E-B1)
Lesson 2: Victory Garden	4: GLE-47 Sequence stages in the life cycles of various organisms, including seed plants. (LS-E-B2) 4: GLE-50 Explain how some organisms in a given habitat compete for the same resources. (LS-E-C1)
Lesson 3: Get the Dirt On Your Dirt	4: GLE-56 Investigate the properties of soil (i.e. color, texture, capacity to retain water, ability to support plant growth) (ESS-E-A1)
Lesson 4: Recycle, Reduce, Reuse	4 : GLE-58 Draw, label, and explain the components of a water cycle (ESS-E-A3) 5: GLE-51 Describe naturally occurring cycles and identify where they are found (e.g., carbon, nitrogen, water, oxygen) (SE-M-A7) 6: GLE-45 Describe methods for sustaining renewable resources (SE-M-A6) 6: GLE-46 Identify ways people can reuse, recycle, and reduce the use of resources to improve and protect the quality of life. (SE-M-A6)
Lesson 5: Parts of the Plant	3: GLE-36 Compare structures (e.g., roots, leaves, stems, flowers, seeds) and their functions in a variety of plants (LS-E-A3) 4: GLE-40 Explain the functions of plant structures in relation to their ability to make food through photosynthesis (e.g., roots, leaves, stems, flowers, seeds) (LS-E-A3)
Lesson 6: Pollination	4: GLE-45 Identify reproductive structures in plants and describe the functions of each (LS-E-B1).
Lesson 7: Photosynthesis	5: GLE-19 Describe the processes of photosynthesis and respiration in green plants (LS-M-A4)
Lesson 8: Garden Friends and Foes	5: GLE-28 Explain and give examples of predator/prey relationships (LS-M-C4).

Year One Methods

Selecting Treatment and Control Students

The garden curriculum was offered as a 4-H summer camp track titled "Victory Garden". Each week campers from various parishes around the state would attend camp and choose a track in which they would participate. The Victory Garden track and six other tracks (America's Wetlands; Dramatic Arts; Food and Fitness; Outdoor Adventures; Hunter Certification; and Science, Engineering, and Technology) were offered during the first year of this study. On Monday evenings, staff members from each track would present a "commercial" to campers to explain the activities or purpose of their respective tracks.

The "Victory Garden" track was advertised by describing two of the activities from the track, working in the garden and a demonstration from the insect lesson. Campers were then released to a separate area to sign up for their desired track. The number of campers per track varied based on the number of campers attending summer camp each particular week. The Victory Garden track was capped at 20 campers per week. Since the campers were allowed to choose their own track, the number of participants varied weekly (Table 2).

Table 2 Campers Participating in This Study during the 2010 4-H Summer Camp.

Week	Treatment Students	Control Students
	…….....#.....	
1	12	13
2	13	12
3	4	7
4	19	20
5	5	7
6	17	16
7	11	16
8	19	0
9	20	23
Total	120	114

Control students were chosen at random from the America's Wetlands track as this track usually had the most campers per week. Control students were those that did not receive the curriculum but were given the same assessment as the Victory Garden group. The number of participants in the control group was determined based on the number of subjects in the treatment group. This was to ensure that the treatment and control groups would be equal in number to provide an unbiased comparison.

Assessment

Treatment and control students took a pre-and post-horticulture knowledge test along with a survey used to determine how the lessons improved students' confidence in gardening. The test, found in Appendix D, consisted of sixteen multiple choice questions relating to the eight lessons presented in the Victory Garden Track and four gardening confidence questions. Each lesson was represented by two questions. Demographic questions were also asked to gather data on gender, race, grade completed in school prior to attending camp, and questions pertaining to their families' military background. Campers in the Victory Garden track were given the horticulture pre-test on Tuesday morning before lessons were presented and given the horticulture post-test after all lessons had been taught Thursday just before they were released to lunch. Campers in the control group were tested Tuesday and Thursday after lunch during the time reserved for mail dispersal. At this time, all campers were together which made it easier to account for all control campers who needed to participate in the tests. Control campers were compensated with the privilege of eating first at the Thursday evening meal after they had completed both the pre-and post-tests. As camp attendance could be quite large, this meant control campers did not have to wait in line to eat.

Presentation of Lessons

Eight lessons were taught over three day period in increments of three hours each day. Lesson plans are located in Appendix A along with worksheets (Appendix B) associated with the lessons. Lessons were presented Tuesday, Wednesday, and Thursday mornings. Afternoons were reserved for group rotations to each of nine activities planned by the camp administrators. The Victory Garden track lessons were taught for nine consecutive weeks to treatment campers. Each day two to three lessons were taught. Lessons lasted approximately one hour. Due to scheduling constraints, lessons two, three, and five were completed the next day. Lessons included: Propagation; Victory Garden; Get the Dirt on your Dirt; Recycle, Reduce, Reuse; Parts of a Plant; Pollination; Photosynthesis; and Garden Friends and Foes. Each lesson was chosen based on core horticulture principles (Table 3).

Propagation is the foundation of all horticulture. The objectives of the lesson on propagation were for students to learn several methods for propagating plants and to successfully propagate plants by seed and by stem cutting. Students were given worksheets explaining the steps of planting seeds and taking stem cuttings. Students filled plug trays with soilless media and planted various types of seeds suitable for summer gardens such as tomatoes, peppers, and cucumbers. Students also took cuttings of ornamental sweet potatoes and rosemary and placed them into the plug trays.

The objectives of the Victory Garden lessons were for students to learn the history and importance of Victory Gardens and to learn how to create and maintain their own home garden.

The students were given a brief history of Victory Gardens and then were instructed on how to properly plant seeds in the garden area, how to remove weeds by hand, and how to

Table 3. Schedule of Lessons Presented Each Week at the 2010 4-H Summer Camp.

Start Time	End Time	Total	Lesson(s)	Activity
Monday – Day 1				
Present track recruitment "commercial" and randomly select campers for Control Group				
				Tuesday – Day 2
8:30	9:00	30 min		Pre-test/Survey
9:00	9:30	30 min	4	recycled paper, Compost lesson, compost materials
9:30	10:00	30 min	1	Propagation lesson (crowding and ways to propagate)
10:00	10:15	15 min		Snack/drink break
10:15	10:45	30 min	2	Work in the garden
10:45	11:15	30 min	3	Get the dirt on your dirt
11:15	11:30	15 min		Clean up and line up for lunch
12:30	1:00	30 min		Pre-test Control Campers
				Wednesday – Day 3
8:30	9:15	45 min	2	Work in the garden
9:15	10:00	45 min	5	parts of a plant/ flower water uptake Plant Part game
10:00	10:15	15 min		Snack/drink break
10:15	11:15	60 min	6	Pollination Lesson
11:15	11:30	15 min		Clean up and line up for lunch
				Thursday – Day 4
8:30	9:00	30 min	4	Compost/ Water Cycle
9:00	9:30	30 min	7	Photosynthesis
9:30	10:00	30 min	8	Good Bug Bad Bug
10:00	10:15	15 min		Snack/drink break
10:15	11:15	60 min	2, 3, 5	Wrap up and work in garden (dirt, water uptake)
11:15	11:30	15 min		Post-Test Treatment Campers
11:30	12:00	30 min		Clean up and line up for lunch
12:30	1:00	30 min		Post-test Control Campers

properly water a garden. Students were also exposed to different types of gardens, both in-ground and raised beds. Students were given a worksheet that explained how to create a home row garden.

The soil lesson exposed students to the chemical and physical properties of soil and how soil affects plant growth. Students learned the properties of soil then combined different soil samples into jars with water to perform a basic soil texture test. Students recorded their findings on a simple worksheet.

The purpose of the recycling lesson was to expose students to the water cycle, composting, and what products are suitable for recycling. Students were given paper to recycle into ornaments. They were allowed to choose two colors of paper. After tearing their choices into small pieces, students blended their paper with water and molded the mixture into a cookie cutter of their choice. Students sprinkled a tablespoon of wildflower seeds into their mixture before it dried. When the students returned to their homes, they could water their ornament and watch it grow. Students also added non-protein food scraps to an existing compost pile and took simple moisture readings using the squeeze test and pH readings using pH strips. Additionally, students acted out different steps of the water cycle. Students filled in a worksheet with the steps of the water cycle.

The objective of the plant parts lesson was to teach students the purpose of each part of a plant and how they work together. Students also learned which parts of different vegetables plant are edible. Students were shown representations of the parts of plants then choose a different word to describe various vegetables. Students labeled the parts of a leaf and a stem on a worksheet.

In the pollination lesson, students were shown a representation of the parts of a flower and learned how the different parts worked together. Students also competed in a pollination relay race mimicking bees cross pollinating flowers.

The objectives of the photosynthesis lesson were for students to understand the photosynthetic process as well as learn different pigments in a leaf. Students were shown a representation of the photosynthesis formula and the process inside the leaf and then asked to interpret the information in their own way.

The objective of the insect lesson was to teach students the differences in pest and beneficial insects as well as to learn the different mouthparts of several insects. Students did this by imitating their feeding behaviors while eating candy or food. For example to imitate piercing/sucking insect mouthparts, students held straws in their teeth while trying to insert the straw into a juice box. Students were also shown a collection of real insects.

Year Two Methods

Selecting Treatment and Control Students

Both treatment and control subjects were chosen the same way as Year One although numbers were capped at ten campers the first two weeks of camp, fifteen campers week three to week 7 and twenty campers the last week of summer camp. This was altered from the previous year because the first weeks of summer camp had a smaller attendance than weeks later into the summer (Table 4).

Table 4. Campers Participating in This Study during the 2011 4-H Summer Camp.

Week	Treatment Students	Control Students
	……#.....	
1	10	9
2	9	0
3	11	8
4	14	12
5	14	25
6	0	0
7	15	18
8	15	23
9	20	19
Total	108	114

Assessment

Testing was the same as year one for the treatment subjects, however post-tests were given the Wednesday afternoon for year two as campers did not meet for mail time on Thursdays. Horticulture pre- and post-tests were also altered to reflect changes to the lesson

plans. One short answer question was also added to both tests to evaluate the students' abilities to analyze and apply the information they learned during the lessons. This question evaluated student's in their knowledge of flower adaptations that attract pollinators. Changes were made to reflect alterations in the lessons for year two. See Appendix D for a copy of the pre- and post-tests.

Presentation of Lessons

Changes were made to four of the lesson plans to offer a more hands-on approach to the activities (Table 5).

Table 5. Schedule of Lessons Presented Each Week at the 2011 4-H Summer Camp.

				Monday – Day 1
Present Track commercial and randomly pick campers for control group				
Start Time	End Time	Total	Lesson(s)	Activity
				Tuesday – Day 2
8:30	9:00	30 min		Pre-test/Survey
9:00	9:30	30 min	4	recycled paper ornaments
9:30	10:00	30 min	1	Propagation lesson(garden buddy)
10:00	10:15	15 min		Snack/drink break
10:15	10:45	30 min	2	Work in the garden
10:45	11:15	30 min	3	Get the dirt on your dirt
11:15	11:30	15 min		Clean up and line up for lunch
12:30	1:00	30 min		Pre-test Control Campers
				Wednesday – Day 3
8:30	10:00	90 min	2	Work in the garden
10:00	10:15	45 min	5	parts of a plant/ flower water uptake
10:00	10:15	15 min		Snack/drink break
10:15	11:15	60 min	6	Pollination Lesson
11:15	11:30	15 min		Clean up and line up for lunch
				Thursday – Day 4
8:30	9:00	30 min	4	Water cycle (terrarium)
9:00	9:30	30 min	7	Photosynthesis
9:30	10:00	30 min	8	Good Bug Bad Bug
10:00	10:15	15 min		Snack/drink break
10:15	11:00	60 min	2,3,5	Wrap up and work in garden (dirt, water uptake)
11:00	11:30	30 min		Post-test/survey
11:30	11:45	15 min		Clean up and line up for lunch
12:30	1:00	30 min		Post-test Control Campers

In the propagation lesson, campers made a “garden buddy” with perennial rye grass seed and a knee high stocking. This change in the lesson taught them about overcrowding and demand for resources. When camp ended, campers were allowed to take their “garden buddy” home. This allowed them to continue observing and understanding the principles of the propagation lesson.

In the Victory Garden lesson many different types of vegetables had been planted months prior to the starting date of summer camp so campers were able to pick and taste produce from the garden. This portion of the lesson also exposed some students to new foods that they had never tried or stated previously that they disliked. Campers were also shown vintage Victory Garden posters created for the War effort and were asked to create their own advertising poster. This was used to reinforce the importance of advertising these gardens for the War effort.

