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Integrating Horticulture Therapy in a Juvenile Detention Center Using Raised Bed Gardening and Exploratory Substrate Research

Stephanie Rene Gravois

Louisiana State University and Agricultural and Mechanical College

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INTEGRATING HORTICULTURE THERAPY IN A JUVENILE DETENTION CENTER
USING RAISED BED GARDENING AND EXPLORATORY SUBSTRATE RESEARCH

A Thesis
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
Requirements for the degree of
Master of Science

In
The School of Plant, Environmental and Soil Sciences

by
Stephanie Rene Gravois
B.S., Louisiana State University 2009
May 2018
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Abstract

Bagged media products are readily available at garden retails. However, most need to be amended or have supplemental topsoil combined for use in raised beds. Three media mixes were evaluated for the growth and yields of lettuce, broccoli and cauliflower. Two tested media were commercially available purchased products and the third was developed at Louisiana State University Agriculture Center (LSU AgCenter) specially designed for raised bed vegetable production. The LSU AgCenter medium produced greater yield and plant growth in all three crops (p ≤ 0.05) as compared to the commercially available media. The commercial products without additional amendments were found to lack appropriate nutrients and texture to produce quality vegetables, whereas the LSU AgCenter media containing micronutrients and dolomitic lime produced a quality product. Additionally, raised bed gardening was incorporated in a juvenile detention center garden workshop series to determine if horticulture focused lessons improved students’ science based knowledge and emotional state of being. Garden lessons were developed and implemented for three consecutive days, once a month for seven months. Each lesson was paired with pre and post mood selection charts and two pre and post knowledge based questions. Two lessons with hands on activities were conducted each day on all three days totaling 6 lessons. Additional time was dedicated to providing gardening opportunities that tied into the lessons. Participants’ mood was elevated two of the three days (p ≤ 0.05) each month and post-test scores were increased by 20% (p ≤ 0.05).
Chapter 1 Introduction and Literature Review

United States Vegetable Farm Outlook

The most widely planted vegetable crops in the United States fresh market are potatoes, lettuce, sweet corn, watermelons, and tomatoes (USDA, 2015). According to the 2012 USDA census there was an increase of 2.2 billion dollars (15%) in vegetable sales in the United States (US) from 2007 to 2012 for a total of $16.9 billion in sales. However, the number acres planted in vegetables decreased from 4.7 million acres to 4.5 million acres from 2007 to 2012 (USDA, 2015) while the number of vegetable farms increased. Today, many farms produce vegetables for the fresh market while other farms grow for both the fresh and processed markets and very few farms grow solely for the processed market. In the United States 65,814 farms produced vegetables for the fresh market and 13,072 produced vegetables for the processed industry (USDA, 2015). On a global level, fruit and vegetable production increased by three percent as of 2011. Over the past 50 years, crop production has increased threefold (FAO, 2013). Top vegetable producing states in the US are California (38 percent of US production), Idaho, Washington, Wisconsin, and Florida. Over 50 percent of vegetable farmers are between the ages of 45 to 64 years of age (USDA, 2015). US Farm size in terms of acres are trending either to larger farms or smaller farms. Large farms depend on wholesale contracts and small farms operate primarily in open markets such as farmers markets where the product is sold and immediately picked up (USDA, 2015). Small US vegetable farms may benefit from the use of raised beds, especially in areas with poor drainage and poor soils.
Louisiana Vegetable Production

Agriculture in Louisiana faced increased economic struggles in 2016 due to record precipitation and flooding that impacted parishes that contribute to vegetable production. According to the Louisiana State Vegetable Extension Specialist, Dr. Kathryn Fontenot, Louisiana has approximately 375 fruit and vegetable producers, with a majority of producers growing on farms ranging from 1 to 5 acres. On these farms, fruit and vegetable producers grow up to 31 different vegetables species with watermelon, tomatoes, and mustard accounting for the highest economic value (LSU AgSummary, 2016). The top watermelon growing parishes included Washington, Bienville, and Union, with farms growing several vegetable species with the highest economic value in Louisiana being in Tangipahoa Parish. The top three vegetables produced by acreage included watermelons at 1375 acres, southern peas at 742 acres and sweet corn 451 acres. The 2016 Gross Farm Value (GFV) of vegetable crops in Louisiana was estimated $45.2 million. When combined with value added practices such as producing jams and jellies the vegetable GFV value increased to $106.2 million. Due to the average size of farms in Louisiana ranging from 1-5 acres, the willingness to use a raised bed system for growing vegetables is viable. In New Orleans, the oldest building boasts one of the oldest raised bed gardens from 1753 at the Ursuline Convent. This further supports the notion that not only are raising vegetables for profit in small spaces not a new practice, but working in raised beds is also not a novel concept (LaBorde, 2015).