In the photosynthesis lesson, students were no longer required to draw the formula for photosynthesis. Many students from Year One expressed this was their least favorite lesson and as a new drawing component was added to the Victory Garden lesson we felt this lesson could be modified.

In the recycling lesson students made their own terrarium using a two-liter soft drink bottle to represent the water cycle. Students also were shown vermiculture bins and each week campers created a bin using newspaper, soilless media, and worms from the existing bin.

Worksheets were no longer used for any of the lessons because students felt written assignments were too similar to schoolwork. There was also an assistant instructor for the track

Chapter 4 Results and Discussion

Discussion of Year One General Knowledge Overall Test Results

Data from the general knowledge portion of the exam was reported by converting answers into a binary system. If students responded correctly, it was recorded as a value of 1. If students responded incorrectly it was recorded as a value of 0. Non-answers were recorded as a dot (.) as not to negatively skew the data. The data was analyzed using PROC GLIMMIX and shown data is taken from the Differences of Least Squares Means Test with a Bonferroni correction. Data was reported in tables by averaging the scores for each participant and then averaging the treatment and control groups separately by week. Data for week 3 and week 5 of year one is not shown because treatment group sample sizes were too small for the procedure to run, four participants and five participants respectively. Though demographical data was taken on the participant's age, race, and gender, this data is not shown because there was no statistical difference found (Table 6).

Table 6. Victory Garden Track Demographics for the 2010 and 2011 4-H Summer Camps.

Year	Student Population	Male	Female	4th Grade	5th Grade	6th Grade	N.A.[1]	Caucasian	African American	Other
		……..……..……#……								
2010	Treatment	27	84	53	42	16	0	92	19	0
2010	Control	35	64	32	45	22	0	82	11	6
2011	Treatment	14	94	37	55	14	2	92	8	8
2011	Control	35	79	49	32	18	15	100	9	5

[1] no answer

The majority of the participants were white females in fourth grade. This white female demographic is typical of 4-H camp. Data for week 8 is not shown in table 5 or table 6 because data from the control group was not completed. Rain on Thursday afternoon prevented the collection of post-test data.

The average pre-test score of the treatment group ranged from 47% to 57% with an overall average score of 51%. The average pre-test score of the control group ranged from 48%

to 57% with an average overall score of 53%. There were no significant differences in mean pre-test scores for year one. (Table 7).

Table 7. Mean Test Scores on Horticulture Pre-test for Students at the 2010 4-H Summer Camp.

	Week 1	Week 2	Week 4	Week 6	Week 7	Week 9	Overall
	……...……% correct…….……						
Treatment	49	51	47	57	56	49	51
Control	48	51	52	57	55	53	53
Significance	N.S	N.S	N.S	N.S	N.S	N.S	N.S.

N.S. = no significance

There were no significant differences in each week and overall between the treatment and control groups' pre-test scores. This finding is important as it suggests both the treatment and control groups had an equal knowledge of horticulture before the beginning of the Victory Garden track. However there were significant differences in the post-test scores between treatment and control students. The average score on the general horticulture knowledge post-test for the treatment group ranged from 64 to 77% with an average overall score of 69%. This was significantly higher than the average scores of control group which ranged from 41 to 57% with an average overall score of 50% (Table 8).

Table 8. Mean Test Score on Horticulture Post-test for Students at the 2010 4-H Summer Camp.

	Week 1	Week 2	Week 4	Week 6	Week 7	Week 9	Overall
	……% correct…….……						
Treatment	66	64	67	74	77	69	69
Control	41	45	53	57	53	53	50
Significance	***	*	*	***	***	**	***

* = pvalue is ≤ 0.05 ** = pvalue≤ 0.005 ***=pvalue≤ 0.0005

Each week the post-test scores for the treatment group, those that received the lessons, were significantly higher than those in the control group. The results suggest that the students that were exposed to the Victory Garden summer camp track gained knowledge that the control

group campers did not. This is not surprising as the America's Wetlands track, the track from which the control group was selected, did not include any gardening concepts. Participation in the Victory Garden Track prepares students for the coming school year by reinforcing some subject matter covered during the 4th grade, and introducing concepts to be taught during the fifth and sixth grades.

Within the treatment group, post-test scores were significantly higher than those on the pre-test scores. The average score for the treatment students on the pre-test ranged from 47 to 57% with an average overall score of 52%. The post-test scores ranged from 64 to 77%. This is a significant increase of 18 points from pre-test to post-test scores (Table 9).

Table 9. Mean Test Score for Treatment Group Participants at the 2010 4-H Summer Camp.

	Week 1	Week 2	Week 4	Week 6	Week 7	Week 8	Week 9	Overall
	……..% correct……							
Pre-test	49	51	47	57	56	55	49	52
Post-test	66	64	67	74	77	74	69	70
Significance	*	**	***	***	***	***	***	***

N.S. = no significance * = pvalue ≤ 0.05 ** = pvalue ≤ 0.005 ***=pvalue ≤ 0.0005

This suggests that students gained knowledge from the lessons presented. This also suggests that the lessons were effective and presented these students with the relevant horticulture-based concepts.

The average score for the general horticulture knowledge pre-test for the control group ranged from 48 to 57% with an overall average score of 53%. The post-test scores ranged from 41 to 57% with an overall average score of 50% (Table 10).

Though there are no significant differences between pre-test and post-test scores for the control group, there is a 3 percent points drop in the overall average score. This suggests that the control group learned no new horticulture knowledge during summer camp as pertaining to the

Table 10. Mean Test Score for Control Group Participants at the 2010 4-H Summer Camp.

	Week 1	Week 2	Week 4	Week 6	Week 7	Week 9	Overall
				% correct			
Pre-test	48	51	52	57	55	53	53
Post-test	41	45	53	57	53	53	50
Significance	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. =no significance

questions asked on the test. These students did not have an opportunity to increase science knowledge compared to those who did participate in the Victory Garden track.

Each individual question on the horticulture knowledge tests was analyzed for differences in responses between treatment and control groups, and pre-tests and post-tests. There was no significance between average scores for each question on the general horticulture knowledge pre-test except for question five which pertained to the different particles in soil. However, it was the control group that scored significantly higher which did not bias our data in regards to the treatment students who received the Victory Garden Track lessons (Table 11).

Table 11. Correct Responses (%) on the Horticulture Knowledge Pre-Test at the 2010 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
								% correct								
Treatment	50	42	53	77	55	57	54	38	35	27	89	23	73	74	27	52
Control	53	40	53	80	93	48	45	49	37	28	83	19	72	70	21	55
Significance	N.S.	N.S.	N.S.	N.S.	***	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. =no significance ***= pvalue ≤0.0005 Q=question

Questions four and eleven had a high initial score for both groups suggesting that this information was previously well known by the participants. These questions pertained to warm season plants and pollination respectively. Students tend to learn the basics of pollination early in school. During the track advertisements on Monday afternoon the purpose of a Victory Garden

was announced to the entire population of campers in order to attract participants with a military background to the track per the grant requirements. This could have led to a higher than average correct response by both the control and treatment students on the pre-test because the answer to this particular question was given in the track advertisement. The post-test score was generally lower for control responses but not significantly (Table 12).

Table 12.Correct Responses (%) on the Horticulture Knowledge Post-Test at the 2010 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo-synthesis		Insects	
	…...……% correct…….……															
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Treatment	69	66	91	82	90	59	86	75	55	42	91	40	72	80	58	64
Control	49	48	49	76	95	34	50	48	47	31	82	21	71	49	17	53
Significance	N.S.	*	***	N.S.	N.S.	**	***	**	N.S.	N.S.	N.S.	**	N.S.	*	***	N.S.

N.S. =no significance *= pvalue ≤0.05 **=pvalue≤0.005 ***=pvalue≤0.0005
Q=question

There were several questions that indicated a significant difference between treatment and control general horticulture post-test answers. Questions that had significance between treatment and control groups were questions two, three, six, seven, eight, twelve, fourteen, and fifteen. These questions pertain to vegetative propagation, Victory Gardens, types of soils, composting, pH, parts of a flower, the photosynthetic formula, and beneficial insects respectively. This finding suggests that students in the treatment group gained more knowledge in these lessons than the other lessons presented. Both questions for lesson 4, the Recycling lesson showed significant improvement for the treatment group suggesting that students understood this lesson more than the other lessons.

The questions that had a higher percent of correct responses by both treatment and control campers, those with a score above 0.75, were questions four, five, and eleven. These questions pertained to the Victory Garden Lesson, the Soil Lesson, and the Pollination Lesson

respectively. The most likely cause for non-significance for these questions was that pre-test scores of these questions were high for the control group. When looking at the scores for the treatment group, the majority of questions indicated a significant improvement from pre-test answers to post-test answers (Table 13).

Table 13. Correct Responses (%) on Horticulture Knowledge Test for Treatment Group at the 2010 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	…..…% correct…..….															
Pre-Test	50	42	53	77	55	57	54	38	35	27	89	23	73	74	27	52
Post-Test	69	66	91	82	90	59	86	75	55	42	91	40	72	80	58	64
Significance	**	**	***	N.S.	***	N.S.	***	***	**	*	N.S.	*	N.S.	N.S.	***	N.S.

N.S. =no significance *=pvalue≤0.05 **=pvalue≤0.005 ***=pvalue≤0.0005
Q=question

All scores improved from pre-test to post-test except for question thirteen which only dropped one half of a percent point. This question pertained to chlorophyll which most students learn early in their education. The photosynthesis lesson taught students new pigments found in a leaf which may have confused some students. Questions that were not significant all had a high correct response, above 50% both on the pre-test and post-test, were questions four, six, eleven, thirteen, fourteen, and sixteen suggesting participants had previous experience with this knowledge. These questions pertained to warm season vegetables, types of soils, pollination, photosynthesis, and insect mouthparts respectively. Also, each question had only three possible answers meaning participants had a 33% chance of answering the questions correctly. There were no significant differences between pre-test and post-test responses for the control group participants (Table 14).

Table 14. Correct Responses (%) on Horticulture Knowledge Test for Control Group at the 2010 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	% correct															
Pre-Test	53	40	53	80	93	48	45	49	37	28	83	19	72	70	21	55
Post-Test	49	48	48	76	95	34	50	48	47	31	82	21	71	49	17	53
Significance	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. = no significance Q=question

Though some averages were higher on post-test questions than pre-test questions they were not significantly higher. This suggests that control students did not learn new horticulture knowledge, but perhaps were better at guessing answers.

Discussion of Year Two General Knowledge Test Results

Data from the second year of this study was analyzed and reported using the same methods as the data collected from year one. Data is not shown for week 2 because data for the control group was incomplete. Data for week 6 is not shown because data was not taken that week. There were no significant differences between treatment and control general horticulture knowledge pre-test scores (Table 15).

Table 15. Mean Test Scores on Horticulture Pre-test for Students at the 2011 4-H Summer Camp.

	Week 1	Week 3	Week 4	Week 5	Week 7	Week 8	Week 9	Overall
	% correct							
Treatment	48	54	57	53	66	58	58	56
Control	56	51	53	49	52	53	55	53
Significance	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. =no significance

There are no significant differences between the treatment and control groups' pre-test scores, suggesting that all participants had an equal level of horticulture knowledge. There are

no significant differences for week 1 and week 3 post-test scores though each week following did have significant differences (Table 16).

Table 16. Mean Test Score on Horticulture Post-test for Students at the 2011 4-H Summer Camp.

	Week 1	Week 3	Week 4	Week 5	Week 7	Week 8	Week 9	Overall
				% correct				
Treatment	66	69	74	54	67	67	62	67
Control	55	55	48	42	48	57	48	51
Significance	N.S.	N.S.	***	*	***	*	**	***

N.S. = no significance * = pvalue ≤ 0.05 ** = pvalue ≤ 0.005 ***=pvalue ≤ 0.0005

Post test scores for the treatment group were higher than control group scores each week and significantly higher for weeks 4 through 9 suggesting treatment students learned general horticulture knowledge from the lessons presented. When analyzing data for the treatment group alone, each week post-test scores were higher than pre-test scores for the treatment group with weeks 1, 2,3,4,8 and the overall scores being significant (Table 17).

Table 17. Mean Test Score for Treatment Group Participants at the 2011 4-H Summer Camp.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 7	Week 8	Week 9	Overall
					% correct				
Pre-test	48	54	54	57	53	66	58	58	56
Post-test	66	83	69	74	54	67	67	63	67
Significance	**	***	*	**	N.S.	N.S.	*	N.S.	***

N.S. = no significance * = pvalue ≤ 0.05 ** = pvalue ≤ 0.005 ***=pvalue ≤ 0.0005

There are many factors that could have led to some of the weeks not having a significant improvement. There was a secondary instructor during year two, who while not teaching the lessons may have provided a distraction for some students. More of the allotted time was spent in the outdoor garden area making other lessons shorter and more rushed.