United States Home Vegetable Gardens

According to the National Gardening Survey (NGS), the number of homeowners participating in some form of gardening has increased to pre-recession levels in 2008 but has not equaled participation levels of 2002 of $39.6 billion with Do It Yourself (DIY) garden industry
sales and projections for the green industry sales for home gardens in 2015 was estimated at $36 billion, trending upward once more. Almost 90 million households participate in some form of gardening (Baldwin, 2016). According to the NGS, the four categories of gardening falling under “food gardening” classification are berries, herbs, fruit trees and vegetables (Baldwin, 2016). Additional statistics were revealed by the results from the National Gardening Association’s (NGA) report such as food gardening increasing 17% in the US from 2008 to 2013 or 36 million to 42 million households producing a portion of their food. Households producing “some” of their own food have the highest participation rate recorded in more than a decade. Interestingly, the category of food gardening has exhibited the highest increase in participation at 63% for millennials (ages 18-34) as indicated with a nearly doubling in spending on food gardening during 2008 to 2013 (Sinnes, 2018). National Gardening Survey results also highlighted a 25% increase in participation from households with children. Mr. Mike Metallo, CEO and president of the National Gardening Association, feels that there is truly a food revolution occurring in the US. The NGA has been providing gardening statistics since 1978 (Sinnes, 2018). The report also touched on the increases in urban gardening increasing from 7 million to 9 million gardens, a 29% increase. Community gardening was up 300% in the 5 year gap (Sinnes, 2018). Specifically looking at gardening habits in Louisiana, an upward participation trend also exists for home or hobby gardeners. The 2016 Louisiana Ag Summary approximates the total of home grown gardens produced in Louisiana was 632,366 up from 475,337 in a four year span from 2012. The United States Department of Agriculture’s (USDA) research states one in every three households have a garden to supplement limited income, for better health, or simply as a hobby (LSU AgCenter Louisiana Ag Summary, 2016). Home and hobby gardeners are found throughout the
United States. Located in rural, suburban or urban areas, community, school, home and hobby gardens are commonly smaller spaces and are ideal for using raised beds.

**History of Raised Bed Gardening**

Raised bed gardening has numerous advantages for home vegetable production. Foremost raised bed gardening is ideal for small or limited spaces and for gardeners with limited gardening equipment (LSU AgCenter, 2015). Raised bed gardens are unique in that the substrate is elevated in containers above the natural soil elevation. Unlike containers, raised beds traditionally do not have bottoms, allowing for potential penetration of roots from the fill media into soils below the bed. The size of raised beds can vary widely depending on the space with which it will be placed, however the LSU AgCenter currently recommends the width of raised bed not exceed 3-4 feet wide so the gardener does not have to step into the bed to maintain it (Harris et al., 2012).

Hieroglyphs dating from 4000 BC discovered in Egypt show container gardens were in use (Raviv and Ledith, 2008). In the United States, vegetable gardens, as a means of education and production, dates to 1891 (Subramaniam, 2002). Historical events such as World Wars I and II and the Great Depression have impacted home vegetable production. The World Wars brought about challenging times for US families as crops were sent to support troops. This led to the implementation of Victory Gardens to increase vegetable availability to US families during potential food shortages. Federal initiatives encouraged families to grow their own fruits and vegetables as a sign of patriotism (Schupp and Sharp, 2012). Accompanying the home initiative was school programing instated by the US Bureau of Education called the US School Garden Army. As a result, the US School Garden Army Program helped enhances school gardening curriculum (Francis, 1919).
Today, home vegetable gardening as a hobby has continued to increase. The increase in gardening participation by Americans can be attributed to promotion of First Lady Michelle Obama’s “Let’s Move” campaign played a role in students gardening and exercising in addition other state departments as well as non-profits were also promoting campaigns and projects to increase knowledge, participation and engagement in home and community food gardening such as the Peoples Garden program.