There were no significant improvements or declines for the control group during the second year of the study, though most weeks did see a decline in scores (Table 18).

Table 18. 2011 Mean Test Score for Control Group Participants at the 2011 4-H Summer Camp.

	Week 1	Week 3	Week 4	Week 5	Week 7	Week 8	Week 9	Overall
				% correct				
Pre-test	56	51	54	49	52	53	55	52
Post-test	55	55	48	42	48	57	48	51
Significance	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. =no significance

As this group did not receive the information presented during the Victory Garden Summer Camp tracks many of the answers may have been a guess for these students. This suggests they did not learn any horticulture knowledge as it pertains to this study within their own track. When analyzing data for individual questions from the pre-test, several were found to have significant differences (Table19).

Table 19. Correct Responses (%) on the Horticulture Knowledge Pre-Test at the 2011 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
							% correct									
Treatment	52	45	42	79	56	53	45	64	33	34	91	78	84	67	19	68
Control	56	43	45	75	51	50	64	68	27	33	82	60	60	53	17	55
Significance	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	*	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.	N.S.

N.S. =no significance *=pvalue≤0.05 **=pvalue≤0.005 Q=question

Significant differences were found for questions seven, eight, and thirteen. These questions pertained to composting, vermiculture, and photosynthesis respectively. The control group had a higher score on questions pertaining to composting and vermiculture perhaps because of chance decisions. This indicates that there was no bias when choosing students to participate in the individual tracks. We found significant differences in the post-test between

treatment and control group correct response averages for all questions except 4, 5, 6, 7, and 9 (Table 20).

Table 20. Correct Responses (%) on the Horticulture Knowledge Post-Test at the 2011 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo-synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	…..…….……% correct……..…..……															
Treatment	60	61	87	77	83	42	63	80	44	45	90	74	86	75	35	67
Control	43	36	32	68	59	45	67	64	51	31	77	51	64	49	13	46
Significance	*	*	***	N.S.	N.S.	N.S.	N.S.	*	N.S.	*	*	*	**	***	*	*

N.S. =no significance *=pvalue≤0.05 **=pvalue≤0.005 ***=pvalue≤0.0005
Q=question

Participants from the treatment group had a larger number of correct responses than the control group except for questions 4, 6, and 7 though these differences were not significant. These questions pertained to warm season vegetables, types of soil, and composting respectively. This suggests that participants in the treatment group, those that received the lessons learned more horticulture knowledge than those students not in the track. Both questions for lesson one, lesson six, lesson seven and lesson eight had a higher correct response average than that of the control group suggesting that these lessons were more effective than those with only one or neither question significantly higher.

When analyzing data for the treatment group alone we found that only question's 2, 3, 5, 7, 8, and 15, had a significantly higher average score on the post-test than on the pre-test(Table 21).

On every question except questions 4, 6, 11, 12, and 16 the treatment students had higher scores on the post-test than the pre-test. None of these instances are significant as the difference between averages is very small. These questions pertain to warm season vegetables, types of soils, pollination, and honey production. For this year of the study only Lesson 4, recycling, had

Table 21. Correct Responses (%) on Horticulture Knowledge Test for Treatment Group at the 2011 4-H Summer Camp.

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo-synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	…....……..……%correct……..…..……															
Pre-test	52	45	42	79	56	53	45	64	33	34	91	78	84	67	19	68
Post-test	60	61	87	77	83	42	63	80	44	45	90	74	86	75	35	67
Significance	N.S.	*	***	N.S.	***	N.S.	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S	**	N.S.

N.S. =no significance *=pvalue≤0.05 **=pvalue≤0.005 ***=pvalue≤0.0005
Q=question

a significantly higher average score on the post-test than the pre-test suggesting this was the most effective lesson. This could be due to changes in the teaching style, and also less time spenton lectures. Lessons were altered to provide a more hands-on approach and students may have been focusing more on having fun rather than learning. When analyzing the data from the control group, significant differences were only found for questions 1, 3, and 9. Out of these questions, only question 9 had a higher post-test average than pre-test average (Table 22).

Table 22. Correct Responses (%) on Horticulture Knowledge Test for Control Group at the 2011 4-H Summer Camp

	Propagation		Victory Garden		Soils		Recycling		Plant Parts		Pollination		Photo synthesis		Insects	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	…....……..……%correct……..…..……															
Pre-test	56	43	45	75	51	50	64	68	27	33	82	60	60	53	17	55
Post-test	43	36	32	68	59	45	67	64	51	31	77	51	64	49	13	46
Significance	*	N.S.	*	N.S.	N.S.	N.S.	N.S.	N.S.	***	N.S.	N.S.	N.S.	N.S	N.S.	N.S	N.S.

N.S. =no significance *=pvalue≤0.05 ***=pvalue≤0.0005 Q=question

This question pertained to water uptake in the plant. As the participants for the control group were chosen from the Wetlands track, it is possible they learned this information in their own track. The majority of the questions had a higher pre-test average than post-test average except for questions 5, 7, 9, and 13 which of these only 9 was significantly higher.

Discussion of Year One Confidence Analysis

Data from the confidence portion of the exam was reported by converting data into a binary system. Responses from the pre-test were subtracted from the post-test for each participant. If the participant gained confidence from the pre-test to the post-test, a positive difference, the data was represented as a 1. If the participant did not change their response or lost confidence from pre-test to post-test the differences was represented as a 0. Each difference was averaged together for each treatment and reported for each question. If the difference is represented at a negative value, the average confidence is less on the post-test than on the pre-test. The data was analyzed using a logistic procedure PROC LOGIT and data was taken from the Odds Ratio Estimate Table. The model for the data (Q1Post=Treatment Q1 Pre) tested the effect the treatment, control or treatment had on the response. Q1 Pre was used as a continuous covariate as the pre-test response and post-test response are correlated from participant to participant. The data presented in the estimate row is the odds ratio that confidence increases from the treatment group to the control group. A value less than 1 is interpreted as a decrease in confidence from treatment to control and a value greater than 1 in interpreted as a gain in confidence from treatment to control. A value is interpreted as significant if the 95% confidence contains 1. The confidence portion of the exam contained questions pertaining to the confidence in being able to plant a seed, explaining to others how to plant a seed, growing multiple plants, and growing a plant successfully to maturity. The average treatment group participant gained confidence from the pre-test to the post-test versus the average control group participant losing confidence for each but the first question (Table 23).

The Confidence questions asked of the participants were: How sure are you that you can plant a seed that will grow into a small plant (Q1), how sure are you that you can explain to your

Table 23. Differences in Confidence from Pre-test to Post-test for Participants at the 2010 4-H Summer Camp

	Q1	Q2	Q3	Q4
Treatment	0.1688	0.1039	0.1429	0.0519
Control	0.0455	-0.2045	-0.1364	-0.0682
Estimated Difference	0.52	0.32	0.18	0.45
Significance	N.S.	*	**	N.S.

N.S. = no significance *=pvalue≤0.05 **=pvalue≤0.005
Q=question

friends how to grow a plant (Q2), how sure are you that you can grow more than one kind of plant (Q3), and how sure are you that you can grow a plant that produces a vegetable or food you can eat (Q4). Garden confidence was gained significantly by the treatment group in relation to the control group for questions 2 and 3. Question 2 asked participants how confident they were that they could plant a seed that would grow into a small plant and question 3 asked participants how confident they were that they could explain to a friend how to grow a plant. Though participants gained confidence in planting a seed and growing a plant to maturity in relation to the participants of the control group this relation was not significant. Data being non-significant may be due to the manner in which data was converted to fit the procedure used to analyze the data.

Discussion of Year Two Confidence Analysis

Data collected from the second year of this study was analyzed and reported using the same methods as the first year of this study. Significance was found only in the relationship between the treatment and control groups' confidence levels for the first question (Table 24).

Each week the treatment group gained confidence from the pre-test to the post-test whereas the control group only gained confidence for questions 2, 3, and 4. The control group gained less confidence than the treatment group for these questions but not at a significant level.

Table 24. Differences in Confidence from Pre-test to Post-test for Participants at the 2011 4-H Summer Camp

	Q1	Q2	Q3	Q4
Treatment	0.2419	0.2016	0.0927	0.0887
Control	-0.0875	0	0.0375	0.0250
Estimated Difference	0.38	0.74	0.76	0.79
Significance	*	N.S.	N.S.	N.S.

N.S. = no significance *=pvalue≤0.05 **=pvalue≤0.005 Q=question

Discussion of Year Two Short Answer Question

In the second year of this study a short answer question was added to both the pre-test and post-test. This was to determine if participants in the Victory Garden Track could comprehend the information presented rather than just testing memorization. Comprehension is the second level of Bloom's Taxonomy, a categorization of learning objectives within education. In the analysis of the short answer question added to the second year assessment, we found that overall students in both the control group and the treatment group answered the pre-test question with one response and/or incorrectly. However on the post-test, treatment group students answered with two or more correct responses. This suggests that participants in the treatment group were able to comprehend the question more fully than the control group after receiving the Victory Garden track lessons.

Chapter 5 Conclusions

Results indicated that the addition of a gardening curriculum to a summer camp significantly increased science knowledge of participating students by 17% points the first year and 11 percent points the second year in most of the topics presented. These results are similar to results found in other research of garden programs (Smith and Motsenbocker, 2005; Klemmer et al., 2005a). The addition of an assistant the second year of the study could have accounted for a smaller change in scores. The assistant wanted campers to spend more time on the garden areas rather than working on other lessons. This meant that some lessons had to be shortened to make up the loss of time. The lessons also helped develop students' analytical and deductive reasoning skills through the use of short answer query.

Lessons and experiences gained throughout the program also increased students' confidence of growing and maintaining a garden. The students in the treatment group were significantly more likely than the students in the control group to be confident that they could explain to a friend how to grow a plant and that they could grow more than one plant after participation in the lessons. Hopefully this increased confidence in gardening will allow students to feel comfortable in establishing their own gardens for their families, their schools, or their communities. The results of these lessons could lead to the development of a Junior Master Gardener Program in Louisiana. Junior Master Gardeners can be a valuable resource for 4-H agents and other LSU AgCenter staff as they work with community and school groups to establish gardens.

The timing for this track, only nine hours, was a very short time to present the topics for optimal comprehension by students. Each topic could be expanded into a full set of lessons and activities to help students better understand the concepts. It is also more likely to increase

application of gardening concepts so that they become valuable life skills for participants. If the lessons were expanded the long-term memory effects could be studied as well.

Childhood obesity in Louisiana is a growing problem. In the 2008-2009 school year 13,000 school aged children were surveyed and almost 50% were overweight and of that 50%, 30% were obese. Childhood obesity has been linked to hypertension and diabetes as well as many other serious diseases. Adding a nutrition component to these lessons could benefit not only overweight and obese children but help all participants stay healthy. The inclusion of a nutrition component to gardening lessons is proven to increase the likelihood that students will eat healthy fruits and vegetables (McAleese and Rankin, 2007; Morris and Zidenberg, 2002; Auld et al., 1998).

Expanding this Victory Garden program into after-school and regular school curriculum would create valuable opportunities for research across the state of Louisiana. This program has the potential with additional research to benefit not only students' science knowledge, but also their math, geography, reading comprehension and environmental attitudes. With current trends tying teacher effectiveness to student achievement, a school gardening program will offer schools alternative teaching strategies to educate students who have difficulty learning in the traditional classroom settings.

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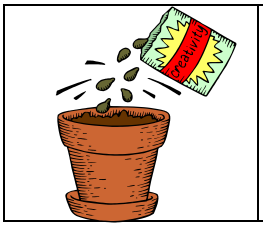
Appendix

Appendix A Lesson Plans



Propagation

Lesson 1

Grade Level:
4-6

Duration:
30 min

Setting:
Outdoor classroom and in the garden area

Vocabulary:
propagation, seeds, germinate, cutting, node, division, layering

Focus/Overview

Propagation means making new plants from older ones. This lesson will provide students the opportunity to see demonstrations of the most frequently used forms of propagation. Students will practice the propagation techniques of planting seeds and stem cuttings.

Learning Objectives

The learner will:

Learn several methods in which plants are propagated

Learn to propagate plants by direct seeding and stem cuttings

Louisiana Grade Level Expectations

4: GLE-46 Describe how some plants can be grown from a plant part instead of a seed. (LS-E-B1)

Materials List for Twenty Campers

-student worksheet (see Appendix B)

-seeds (sunflower, beans, peas, etc.) two to three per participant

-potting soil (about 3-4 cups per camper)

-40 6-inch pots (two per camper)

-stock plants for cuttings (i.e. Mint, Pothos Ivy, English Ivy, Rosemary etc.) Small plants can accommodate 2-3 campers larger more established plants can accommodate 20 campers

-scissors or pruning shears (younger campers will need cutting taken for them. Older campers can share scissors)

-labels two per camper

-permanent Markers for writing on the labels

Background Information

Seeds should be planted twice as deep as they are wide. Small seeds like tomato or lettuce should be placed on top of the soil and sprinkled with a small amount of potting soil. Large seeds like sunflowers must be planted deeper. Some cuttings need rooting hormone, but most will grow on their own even though it is not as fast. Cuttings should be planted two nodes below and two nodes above the ground. A node is the growing part of a plant, where the leaf and bud are located. Cuttings are taken when plants do not produce viable (living) seed or when using a seed is not an option. Some plants are propagated by cuttings because this practice is much faster for growing a larger plant. If the space between two nodes (the internode) is very long such as ivy, a cutting that is only two nodes long can be used. Plants with very short internodes should be cut to 3-4 inches long.

Advance Preparation

Gather all seeds and stock plants before the lesson begins. If possible arrange an area outdoors for this activity as working with potting soil can be messy.

Procedure for Lesson 1 Propagation

1. Ask the students if they have ever propagated anything. Either by seed or some other method. Describe the way that plants are propagated. Explain how seeds are planted and that they need water and oxygen to grow. However, not all seeds need light to grow. Some cannot grow when there is light.

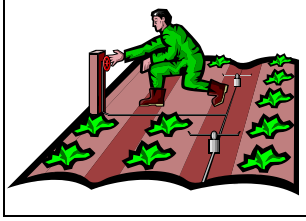
2. Allow the students to plant seeds. Show them how to plant a seed twice as deep as its width and cover lightly with soil.
3. Explain why cuttings are sometimes used instead of seeds and describe the process.
4. Allow the students to take and plant their own cuttings. Remind them to cut a piece of plant four nodes long, explaining what a node is. The leaves from the lower nodes should be cut or gently pulled from the stem being careful to no damage the stem. If the cutting has very large leaves cut them in half leaving the area closest to the stem. Instruct them to place the cutting two nodes below the soil line and two nodes above. (disregard this if internodes are very long or very short and plant at least half of the stem below the soil.
    a. Make a label for each pot with the camper's name, the name of the plant, and the day it was planted.
    b. Place the two pots indoors near but not in full sunlight and water frequently. Do not allow the soil to dry out.

Follow up

Over several days and weeks have campers check the growth of their new plants. The first thing campers will see is the stem poking through the soil. Two seed leaves will open and soon true leaves will develop. After the seed has rooted thoroughly the new plant can be planted in a larger container or in a garden. The cutting will take anywhere from a few days to several weeks to fully root. Campers can check the progress by gently tugging on the stem. When most of the soil stays with the cutting it can be planted in a larger container or in a garden.

Adapted from:

JMG Kids. 1999. Propagation Demonstration. Junior Master Gardner Teacher/Leader Guide. p21.



Victory Garden

Lesson 2

Focus/Overview

Grade Level:
4-6

Duration:
1-2.5 hr.

Setting:
Outdoor classroom and Garden Area

Vocabulary:
Victory Garden, fertilizer

The Victory garden lesson allows the students to learn the purpose of a Victory Garden and where their food comes from. They will learn the requirements for plant survival such as water, sunlight, and nutrients. They will also learn about proper spacing of plants for optimum growth. Students will learn of the different types of gardens such as in ground, raised beds, and handicap accessible

Learning Objectives

The student will

Learn the purpose of a Victory Garden

Learn how to install a Victory Garden

Louisiana Grade Level Expectations

4: GLE-47 Sequence stages in the life cycles of various organisms, including seed plants. (LS-E-B2)

4: GLE-50 Explain how some organisms in a given habitat compete for the same resources. (LS-E-C1)

Material List for Twenty Campers

-student worksheet (see Appendix B)

-raised garden beds (see Appendix C for building instructions)

-seeds (Watermelon, cantaloupe, beans, peas, etc. whatever is appropriate for the climate)

-transplants (Tomatoes, peppers, etc. whatever is appropriate for the climate)

-bamboo or tomato cages

-string for use with bamboo

-labels, enough to label types of plants

-markers for labeling

-5 rakes

-5 shovels

-5 hoes

-wheelbarrow

-20 spades

-fertilizer (13-13-13 granular) amount based upon plant needs

Background Information

Victory Gardens were introduced during World War II. Families began to plant their own gardens so that commercially grown produce could be sent overseas to fighting troops. Some plants are better started as seeds indoors then transplanted into the garden after the last frost. Others do better directly seeded into the ground. Spacing is a very important part of gardening. If plants do not have enough room to grow the quantity and quality of the produce will be affected. Seeds take on water and oxygen and swell until they crack open and begin to sprout. In Louisiana and in other parts of the country types of plants are separated into warm season and cool season. Warm season plants are usually sown indoors and planted after the last frost. Cool season plants cannot handle the hot Louisiana summers and are grown from Fall to Spring. Fresh

produce from home gardens is usually considered to be healthier than produce purchased from a store. Gardens can also provide exercise due to the maintenance they need.

Advance Preparation

There is much preparation needed to install a garden. Soil samples must be taken to test soil pH and fertility. Use the method described in Lesson 3. Glyphosate should be sprayed over the entire area two weeks before tilling to kill any grass or weeds. In ground beds should be tilled adding any fertilizer or amendments needed for the garden and covered until put into use. Each garden is unique, and the amendments needed for the garden will depend on the soil analysis results. A tiller should be used to work (loosen) the soil at least 12 inched deep. The land should be hipped into rows either using a tiller or by hand. If by hand, spade should be used to pull soil towards you into a row. Beds for children's gardens should be no more than 3 feet wide and 8-12 inches high. The row middles should be a least 3 feet wide and 5ft wide if they are to be wheelchair access. See Worksheet 2 for full instructions on creating a garden. If using raised bed, build following the instructions in Appendix C or by researching other designs. First kill grass in area to be used, then lay ground cloth to hinder the growth of weeds. Place the raised beds over the ground cloth and fill with purchased planting soil. Seeds for transplants should be sowed 6 weeks before the planting date. If beans are planted that need climbing support, students should build teepees to support them. See student diagram for instructions. All of these steps can be done with the help of campers or before campers arrive. If all plantings are completed before campers arrive, there will still be plenty of work for them as well as the rewards of fresh produce.

Procedure

1. Ask if campers have ever grown their own garden at home. Explain to the students the benefits of growing their own vegetables, and walk them through the process of planting

their own garden. Explain how seeds take on water and oxygen and swell until it cracks and the new plant can begin to sprout.

2. Instruct the students to use the wheel barrows and shovels to fill their raised beds and plant the tomato and pepper transplants and bean and peas seeds. Help the students construct teepees for the beans and stake the tomatoes.
3. If campers are still in attendance at harvest time, have them harvest the produce and prepare it in many ways. (raw, steamed, fried, etc.)

Resources

Louisiana Planting Guide <http://www.lsuagcenter.com/en/lawn_garden/home_gardening/vegetables/home_garden_crops/Louisiana+Vegetable+Planting+Guide.htm>

Get the Dirt On Your Dirt

Lesson 3

Grade Level: 4

Duration: 30 min for the lesson 48 hours to see results

Setting: Outdoor classroom

Vocabulary: sand, silt, clay, loam, particle, soil, pore

Focus/ Overview

In this lesson the student will learn how everything in the world relies on soil. Soil has many different properties and sections of soil can vary within feet of each other. Soil is made up of three different particles that vary in amounts depending on the location of the soil.

Learning Objectives

The student will:

Learn the different parts of soil

Learn the different soil particles

Learn about soil texture

Learn about the different properties of soil

Louisiana Grade Level Expectations

4: GLE-56 Investigate the properties of soil (i.e. color, texture, capacity to retain water, ability to support plant growth) (ESS-E-A1).

Materials List for Twenty Campers

-student worksheet (see Appendix B)

-4 different soil samples about 2 cups each

-8 cups water

-4 quart jars

-4 permanent markers

-4 liquid measuring cups

-4 small bowls

-4 rulers

Background Information

This experiment could take anywhere from 30 minutes to 24-48 hours for the soil to completely separate. The different sized particles of soil are sand, silt and clay. Sand is 2 - 0.05mm in diameter and feels gritty to the touch. Silt is .05-.002 mm in diameter and feels like flour to the touch. Clay is the smallest particle at less than .002 mm in diameter and feels sticky when it is wet.

Advanced Preparation

The soil samples should come from different areas so they are different enough to show variability.

Procedure

1. Ask the campers if they know what the different parts of soil are. Explain what they are and how there are four components of soil and show them the diagram. Compare a sand particle to a basketball as it is the largest. Compare the silt particle to a softball in relation to the sand. Compare the clay particle to a small rubber ball in relation to the other particles.
2. Split the campers into four groups and give each group a small bowl with a different soil sample. Tell them to move the soil around with their fingers and ask them to describe how the soil feels. Tell them to take a small pinch in the small of their hand and add a few drops of water. Rub the soil in their hand until it forms a long ribbon. Ask them what

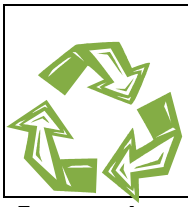
happens to the ribbon? Does it form or does it fall apart? Does it separate easily or stay in a ribbon. Explain that ribbons that don't form the sample are full of sand, if they fall apart easily they have more silt, and if the ribbon stays mostly together it is mostly clay. This is because sand particles are very large and do not stick together very well. Silt particles are smaller and fit together better but still leave some space between them. Clay particles are the smallest and fit together almost like puzzle pieces with very little space between them.

3. Give each student a jar and tell them to write their name and their soil sample number on the lid of the jar. Tell them to put one cup of soil and two cups of water and screw the lid on tightly. Instruct the student to shake the jar for one minute and then place it on the table in front of them. Through the next 24-48 hours keep a watch on the jars until all the soil particles have settled. Have the students measure the height of each layer then use the conversion chart to figure the percentages of each. Show them the soil triangle and help them find their soil.
4. Explain how the different percentages of particles give each soil unique properties such as color, texture, water holding ability etc. ask them if they have any questions. Inform the students that a soil with a mixture of all three, called loam is the best soil for growing plants. This is because it holds water long enough for plants to use it, but drains easily so oxygen can reach the roots as well. Since it does contain some clay, the loam soil holds nutrients well.

Adapted from:

JMG Kids. 1999. Mud Pies. Junior Master Gardner Teacher/Leader Guide. p26.

JMG Kids. 1999. Shake, Rattle and Roll. Junior Master Gardner Teacher/Leader Guide. p26-27.



Recycle, Reduce, Reuse

Lesson 4

Grade Level:
4-6

Duration:
2 hours split up into two sessions if needed

Setting:
Outdoor Classroom and Compost Area

Vocabulary:
compost, heat energy, moisture content, evaporation, condensation, precipitation, collection, recycle, reduce, reuse

Focus/Overview

The compost lesson will teach students the benefits of recycling waste to improve their garden. It will teach the students an easy way to reduce the amount of waste in landfills by composting them. This project gives students hands in knowledge about environmental stewardship. This lesson will also give students a brief introduction to the water cycle.

Learning Objective

The student will:

Learn how a compost pile works

Learn a brief synopsis of the water cycle

Learn the best processes for composting

Work with others on an environmentally friendly project

Louisiana Grade Level Expectations

4: GLE-58 Draw, label, and explain the components of a water cycle (ESS-E-A3)

5: GLE-51 Describe naturally occurring cycles and identify where they are found (e.g., carbon, nitrogen, water, oxygen) (SE-M-A7)

6: GLE-45 Describe methods for sustaining renewable resources (SE-M-A6)

6: GLE-46 Identify ways people can reuse, recycle, and reduce the use of resources to improve and protect the quality of life. (SE-M-A6)

Materials List

-student worksheet (see Appendix B)

-compost bin

-pitch fork

-leaves, grass clippings, hay, and food scraps

-fertilizer

-thermometer

-pH indicator strips

-blender

-paper scraps

-water

-seed

-cookie cutters

Background information

Using the directions provided, familiarize yourself with water and carbon cycle and building a compost bin. If the compost bin is already provided, be able to assist the students with layering the waste materials, fertilizer, water, and soil. Repeat the layers of soil, leaves, grass, and food scraps; water; and fertilizer. Repeat this until you are out of scraps or your bin is 3/4's full. See student worksheet for a diagram. Larger piles compost faster, Compost works through heat energy. As the microorganisms in the compost break down the organic matter they will give off heat. This is why the compost heats up. Temperatures in the middle of the pile can reach upwards of 150 degrees. If the pile becomes too hot, use a shovel to flip it, allowing oxygen to reach the middle of the pile. Add water if the pile is too dry. If a handful of compost forms water

when squeezed then it does not need added water. Do not add meat, dairy or manure to the compost pile. These will eventually degrade but they will cause your compost to give off a bad odor and will attract nuisance wildlife. The pH of the compost should be check as well. pH ranges from 0-14. Less than 7 is considered acidic, and more than 7 is considered basic. A pH of 7 is neutral.