In 2009 the USDA, inspired by Abraham Lincoln’s 200th birthday, created The People’s Garden from his designation of the USDA as “The People’s Department”. This program is a multifaceted effort with different types of organizations creating numerous types of gardens, farms, or agricultural projects. Included gardens must benefit the community and must include sustainable practices (USDA-People’s Garden-About, 2018). The benefits of gardens are numerous. Gardens provide communities with fresh produce; hands on learning not only for school aged children, but work force preparation of young adults. Gardens create wildlife habitats; are environmentally friendly; and beautify urban and rural settings (USDA-People’s Garden-Impact, 2018) Food gardens showcase economic and beginner-friendly practices, and have impacted the local food movement which is increasing in popularity. This trend was recently acknowledged by Congress when they called for research to be conducted by the Economic Research Service (ERS) in 2014 to report the trends and magnitude of the local and regional food systems (USDA, 2015). The public has increasing concerns of where and how food is produced, which is evident in the 22 percent increase in sales projected from farms participating in direct to consumer sales from 2002 to 2012 (USDA, 2015). Many consumers are now producing their own fruit and vegetable crops and even raising their own animals as a means of controlling food security which provides them in knowing where their foods was safely
produced, processes and packaged. Active participation in food production provides consumers with a greater understanding and appreciation for of the labor and efforts involved in commercial food production (Corboy, 2016). Because a great deal of labor is required in most vegetable production, home gardeners have sought more manageable methods for gardening. This has led to an increase in raised beds which has led to a demand for more information by the public. Extension agents in Louisiana are receiving multiple requests for urban and small garden practices. Kathryn Fontenot, PhD (Vegetable Extension Specialist with the LSU AgCenter) commented that many Louisiana gardeners are now living with smaller yards or simply do not have the desire to dedicate to large gardens. Therefore Master Gardener Associations, Home Garden Clubs, and even community gardeners are requesting information on growing edible plants in containers, raised beds and in small spaces (personal communication, 2017). The LSU AgCenter website, www.lsuagcenter.com, provides information to encourage the urban, home, school and community gardener to grow food. Raised beds are the answer to gardening on a time frame. Media selection for raised beds is an ever present challenge. At the beginning of this study, there were no bagged raised bed media choices available on the commercial market. There are many substrate mixes available that are labeled for vegetable growth but are required to be mixed with top soil or a mineral based soil, they do not stand alone. Creating a bagged substrate media that needs no alteration and that is amended so that high quality vegetables yield from that mix would benefit gardeners who do not have the tools nor the desire to alter native soil in their yards. A ready to use soil that produces optimum yields of edible crops is needed for the novice raised bed gardener.
Purchasing Characteristics of Garden Soil Media

Gardeners consider costs associated with purchasing soil mixes for raised beds. Generally the cheapest method is to purchase bulk soil mixes from hardware stores, plant nurseries and commercial recycle operations. However, purchasing bulk soil requires the gardener has a truck or large vehicle to move copious amounts of loose soil. Therefore, even though more costly, gardeners are often limited to purchasing soil mixes in bags. Factors that influence what a person will purchase include price, included additives (such as fertilizer), and weight of the bag. Weight is particularly important. If a soil mixture is heavy, it limits the size of the bag that it can be sold in and or limits purchases to only those consumers who feel comfortable lifting heavy weights. One of the benefits to soilless media, which was eventually constructed during plant nutrition research beginning in the 19th century, is that it’s lighter than soil (Raviv and Ledith, 2008). Colorful, eye catching labeling also influences purchases. Marketing, at the most basic level, begins with packaging and labelling. It’s useful in catching the attention of a potential customer and it highlights the attributes of the product (Ochre Media, 2018). At the time of this study there soil mixes marketed exclusively for raised bed gardening were not in existence.

History of School Garden Education

The first school garden in the US was conceived in 1891, but the need for them during WWI and WWII rose and thus the creation of Victory Gardens and the Unites States School Garden Army (Subramaniam, 2002; Schupp and Sharp, 2012; Francis, 1919) occurred. The importance of school gardens has regained vigor in the 2000’s with multiple programs supporting such efforts including the People’s Garden created in 2009 by the USDA (USDA-People’s Garden-About, 2018). Michelle Obama’s Let’s Move project encouraged healthy eating, consistent physical activities, and beginning a vegetable garden at the White House. These
programs showcase the benefits that are experienced when utilizing school gardens as a means of education. However, the utilization of these garden programs with juvenile detainees is still relatively unstudied.