Advance Preparation

Build the compost bin using the instructions in the student handout.

Gather the compost materials. (leaves, grass clippings, and food scraps)

Bring buckets of water for the compost if there is no water source close by.

Collect newspapers or regular paper to be made into the recycled ornaments

Procedure Composting

1. Ask the students what they think of the importance of composting
2. Have them read aloud, or read to them the student handout.
3. Show the students the thermometer and pH indicator strips they will be using and explain where they will be used.
4. Explain the squeeze test
5. Explain that some materials cannot be composted and ask the students what they think these materials are.
6. Move to the composting area and have your students begin layering the pile, explaining each layer as they build.
7. Explain the temperature and pH chart and ask a student to write the values each week.
8. Keep the chart, thermometer, pH strips and color chart all in the same spot to keep them from becoming lost.

Procedure Recycled Ornament

1. Ask the students if they've ever recycled anything.
2. Tell them that instead of throwing away newspapers and other old papers they can reuse them to make a functional and pretty ornament.
3. Explain that they are going to tear paper into small pieces and then blend them with water to make their ornaments. Pour about half a cup of the paper mixture into a small bowl for each student, Take around a box of food coloring and add one or two drops of color to each student's bowl if they wish. Tell them to spoon a bit into their cookie cutter and press down to flatten it and remove some of the water. Give them some small seeds (a wild flower mixture works great) to sprinkle over the top of their ornament. Then they should add another small spoonful of paper mixture over the seeds, flattening this layer over the seeds. They can remove the ornament to a place outside to dry. They can reuse their ornament and plant it in the ground.

Procedure Water Cycle

1. Show the students the simple water cycle provided with the lesson. Walk them through the water cycle as it moves through the clouds, into rain, collecting in water bodies, then evaporating into the sky again to become rain.
2. Have all the students stand up to act out the water cycle First they are a water droplet floating in the clouds(have them sway side to side). Then, all of a sudden they fall to the earth as rain (have them sit on the carpet) Then they run along the ground until they all collect in a puddle (have them all scoot along the floor until they are in a large group.) Then the sun comes out (stand over them as the sun) and they begin to evaporate into the sky (stand up and stand behind the sun). Until they form into their cloud, condense, (have them stand in a loose

group). This completes the water cycle. (If you have students that are older you can read them the story of Wally the water drop. (to be made up later)

3. Have the students take their seat and give them the water cycle worksheet and have them fill in the blanks with the Water Cycle Words.

Adapted from:

JMG Kids. 1999. Building Bins and Compost Sandwiches. Junior Master Gardner Teacher/Leader Guide. p31

JMG Kids. 1999. Grow Cards. Junior Master Gardner Teacher/Leader Guide. p63.

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Parts of the Plant

Lesson 5

Grade Level:
4

Duration:
45 minutes

Setting:
Outdoor classroom

Vocabulary:
primary root, secondary roots, root cap, root hairs, terminal bud, lateral bud, leaf scar, node, internode, lenticels, petiole, midrib, xylem

Focus/Overview

The purpose of this lesson is to teach the students the basic parts of a plant and their functions. The student will be able to pair the vegetable they eat with the different plant structures. Students will also gain a simple knowledge of water uptake in plants.

Student Objectives

The student will:

Have a basic knowledge of the parts of the plants and their functions

Recognize vegetables and different parts of a plant

Understand water uptake

Louisiana Grade Level Expectations

3: GLE-36 Compare structures (e.g., roots, leaves, stems, flowers, seeds) and their functions in a variety of plants (LS-E-A3)

4: GLE-40 Explain the functions of plant structures in relation to their ability to make food through photosynthesis (e.g., roots, leaves, stems, flowers, seeds) (LS-E-A3)

Materials List

-student worksheet (see Appendix B)

-fresh examples of fruit and vegetables (one or two examples for each plant part)

-knife to cut them open

-laminated pictures of fruits and vegetables

-white flowers (daisies, carnations, etc.) or celery

-water (amount depends on size of glass)

-2 glasses or vases

-red or blue food coloring

Background Information

Know the difference in botanical fruits and vegetables and social definitions of fruits and vegetables. A fruit is anything that has the ovarian tissue surrounding a seed. A vegetable is any food that comes from the leaves, roots, or stems.

Advanced Preparation

Have your chosen fruits and vegetables printed and laminated for durability. Cut the flowers and prepare the three glasses of water, food coloring, and flowers ahead of time only if you do not have at least 24-48 hours.

Procedure for Parts of Plants

1. Ask the students if they can name the parts of the plants. Keep prompting them until they've named stems, roots, flowers, leaves, fruits and seeds.
2. Explain the different parts of each component.
3. Add 5 drops of food coloring to one of the glasses of water. Place one flower in a glass with clear water and one in the glass with colored water. Show the students the flowers and explain how the xylem takes up water and moves it through the plant.

4. Show them actual examples of the fruits and vegetables and ask them if botanically it is a fruit or vegetable. Cut open the examples to show if it is a fruit or vegetable.(i.e. true fruits will have seeds whereas true vegetables are leaves, stems, roots, or flowers of a plant)
5. Show the students laminated pictures of food. Ask them which part of the plant each food comes from then place it on the food web where it belongs.
6. Have the students observe the plants from step three to see the flowers take up water.

Adapted from:
JMG Kids. 1999. Plant Parts We Eat. Junior Master Gardner Teacher/Leader Guide. p9.

Pollination

Lesson 6

Focus/Overview

The purpose of the pollination lesson is to provide the students with basic knowledge of flower and seed structures. It will also help the students understand the process of pollination, and seed dispersal.

Student Objectives

The student will

Learn the basic structures of seeds and their functions

Learn the basic structures of flowers and their functions

Understand the process of pollination

Learn the different methods of seed dispersal

Grade Level:
4

Duration:
30 minutes

Setting:
Outdoor Classroom and large area for relay race

Vocabulary:
stigma, style, filament, anther, petal, sepal, pollen, pollen tube, ovary, pericarp, cotyledon, endosperm, micropyle, pollination

Louisiana Grade Level Expectations

4: GLE-45 Identify reproductive structures in plants and describe the functions of each (LS-E-B1).

Materials List

-felt or cardboard Flowers

-easel

-Velcro® or other similar hook and loop fabric

-yellow table tennis balls

-orange cones or flags

Background Information

Flowers are made up of many parts. The sepal is what protects the flower before it is open. The petals attract insects for pollination purposes. The stigma is the female receptor to the pollen, and the style is the stalk that holds up the stigma. The anther is the male part of the flower that holds the pollen, and the filament holds up the anther. When pollen reaches the stigma, a pollen tube forms down to the ovary, the pollen forms with the ovule, and the seed begins to form. Surrounding the seed is the pericarp, which is made up of the outer, middle, and inner layers. The plant embryo is surrounded by the endosperm which is the food source, much like the egg yolk is for a chicken embryo. The micropyle is the tiny pore that seeds use to take on water to begin the sprouting process. To begin the cycle of pollination, an insect, usually a bee, circles a flower and takes the nectar for food for the hive. In the process, pollen is collected in the bees, fuzz and carried to the next flower where it brushes onto the stigma. Bees do not fly in a straight pattern, but instead fly in circles looking for the next flower. Seed dispersal can be accomplished by wind, water, gravity, and animal dispersal. Some plants can even shoot their seeds a distance away.

Advanced Preparation

The large flowers should be printed on a tough paper or made out of felt. Velcro should be applied to the ping pong balls and the ping pong balls applied to the flowers. The cones or flags should be set up prior to the lesson beginning. Set up the cones in a random pattern and tell the students to round the cones as they approach them.

Procedure for Pollination Lesson

1. Ask the students if they have ever taken apart a flower to look at the different parts. Show them the diagram of the flower and give them their own copy. Point out the different parts of the flower and explain what they do, as you have each student fill in the names of each part on their own sheet. Show the students the diagram of the seed and explain each part and its function as they fill in their own worksheet. List the ways that seeds are dispersed and give examples of each. See included chart for examples. Explain to the students to process of pollination.
2. Lead the students to the obstacle course. Show them the path you want them to take. Explain the process again as you show them through the obstacle course.

Adapted from:

Illuminat. A Closer Look at Plants. <http://www.caribbeanedu.com/kewl/science/science00.asp>

Photosynthesis

Lesson 7

Grade Level:
5

Duration:
30 minutes

Setting:
Outdoor Classroom

Vocabulary:
photosynthesis, stomata, chlorophyll, xanthophylls, anthocyanins, carotenes

Focus/Overview

The purpose of this lesson is to help the students gain an understanding of the Photosynthesis process. Students will learn why leaves are green and why leaves turn colors in the fall. This lesson will also teach the students about the different pigments in leaves.

Student Objectives

The student will

Understand the process of photosynthesis

Learn the different pigments in the leaves and their functions

Learn that plants are a very important to our health and wellbeing from the oxygen they provide and the chemicals they remove.

Louisiana Grade Level Expectations

5: GLE-19 Describe the processes of photosynthesis and respiration in green plants (LS-M-A4)

Materials List

-crayons or markers

-drawing paper

-diagram of photosynthesis

Background Information

The chemical formula for photosynthesis is $6CO_2 + 6H_2O + \text{Energy} \rightarrow C_6H_{12}O_6 + 6O_2$. This formula can be read as "Six Carbon Dioxide molecules plus six water molecules in the presence of light will form one molecule of glucose (sugar) and six molecules of Oxygen. Leaves take up water from the roots and carbon dioxide through their stomates .These two combine with light in the chlorophyll molecule and recombine to make sugar and the byproduct of Oxygen. The oxygen is released back through the stomates and the sugar is stored in the plant to be consumed at a later date. The different pigments in a leaf are chlorophyll which is green. Xanthophylls which is yellow, Anthocyanins which are purple and red, and Carotenes are orange. Chlorophyll is used in Photosynthesis. Carotenes which are orange help absorb energy and pass it on to chlorophyll. Xanthophylls are related to Carotenes and help modify the levels of light that chlorophyll receives. Anthocyanins are what give fruits and flowers their color, and have shown to act as a sunscreen for leaves to keep the leaves from reacting to high light stress.

Advance Preparation

If possible collect old leaves before they fall off a tree or shrub to show the different colors of leaves.

Procedure Photosynthesis

1. Ask the students if they know what Photosynthesis is or if they know the formula. Explain the process and formula to the students. Show the students the diagram of Photosynthesis as you explain. The carbon dioxide for photosynthesis comes from the air, so have them draw arrows to the leaf on their worksheet that is gray. Roots send water from the soil up into the leaf through the stem and veins, so have them color the veins blue. Energy come from the sun so have the students draw a sun and yellow arrows into the leaf. Explain that this process

happens in the chlorophyll in the leaf and since chlorophyll in green, leaves are green and have them color the rest of the leaf green. Oxygen is released from the leaf because they do not use it, so have the student s draw an arrow red.

2. Explain the presence and purpose of the other pigments and have the students color in a blank leaf. Remind them that chlorophyll is green so color some of the leaf green. Explain that Xanthophylls help regulate the levels of energy that chlorophyll absorbs and are yellow so color parts of the leaves yellow. Explain that Anthocyanins give the plants sunscreen to help block some of the sun, and are red and purple so color some of the leaf the same colors. Have them also draw flowers or fruit in the same color if they wish. Explain that Carotenes which are orange and give carrots their color help the chlorophyll get more energy by absorbing some and passing it to the chlorophyll. Have them draw a carrot if they wish.

Adapted from:
Photosynthesis lesson plan created by Kathryn Fontenot

Garden Friends and Foes

Lesson 8

Grade Level: 5
Duration: 30 minutes
Setting: Outdoor Classroom
Vocabulary: siphoning, proboscis

Focus/Overview

There are many animals that are beneficial and harmful to a garden. This lesson will teach students how to recognize the difference in beneficial and harmful insects.. The students will also learn the different ways that insects chew to destroy their plants

Student Objectives

The student will

Learn how to recognize beneficial and harmful insects

Learn the different mouthparts or insects

Louisiana Grade Level Expectations

5: GLE-28 Explain and give examples of predator/prey relationships (LS-M-C4).