**Youth Horticulture Therapy Programming**

Not all youth learn in traditional in-school settings. An example of a traditional setting for this comparison is a school with multiple grade levels with classes consisting of children in the same grade being taught on a single campus. There are multiple non-traditional learning settings available. Home school programs have increased in number over the last ten years (National Household Education Surveys Program (NHESP), 2017). Home schooling was not legalized in all 50 states until 1993 (Somerville, 2001). As of 2012, National Center for Educational Statistics estimates 3.4% of the students in the United States are being taught at home (NHESP, 2017). Another form of non-traditional learning settings would be in long term (over a year) and short term (less than a year) juvenile detention centers. Personal correspondence with East Baton Rouge Juvenile Detention counselor, Mrs. Maisa Shelmire in 2014, these facilities are mandated to educate enrolled youth at the same standards as traditional schools, but the logistics can be difficult. Alternate teaching methods may benefit the students detained at the detention facility. Hands on studies with detained youth have shown to not only increase their knowledge on the subjects covered, but also aid in their overall emotional state. Specifically, in these studies, the youth displayed improvements to their demeanor. They seemed to be more at ease with each other and lacked the constant competitiveness and negative verbiage. They displayed more team oriented actions and genuinely enjoyed the trips to the garden (Sandel, 2004). Research has also shown that though the students may not have prior garden knowledge, they are receptive to the activities and it can be a strong influential experience for student from
disadvantaged or poverty stricken situations (Sandel, 2004; Olszowy, 1978). The objective of
developing and evaluating a garden workshop series in a juvenile detention facility was to
determine if hands-on garden activities broaden the students’ agricultural and gardening
knowledge base, and to evaluate detained youths’ emotional reactions as a result of participation
in the series. This project can be viewed as one form of horticulture therapy, as the goal was to
teach basic garden principles to students who were socially and/or economically disadvantaged
youth and increase their overall knowledge with hands on, interactive activities. Although text
book “Horticulture Therapy” was not conducted in this project, pieces of the three main types of
programs were incorporated. The three types of Horticulture Therapy (HT) programs are
vocational, therapeutic, and social (Haller, R. 1998). The lessons developed and taught both in
the classroom and in the garden included portions of all three. The manual work and techniques
learned in the garden and in the classroom can be utilized at a potential employment either at a
plant nursery or in a landscaping business. This speaks of the basis for vocational HT which
primarily focuses on skills learned for employment (Haller, R 1998) The hands-on job required
to maintain a garden is therapeutic because of the outdoor smells and sounds, the change in
scenery instead of the inside of the detention center, and the ambiance of simply being outdoors
in a more natural environment (Haller, R. 1998). Lastly, since our participants were temporarily
living in the detention center they were not alone, the social aspect of HT was easily achieved
due to the nature of the facility. The students who wished to participate in the garden workshop
series were accompanied by their like-minded constituents and so were encouraged to work
together to finish tasks and goals. The main goal in a social horticulture therapy setting is to
improve the overall well-being of the participants (Haller, R. 1998). With the social HT program
Objective of Raised Bed Substrate Comparisons

The objectives of this thesis project two-fold. The first objective was to compare two commercially available bagged substrate mixes, sold in home garden stores, to a specially formulated substrate prepared by LSU AgCenter researchers in hopes of identifying an optimum media suitable for vegetable growth in raised bed settings without the need to amend or change the bagged substrate in any way. The LSU substrate recipe used was a 1:1:1 ratio of pine bark, sand, and peat moss amended with micronutrients and dolomitic lime. These products are some of the most common components and have had extensive research conducted on their benefits and properties. Pine bark is ideal in this region because it is a readily available byproduct of Louisiana’s timber industry (Richard, 2006; LSU AgCenter LA Ag Summary, 2016). Their beneficial property includes improved aeration, lightweight, micronutrients, and retains its properties during decomposition (Smith, 1985; Niemiera, 1992; Alexander, 1977). Sphagnum peat moss is a great addition to media because it’s also lightweight, but it can be a costly component (Richard, 2006). Peat’s cation exchange capacity (CEC) and water holding capacity make up for its expense (Biernbaum, 1992; Raviv et al., 2002). Two of the three components are lightweight so sand is added to increase the density of the substrate. Sand was added to the LSU substrate to add bulk density (Hoitink, 1982). Its main purpose is to add weight, but sand also increases aeration and aides in drainage like pine bark (Hoitink, 1982; Biernbaum, 1992). Micronutrient additions, like Micromax™, are common place with media mixtures, and including dolomitic lime can be an aid in the fertilization outcomes (Wright and Hinesley, 1991). The LSU mixture has been researched for several years using vegetable crops and making slight
changes to it (Bertrand, 2014; Richard, 2006). The optimum raised bed soil mixture would be marketed to all gardeners, home, school and community gardeners.

**Objective of the Juvenile Detention Garden Study**

Although somewhat unrelated, this thesis was comprised of two separate projects, testing raised bed media and using a raised bed garden setting to identify if juvenile detention detainees would benefit from growing and participating in garden activities. Studies show that hands-on learning methods in school garden settings help students excel in areas such as science (Karsh et al., 2009). It’s also been found that incorporation vegetables in school gardens helps encourage youth to be more adventurous in their food selections and willingness to eat more vegetable (Morris and Zidenberg, 2002). There is a desire to know if these benefits will translate in non-traditional teaching settings with juvenile detention youth.

**Overall Objectives**

Determine if media products that are readily available to the public for gardening are viable for growing quality vegetables in raised beds without making amendments. Determine if juvenile detained youth benefit both academically and emotionally as a result of participation in hands-on garden activities.
Chapter 2 Determining the Optimum Substrates for Vegetable Gardening in Raised Beds

Introduction and Literature Review

Very small US vegetable farms, hobby gardeners, home gardeners and community gardeners may benefit from the use of raised beds, especially in areas with poor drainage and infertile soils. The Louisiana Agricultural Summary estimates the total of home grown gardens produced in Louisiana has increased to 632,366 from 475,337 in a four year span from 2012 to 2016. The United States Department of Agriculture’s (USDA) research states one in every three households have a garden to supplement limited income, for better health, or simply as a hobby (LSU AgCenter Louisiana Ag Summary, 2016). Benefits of gardens include providing communities with fresh produce; hands-on learning for school aged children as well as work force preparation for young adults. Gardens have the potential to create wildlife habitats; be environmentally friendly; and beautify urban and rural settings (USDA-People’s Garden-Impact, 2018). The National Gardening Survey results highlighted a 25% increase in participation from households with children. Mr. Mike Metallo, CEO and president of the National Gardening Association, states that there is truly a food revolution occurring in the US. The NGA has been providing gardening statistics since 1978 (Sinnes, 2018). The report also touched on the increases in urban gardening increasing from 7 million to 9 million gardens, a 29% increase. Community gardening was up 300% in the 5 year gap (Sinnes, 2018). Through personal communication with Dr. Kathryn Fontenot (LSU AgCenter Extension Specialist) she indicated that the majority of gardeners calling upon AgCenter agents are novice gardeners seeking the most basic gardening information. Dr. Fontenot also indicated the majority of clients are seeking information for vegetable gardening in small spaces including raised beds.
Gardeners often consider costs associated with purchasing soil mixes for raised beds. Factors that influence what a person will purchase include price, included additives (such as fertilizer), and weight of the bag. At the time of this study there were no bagged substrates marketed exclusively for raised bed gardening without the need to amend the bagged soil at the first planting.

**Materials and Methods**

**Research Site and Raised Bed Construction**

Raised beds were constructed and maintained at the Lamar Dixon Exposition Center located in Ascension Parish in the city of Gonzales. This location is in Southeast Louisiana 30.1970° N, 90.9575° W in USDA’s Plant Hardiness Zone 9a.

A total of four raised beds 1.2 m x 3.7 m x 0.6 m (4 ft. x 12 ft. x 2 ft.) were constructed using pressure treated lumber. Each bed was built 1.2 meters (4 feet) wide, 3.7 meters (12 feet) long and 0.6 meters (2 feet) deep. With braces installed inside each of the 4 corners. The braces were placed to a depth of 15 cm (6 inches) with the tops of the braces flush with the top edge of the raised beds.