Material List

-small chewable candies

-unopened juice boxes

-paintbrush for each student

-small bowl of sugar for each group

-small glass or bowl of water for each group

-party blowers for each student

-real insect specimens or pictures of the different beneficial and harmful insects

Background Information

Some insects use a tearing/chewing motion for eating plant tissue. This looks somewhat like a bite taken out of a cookie. Other insects use a piercing/sucking motion to remove the sap from the cells. This causes a spotting effect since the surrounding cells die with no sap. Insects like butterflies and moths, have a siphoning mouthpart that is very similar to the piercing sucking. However, they take nectar from flowers rather than leaves. This specialized mouthpart is called a proboscis and stays rolled up while not in use. Sponging mouthparts belong to insects like flies. The end of the proboscis it blunt and flat. Flies cannot suck up food so they must wet the food to soften it to be able to consume it. This is why flies are considered one of the dirtiest pests because they can transfer bacteria to clean surfaces. However these insects are important because they are the second most vital pollinators. There are many beneficial and harmful insects that are found in the typical garden. See attached chart for examples and their types of mouthparts.

Advanced preparation

If you would like to use real specimens to show your students, you can contact your local Extension Office to ask about obtaining sample, or have the students collect their own insects to study. Pour the sugar and water into separate bowls ahead of time. If possible cool the juice boxes before giving them to the students.

Procedure

1. Ask the students if they have ever caught any insects for a collection OR ever killed any insects. Ask them if they know the difference in beneficial and harmful insects. Pass around the real specimens or show the students pictures are you list insects of each kind. Tell students that some of the insects are beneficial because they eat the bad insects or

they provide some sort of service to the plants. Inform them that there are four types of beneficial insects. Predators, Parasites, Pollinators, and Poopers. Explain each type of beneficial insect.

2. Predators eat other insects, some examples are Ladybugs, praying mantids, dragonflies and spiders.
3. Parasites destroy pests by laying eggs on or inside the pest. When the eggs hatch the larvae eat the pest for food. Most parasitic insects are very small. Many wasps are parasitic
4. Pollinators are animals that carry pollen from flower to flower. These insects include butterflies, bees, and wasps
5. Poopers are also known as decomposers help recycle in your garden. They eat digest and poop dead plant material. This way, nutrients in the plant are returned to the soil. Some examples are worms, pillbugs, and dung beetles.
6. Explain that some insects are known as pest insects. These are insects that feed on plants and kill them or harm them enough that they can't grow properly. Give some examples of these insects. See included chart for examples.
7. Ask the students if they know how insects eat? Describe each mouthpart as the students act them out.
8. Have students put their fists against their cheeks and stick their pinkies out. Place in front of them a few small candies like M&M's or Skittles and have them try to pick them up one by one with their pinkies and try to put them in their mouths. Give examples of insects that have chewing mouth parts.

9. Next give each student a small juice box and have them put the straw in their mouth. Have them try to open the juice box just with the straw and explain that piercing sucking insects can't use their hands to open the leaf so they can get the juice out. Give examples of these insects. Allow students to open their juice boxes with their hands if are still having trouble.
10. Inform the students that some insects have tongues that stay rolled up until the insects are ready to eat. Give each student a party blower and tell them to blow into until it unrolls. Allow them to blow into the noisemakers a few times.
11. Explain that some insects have mouths like sponges. They cannot inhale their food dry. Give each student a paint brush and each group a bowl of sugar and a bowl of water and tell them to try to pick up some sugar with the dry brush. Then each person dip their brush into the water and then into the sugar. Explain how the water causes some of the sugar to dissolve and stick to the brush. Explain how insects like flies spit on their food to dissolve it. Advise the students not to spit in the sugar. Explain that though flies are considered a big pest because of the diseases they can spread that they are actually very important because they pollinate almost as many plants as bees.

    Have the students throw away their juice boxes and noisemakers before they leave.

Adapted from:
JMG Kids. 1999. Chew on This! Junior Master Gardner Teacher/Leader Guide. p94.

Garden Buddy

Alternative to Lesson 1

Focus/Overview

Propagation means making new plants from older ones. This lesson will provide students the opportunity to see demonstrations of the most frequently used forms of propagation. Students will practice the propagation techniques of planting seeds and stem cuttings.

Learning Objectives

The learner will:

Learn several methods in which plants are propagated

Materials List for Twenty Campers

-rye grass seed (about 2 tsp per participant)

-potting soil (about 1 cup per student)

-20 knee high stockings (one per student)

-Googly eyes (two or more per student)

-fabric glue

-20 cups (one per student. You can also use water bottles, soda cans, or Styrofoam cups.)

-water

-paper (optional)

-Markers (optional

Background Information

Rye grass seed grows very quickly so results can be seen in less than a week. Adding too much seed means it will take longer for the grass to sprout and less seed means you have a balding buddy! Be sure to have students fill their stockings correctly or they may end up with a bearded garden buddy. There are two types of rye grass seed, annual and perennial, and either works in this project. Buddies should be placed in sunny areas like outside or a window sill for optimum growth and the fastest results. This activity should be done outside or in an easy to clean area as working with the potting soil can be very messy

Advance Preparation

If possible add water to the potting soil using only enough to moisten the soil. Adding too much water will cause an "earthy" smell that students may not enjoy. The best "body" for a garden buddy is a plastic water bottle with a removable lid although soda cans or Styrofoam cups can be used. If you are using a water bottle drill a small hole in the lid after emptying the bottle. The stocking will fit through this hole to create a wick to draw up water.

Procedure for Lesson 1 Propagation

1. Give each student a knee high stocking. Explain that they will be creating a buddy to help them with their garden.
2. Have the students gather the stocking with their hand as if they are going to put on the stocking. The toe of the stocking will become the top of the "head" or the garden buddy.
3. Have each student place 2 teaspoons of grass seed into the gathered opening. Pour 1-2 cups of potting soil into the still gathered stocking being careful not to disturb the grass seed. Explain that if they mix their seed with the soil they may end up with a wolf-man or bald garden buddy.

4. If using water bottles have the students feed the hanging end of the stocking through the hole in the lid and tie a firm knot that will lay inside the cap. They students should lightly stretch the stocking to get a closer to the soil. If they knot is too far away they will end up with a bobble head garden buddy. If they are using a cup or a soda can have the students tie a knot as close to the soil as possible.
5. Fill the container with about 2 inches of water so if it spills there is less mess.
6. Place the trailing end of the stocking into the container and explain that the stocking will act as a wick to draw up the water for the seeds.
7. Glue two googly eyes to the stockings with fabric glue pressing firmly for several seconds so the eyes will stick.
8. Allow the students to use paper and markers to create clothing for their buddy.
9. Place the garden buddies in a sunny spot and watch them grow.

Follow up

Over several days and weeks have campers check the growth of their garden buddies. Explain that is takes time for the seed to sprout because it must take on enough water to split open. Having too much seed in the garden buddy means these seeds have to compete for water and sunlight. Have the students watch and record how well their garden buddy grows.

Adapted from:
Family Education <http://fun.familyeducation.com/toys-and-puppets/crafts/37114.html>

Soda Bottle Terrarium/ Vermiculture

Alternative to Lesson 4 the Water Cycle and Composting

Focus/Overview

This lesson is used to teach students the water cycle. When they create their own terrarium they can observe each step of the cycle. The students will also learn about an alternative to composting, vermiculture.

Learning Objective

The student will:

Learn how a compost pile works

Learn a brief synopsis of the water cycle

Work with others on an environmentally friendly project

Louisiana Grade Level Expectations

4: GLE-58 Draw, label, and explain the components of a water cycle (ESS-E-A3)

5: GLE-51 Describe naturally occurring cycles and identify where they are found (e.g., carbon, nitrogen, water, oxygen) (SE-M-A7)

6: GLE-45 Describe methods for sustaining renewable resources (SE-M-A6)

6: GLE-46 Identify ways people can reuse, recycle, and reduce the use of resources to improve and protect the quality of life. (SE-M-A6)

Materials List for Twenty Students

Terrariums:

-20 2-liter soda bottles (one for each student)

-scissors or sharp instrument for cutting

-gravel (pea size or slightly larger works best. 1 cup per student)

-activated charcoal (½ to 1 cup per student)

-peat moss (1 cup per child)

-potting soil (2 cups per child)

-plants suitable for a small humid environment (ivies and mosses work best enough for one 4-inch cutting for each student)

-tape

Vermiculture Bin

-1 container 8-16 inches deep per group of five students or 1 per student

-1 lb of worms per box (red worms)

- bedding (newspaper strips)

-large bowl of water

-soil (1-2 c. for smaller bins 2-4 c. for larger bins)

-food scraps

Background information

True terrariums were first created by Dr. N.B. Ward a physician in the 1800's but clear containers have been used to grow plants since Ancient Greece. Terrariums are a great way to learn the water cycle. Since it is a closed environment, students can observe the four steps of the water cycle, precipitation, collection, evaporation, and condensation. Clear bottles work best for this step as plants may not thrive in colored bottles. The plants used in this terrarium should be adapted to growing in humid areas. Each layer of a terrarium is very important. The gravel acts

as a holding area for the water. The activated charcoal filters the water to prevent disease and algae from growing. The peat moss separates the soil from the gravel and the soil holds the plant. Vermiculture is a form of composting where worms are used in a closed environment to compost food scraps. Vermiculture works well for those with only a small space such as an apartment balcony. Worms are placed in a shallow container as the best worms for vermiculture are surface feeders. Worms prefer a cool space away from sunlight. Just like composting worms should only be fed non-protein foods such as vegetable scraps and paper. Holes should be drilled in the bottom of a vermiculture bin to allow waste water to drain.

Advance Preparation

Bottles should be washed and dried to remove any leftover liquid. Soda bottles should be cut in to two pieces approximately 4-5 inches from the bottom. A mall slit may be added to the bottom piece to make fitting easier. Remove any sharp edges and retain the cap. Activated charcoal can be found in the aquarium section of most stores. Either pelleted or loose pieces can be used. Pea gravel can be found in the garden section of most stores. Vermiculture bins should have several small holes drilled in the bottom of the container for waste removal.

Procedure Terrarium

1. Explain to students the water cycle and what each step means. Tell the students that they will be able to see the water cycle for themselves with a terrarium.
2. Give each student a bottle cut into two pieces. In each bottle layer as follows:
    - Pea gravel
    - Activated charcoal
    - Peat moss
    - Soil
3. Give each student a cutting that is 4-5 inches long and have them place the cutting right side up into their soil.

4. Each student should carefully pour ½ - 1 c. of water around their plant. Too much water keeps their plant from making roots and too little water means the cycle will not happen.
5. Have each student carefully place the top piece of their bottle over their terrarium with the top piece on the outside of the bottom piece are far down as possible without disturbing the plant.
6. Tape each terrarium together and place in a sunny area but out of direct sunlight.

Follow up

Have students observe their terrarium. The inside of the terrarium should become cloudy as the water *evaporates* and *condenses* on the inside of the container. If the water condenses but does not *precipitate,* the students can carefully unscrew the lid and add a small amount of water. As their plant grows they should carefully remove the tape holding the two pieces together and raise the top piece, and re-tape.

Procedure Vermiculture

1. Explain to students how a vermiculture bin works. Worms will eat and digest the food leaving rich fertilizer for their garden. Explain that worms like cool dark places but only wee in the top few inches of soil so they also like shallow homes.
2. Have the students tear newspaper into strips and place in the bowl of water for 5 minutes. Place the newspaper in the container with 1-2 cups of soil and mix to fluff the mixture.
3. Add worms to bin. Put food scraps into one corner of the bin.
4. Place bins in dark cool place.

Follow up

Have students observe their worm bins. The worms do not like light so the students will not see them but they are working! Each week the students should put their scraps in different corners rotating clockwise. If they return to a corner and there are still food scraps wait one more week. After 3-6 months it is time to replenish your bedding. The easiest method is to pile the compost to 1 side of the bin and place new bedding and food in the other side. After 1 month the worms should have migrated over and the composted material can be removed.

Adapted from:

UGA Cooperative Extension <http://spalding.caes.uga.edu/4h/documents/Terrariuminasodabottle.pdf>

Whatcom County Extension <http://whatcom.wsu.edu/ag/compost/easywormbin.htm>

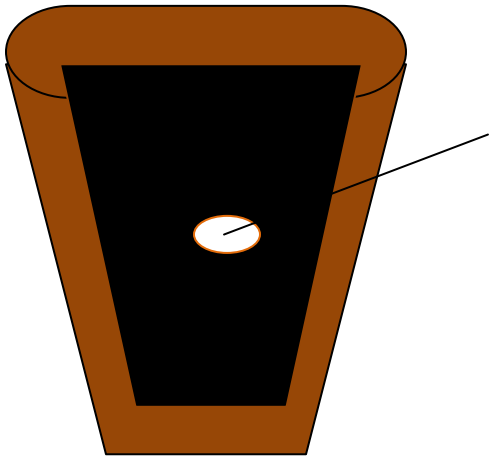
Appendix B Worksheets

Lesson 1: Propagation

Name_____

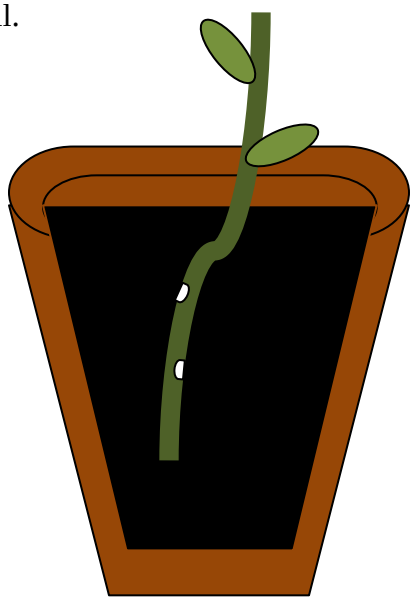
Instructions

Plant seeds twice the width of the seed.



Seed 1 inch wide planted 2 inches deep

Remove the two bottom leaves before planting the cutting. Plant the cutting two nodes above the soil and two nodes below the soil.



Created by Carly Gillett

Lesson 2: Make Your Own Victory Garden

1. If your area is a new garden, take a soil sample of the area and send it to your area Extension Office to test
2. Use an herbicide to kill the grass in the garden area and give the herbicide about two weeks to work.
3. Use a tiller to work the soil and incorporate any amendments your soils needs. (Based on your soil test results)
4. Work your soil into rows. Stand on one side of your row and use a hard rake to pull the soil up towards you.

3 feet wide rows 12 inches high

3-5 feet wide middles

5. Rows for children's gardens should be no more than 12 inches high and three feet wide. Row middles should be at least 3 feet wide and 5 feet wide for wheelchair access. Walk between the rows when you are in the garden.
6. Raised box beds for children's gardens should be no more than 4 feet deep so that children can easily reach the middle of the bed without climbing in.
7. Weed control cloth should be installed underneath raised beds to keep out weeds.
8. Fill your raised beds with garden soil and smooth with a hard rake. Rows can be made in beds or the soil can be left flat.
9. Space your vegetables and flowers according the Louisiana Planting Guide that can be obtained from your Extension Office.

Created by Carly Gillett

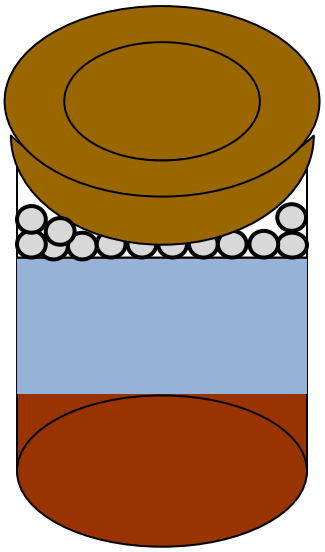
Lesson 3: Get the Dirt on Your Dirt

Group Name_____

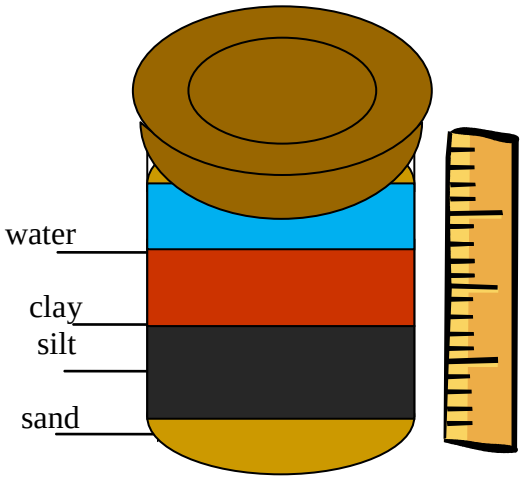
Soil Sample Number_____

Instructions

Fill your jar with 3 inches of soil, and 2 cups of water



Have each group member shake the jar until all the lumps are gone. Set your jar down and leave it for a few minutes until the layers start to settle out. After 24 hours all your layers should be settled. Use a sharpie to mark each layer and measure the amount of each layer. Check your chart and the soil triangle to determine your soil profile.



Inches	Out of	percentage
.5	5	10
1	5	20
1.5	5	30
2	5	40
2.5	5	50
3	5	60
3.5	5	70
4	5	80
4.5	5	90
5	5	100

Your Soil

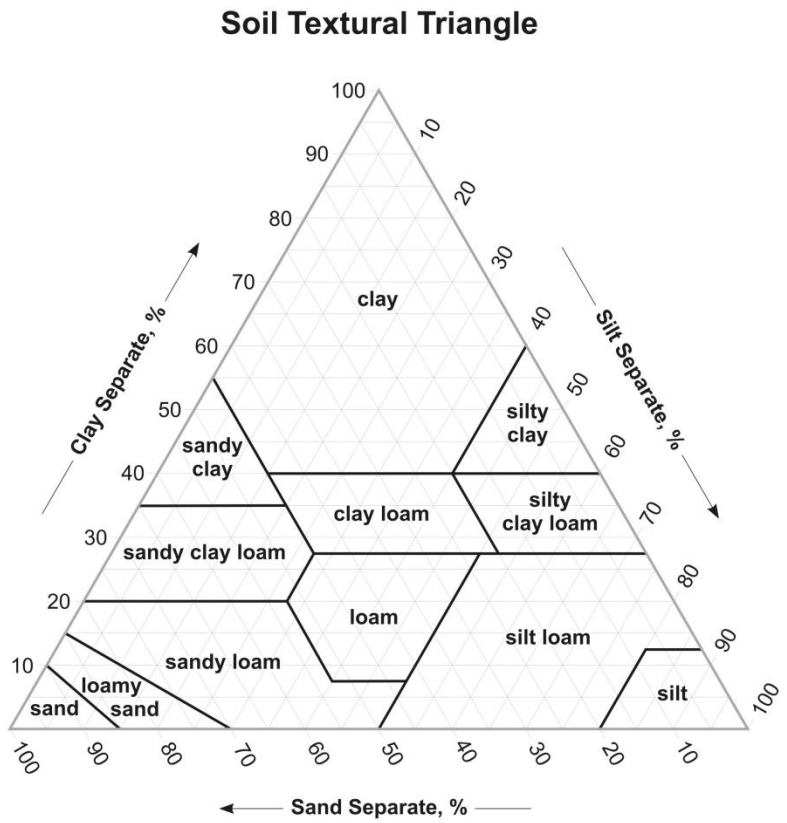
Percent Sand_____

Percent Silt_____

Percent Clay_____

Your Soil_____

Created by Carly Gillett



Soil Texture Triangle. National Resources Conservation Service. Retrieved 3 May 2010. <http://soils.usda.gov/education/resources/lessons/texture/>

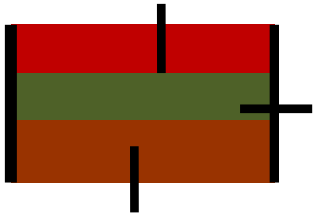
To use the soil triangle: First find the line that your percent sand falls on. Find the line that your percent silt falls on. Trace the two lines with your fingers and find where they intersect. Then find the line that your percent clay falls on. Trace this until you find where all three lines intersect. This gives you your soil type

Lesson 4: Recycle, Reduce, Reuse

Compost

Today we will learn about recycling, composting, and the water cycle. The first thing we will do is layer our compost in the bin. Each layer will be repeated until we run out of material. Layer soil, grass clippings, newspaper, and leaves; adding water and fertilizer for each section of layers. We will measure three things in our compost pile: temperature, pH, and moisture.

Temperature - Temperature in a compost pile is important because it tells us the compost is alive. Tiny microorganisms eat the waste products and give off heat as they digest the compost. Taking the temperature of a compost pile is very easy. To test the temperature, insert the special thermometer in three different spots of the compost. Average these temperatures to get the average of your compost. Be sure to put use the thermometer in three different places in the compost.



pH- measuring the pH of compost is a great way to tell if the compost is working. As the microbes age the compost, the pH of the compost will fall into the normal range. (6.0-8.0) The pH range scale ranges from 0-14. Less than 7 is considered acidic and more than 7 is considered basic. The microorganisms like a pH of 5.5-8.0.

To test the pH, insert the pH indicator strip into the compost. Remove the strip and wait 60 seconds. The strip will turn several colors. Match the strip to the pH color chart. When you find the right combination of colors, it will give you your pH level. Write it down on the compost sheet.

Moisture-Like every living thing on Earth, microorganisms need water to survive. The compost moisture level should be around 50-60 %.

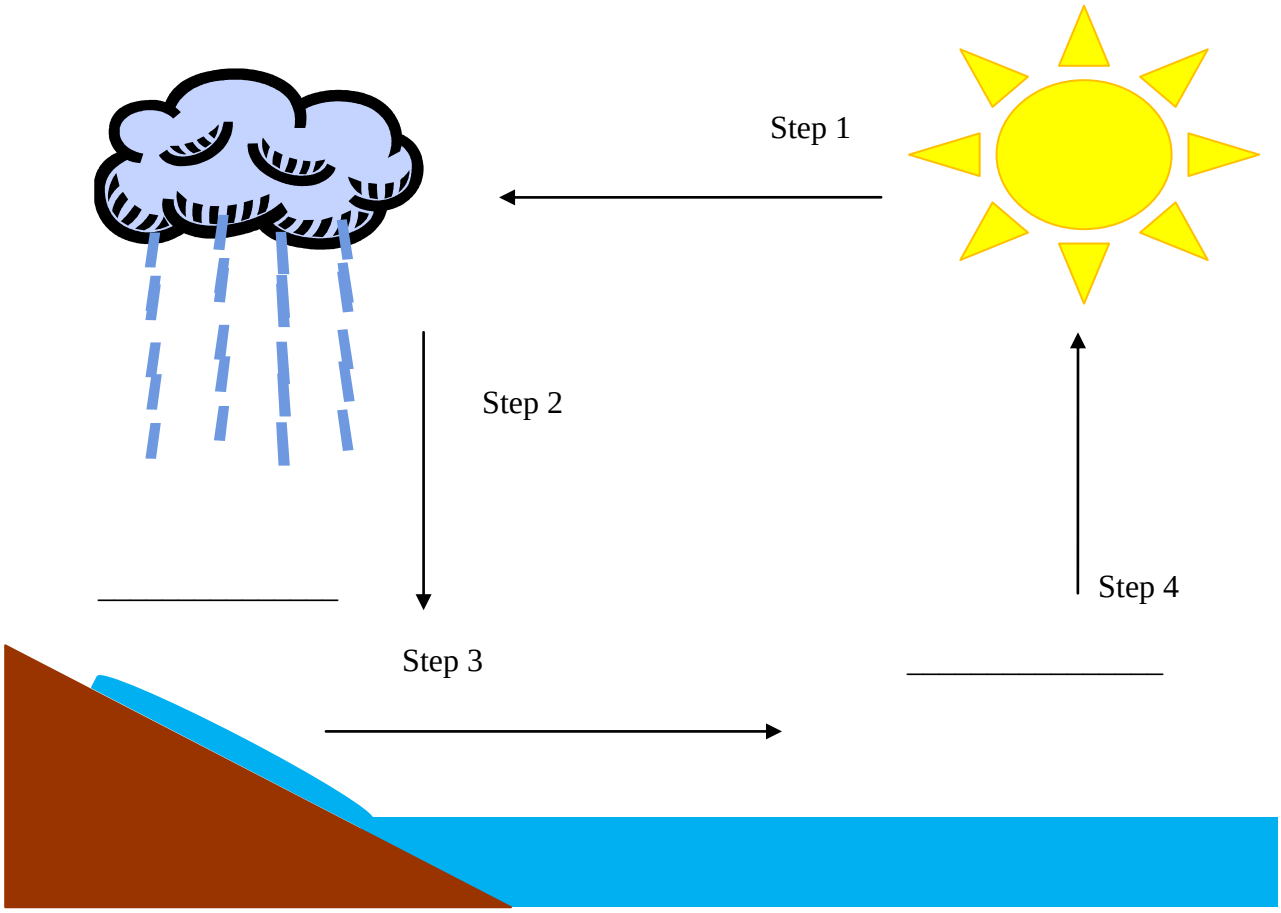
To measure the moisture content of your compost, take a handful of compost, and gently squeeze. If the compost leaves moisture in your hand when you squeeze, it is wet enough. If the compost is too dry, you would add water. Not enough water means the microbes cannot digest the compost and break it down. If there is too much water some of the microbes will die, a foul smell will come from the compost, and the decomposition rate will slow down. Nutrients will also leach from the compost.

Recycle, Reduce, Reuse

Water Cycle

Our most important renewable resource is water. Today we will learn the water cycle and its parts.

Fill out the following Water cycle and explain each step.



Step 1 is _____ and means _____
Step 2 is _____ and means _____
Step 3 is _____ and means _____
Step 4 is _____ and means _____

Recycle, Reduce, Reuse

Paper Ornaments

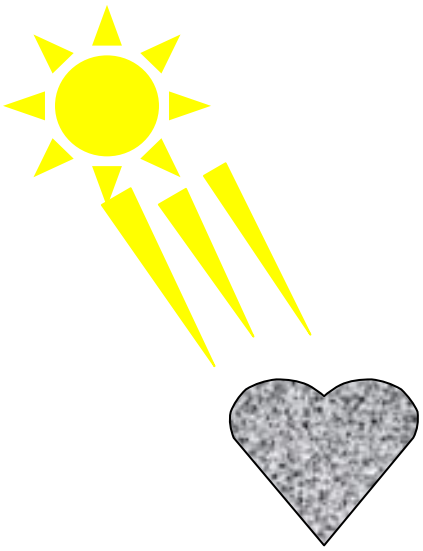
Another way you can recycle is by taking old newspapers and making them into paper ornaments. Today we will learn how you can recycle paper at home.

Take a newspaper and tear each page into small pieces.

Put the pieces in the blender and add water. Blend the paper slowly at first, then speed up until the mixture looks like thin oatmeal.

Pour a small amount of the mixture into a bowl and add a few drops of food coloring if they wish. Spoon some of the mixture into a cookie cutter and flatten it with the spoon, removing most of the water.

Sprinkle seeds on top of the ornament, then add a small spoonful of the paper blend on top of their ornament then flatten it again. Remove the ornament to a dry place outside.



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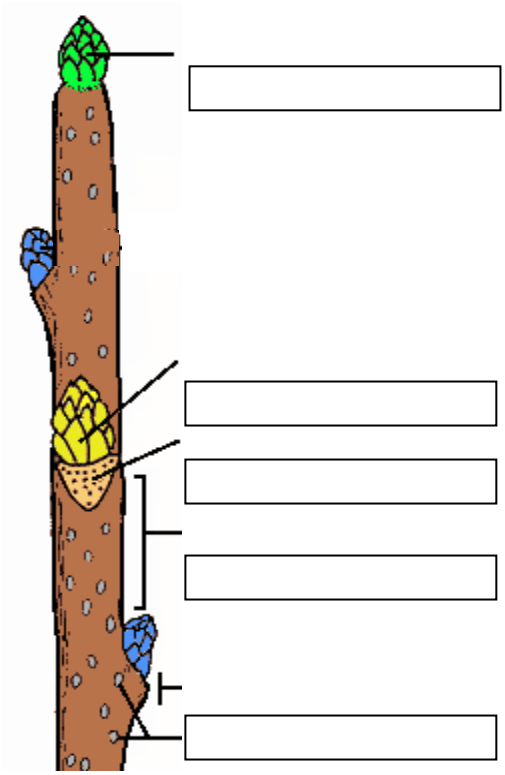
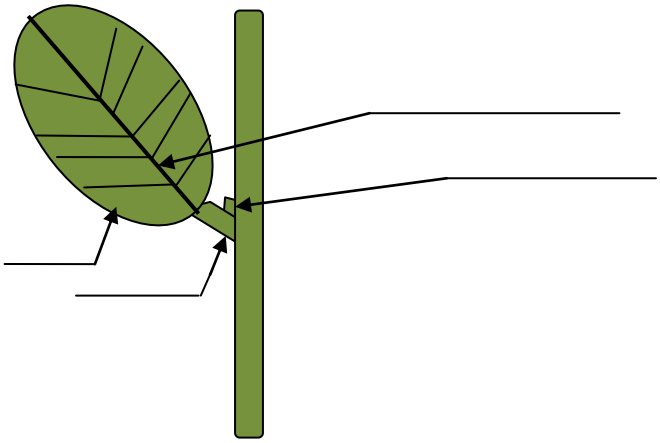
Lesson 5: Parts of a Plant

Label this stem with the following parts. Terminal Bud, Flower bud, leaf scar, internode, node



Reed, D.W. Stem Morphology. TAMU. retrieved 3 May 2010.
<http://generalhorticulture.tamu.edu/h202/labs/lab2/stemm.html>

Label this leaf with the following parts: blade, petiole, bud, midrib



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Appendix C Building a Raised Garden Bed

Materials per Bed:

Three 2”x 12”x 8’ boards (pressure treated is best but can be expensive)
3.5” #14 wood screws
Screw gun with 1/8” drill bit and Phillips head screw bit
Tape Measure
Straight edge
Pencil to mark lines
Circular Saw
A friend

Measure one board and cut the board in half to make two 2”x 12”x 4’ boards if you are unsure about this step or have no access to a circular saw most hardware stores will cut lumber for you. Using a friend dry fit one of the 8’ boards and one of the 4’boards together Place the cut edge of the 4’ board against the inside of the long edge of the 8’ board. See Figure 1. Use the straight edge to measure a 90^{o} angle and moving the boards as needed. Drill one pilot hole using a 1/8” drill bit Two (2) inches down from the top of 8’ board going into the 4’ board. Secure with 1 screw. Drill two more pilot holes using the 1/8” drill bit in the middle of the corner and two (2) inches up from the bottom keeping the corner square. Secure with two screws. See Figure 2. Repeat for the other three corners keeping the 4’ boards to the inside and keeping the whole structure as square as possible. This is where one or several friends will come in handy.

Note: Reclaimed wood can be used for this project for an environmentally friendly design. However, any boards painted with lead paint may leach into the soil and contaminate food products. Raised garden beds can be any length but should be no more than 4ft wide for easy access to plants in the middle of the bed.

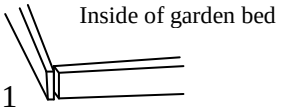
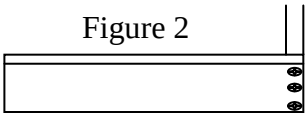


Figure 1

Figure 2



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Appendix D Year 1 Pre Test and Post Test

Name_____

Circle the answer that best matches YOU!

Are you? Male of Female

Grade in school that you just finished? 4 5 6

What race are you? White African American Indian Asian Other

Do You have a family member which is in the military or has been in the military?

a. Yes
b. No

What branch of the military is this person in? (Circle more than one if needed)

c. Army
d. Navy
e. Air Force
f. Marines
g. National Guard

Is your family member?

h. Active
i. Reserve
j. Guard

THANK YOU for answering these questions!

Now Let us know that you learned this week at in camp. Circle the letter with the correct answer for each question.

1. What does a seed need to germinate?

    a. Water and oxygen
    b. Sunlight and oxygen
    c. Carbon dioxide and sugar

2. Vegetative propagation is when you
    a. Plant a seed
    b. Take a cutting and put it in soil of water
    c. Water your plants in your garden

3. What is a Victory garden?
    a. A garden with only flowers
    b. A garden that is grown in times of war
    c. A Japanese Zen garden

4. Which plant is grown in the summer
    a. Tomato
    b. Broccoli
    c. Mustard greens

5. What are the three types of soil particles?
    a. Sand, silt, clay
    b. Dirt, mud, gravel
    c. Leaves, bark, and stems

6. What is a loam soil?
    a. A soil with mostly sand
    b. A soil with mostly clay
    c. A soil with an equal amount of san silt and clay

7. Which item should you NOT compost
    a. Meat
    b. Leaves
    c. Newspaper

8. What is the range of the pH scale?
    a. 0-14
    b. 2-5
    c. 7-12

9. What is the role of the xylem?
    a. Transport water in the plant
    b. Capture sunlight
    c. Stores food

10. What part of the plant surrounds the seed?
    a. Stem
    b. Flower
    c. Fruit

11. What is pollination?
    a. When a flower blooms
    b. When an insect moves pollen from one flower to another
    c. When the plants look yellow and need more fertilizer

12. Is the stigma a male of female flower part?
    a. Male
    b. Female
    c. Neither

13. Which pigment in the leaf is green?
    a. Chlorophyll
    b. Anthocyanins
    c. Xanthophylls

14. What is missing from the photosynthesis equation?
    Carbon dioxide + Water + sunlight = Sugar + _____
    a. Oxygen
    b. Nitrogen
    c. Carbon

15. What kind of beneficial insect is a ladybug?
    a. Predator
    b. Parasite
    c. Pollinator

16. What type of mouth does a butterfly have?
    a. Proboscis
    b. Chewing
    c. Sponging

Directions: Darken the circle for your answer

How Sure are you that you can:	Not Sure at All	Somewhat Sure	Very Sure
Plant a seed that will grow into a small plant	O	O	O
Explain to your friends how to grow a plant	O	O	O
Grow more than one kind of plant	O	O	O
Grow a plant that produces a vegetable or food you can eat	O	O	O

Created by Carly Gillett

Year Two Pre-Test and Post-Test

Name_____

Read the questions below and circle the letter with the correct answer for each question. It's ok if you don't know the answers just do your best.

1. What does a seed need to germinate?
   a. Water and oxygen
   b. Sunlight and oxygen
   c. Carbon dioxide and sugar

2. Vegetative propagation is when you
   a. Plant a seed
   b. Take a cutting and put it in soil of water
   c. Water your plants in your garden

3. What is a Victory Garden?
   a. A garden with only flowers
   b. A garden that is grown in times of war
   c. A Japanese Zen garden

4. Which plant is grown in the summer
   a. Tomato
   b. Broccoli
   c. Mustard greens

5. What are the three types of soil particles?
    a. Sand, silt, clay
    b. Dirt, mud, gravel
    c. Leaves, bark, and stems

6. What is a loam soil?
    a. A soil with mostly sand
    b. A soil with mostly clay
    c. A soil with an equal amount of san silt and clay

7. Which item should you NOT compost
    a. Meat
    b. Leaves
    c. Newspaper

8. What is vermiculture?
    a. Using mice to compost your food scraps
    b. Using worms to compost your food scraps
    c. Using birds to compost your food scraps

9. What is the role of the xylem?
    a. Transport water in the plant
    b. Capture sunlight
    c. Stores food

10. What part of the plant surrounds the seed?
    a. Stem
    b. root
    c. Fruit

11. What is pollination?
    a. When a flower blooms
    b. When an insect moves pollen from one flower to another
    c. When the plants look yellow and need more fertilizer

12. What is honey made from?
    a. Flower petals
    b. pollen
    c. Nectar

13. Which pigment in the leaf is green?
    a. Chlorophyll
    b. Anthocyanins
    c. Xanthophylls

14. What is missing from the photosynthesis equation?

    Carbon dioxide + Water + sunlight = Sugar + _____

    a. Oxygen
    b. Nitrogen
    c. Carbon

15. What kind of beneficial insect is a ladybug?
    a. Predator
    b. Parasite
    c. Pollinator

16. What type of mouth does a butterfly have?
    a. Proboscis
    b. Chewing
    c. Sponging

17. Pretend you are a flower and you need to be pollinated by insects. What would you do to attract more pollinating insects than the other flowers around?

Directions: Darken the circle for your answer

How Sure are you that you can:	Not Sure at All	Somewhat Sure	Very Sure
Plant a seed that will grow into a small plant	O	O	O
Explain to your friends how to grow a plant	O	O	O
Grow more than one kind of plant	O	O	O
Grow a plant that produces a vegetable or food you can eat	O	O	O

Please answer the following questions about yourself.

Are you? Male or female

Grade in school that you just finished? 4 5 6?

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Do you have a family member who is in the military or has been in the military?

a. Yes
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What branch of the military is this person in? (Circle more than one if needed)

c. Army
d. Navy
e. Air force
f. Marines
g. National Guard

Is your family member?

h. Active
i. Reserve
j. Guard

THANK YOU for answering these questions!

Created by Carly Gillett

Vita

Carly M. Gillett was born in 1988 to Douglas and Danna Gillett in Monroe, Louisiana. She graduated from Rayville High School in 2006. She attended Louisiana State University from 2006 to 2010 where she earned a bachelor's degree in plant and soil systems with a concentration in environmental horticulture. She then attended Louisiana State University on an assistantship to earn a master's degree in agronomy, which will be awarded in May, 2012