Each raised bed was subdivided into three spaces with areas of 1.4 m² (1.2 m x 1.2 m) using wooden dividers spaced 1.2 meters (4 feet) apart along the 3.7 m edge of the raised beds. The raised bed was divided into three areas to allow for evaluation of different substrates. Figure 3).
Figure 1. Media Plot Plan

Figure 2. Braces Used in Raised Bed Construction
Soil Mixtures

Three substrates were evaluated for plant growth in the raised beds. Two of the tested soil mixtures were commercially available with the third a soil mixture developed by Louisiana State University (LSU). The soil mixtures that were used in each of the raised beds included:

1) Commercially Available Top Soil Substrate
2) Commercially available Organic & Natural Substrate
3) LSU Substrate with Nutrient Improvements (Bark: Sand: Peat mixture amended with micronutrients and dolomitic lime.)

Figure 3. Construction of a Single Raised Bed Filled with Test Substrates
Photos of bagged mixes are located in the appendix. Each plot was filled with media to a depth of 27.94 cm (11 inches). Media was then irrigated for subsidence and filled again so that a 2.54 cm (1 inch) lip was visible on the inside of each plot.

**Planting and Maintaining the Raised Beds**

Each subplot was planted with eight broccoli (*Brassica oleracea* var. italic) ‘Packman’, eight lettuce (*Lactuca sativa* ‘Red Sails’) heads, and eight cauliflower (*Brassica oleracea* var. *botrytis*) ‘Snow Crown’ on 23 October 2014 and replicated on 26 January 2015. However, due to poor lettuce transplants that didn’t survive, a third planting of lettuce only was completed on 2 February 2015. Prior to the first planting, no amendments were made to any of the substrate mixes other than what they contained at the time of purchase. Lettuce were planted in a single drill with 15 cm (6 inches) between plants while cauliflower and broccoli were spaced 30.5 cm (12 inches) in double drills. Plants were irrigated daily to a depth of 0.25 inch per irrigation event based on current LSU Agricultural Center recommendation of applying 1 acre-inch of irrigation per week (Fontenot et al, 2010). Irrigation was ceased for days precipitation occurred. Side dress applications of fertilizer were applied on 4 December 2014 for the first planting and 19 March 2015 for the second planting. Calcium nitrate (CaNO₃) was applied as the side dress material at a rate of 240lbs CaNO₃ per acre (as recommended in the Louisiana Commercial Vegetable Production Recommendations book by J. Boudreaux) to each four foot by four foot plot. The CaNO₃ was evenly distributed between the three crops. At the time of the initial planting in 2014 plots were not given additional pre-plant fertilizer. During the second planting in 2015 all plants within each substrate treatments received 13-13-13 as a pre-plant application at a rate of 500lbs per Acre using 13-13-13 fertilizer (recommended in the Louisiana Commercial
Vegetable Production Recommendations book by J. Boudreaux). This pre-plant fertilizer was evenly distributed among all four by four foot plots.

**Harvest and Data Collection**

Lettuce was harvested approximately 21 days after transplant (DAT) for the first planting and 32 DAT for the second planting. Prior to harvest, lettuce height was measure from the soil line to the tallest leaf with width recorded twice with perpendicular measurements from widest leaf to widest leaf. Lettuce was cut flush with the soil and biomass recorded.

Broccoli was harvested 61 DAT on the first planting and 66 DAT on the second planting. Broccoli was measured using a two width system where the first width was a horizontal measurement across the plant from leaf edge to leaf edge. The second width was taken perpendicular to the previous measurement, from leaf edge to leaf edge. After the final measurements, broccoli heads were harvested with four to five inches of stem. The heads were then measured for diameter and were weighed. Cauliflower was harvested 75 DAT on the first planting and 85 DAT on the second planting. Cauliflower plants were measured using a two width system where the first width was a horizontal measurement across the plant from leaf edge to leaf edge. The second width was taken perpendicular to the previous measurement, from leaf edge to leaf edge. After the final measurements were complete, cauliflower heads were harvested leaving four to five leaves and stem. Head diameter was measured and heads were weighed.

Data was also collected on the substrates themselves. Bulk density and water holding capacity were calculated. Nutritional foliar tissue analysis was conducted on macro and micronutrients in the tissue of lettuce, broccoli, and cauliflower plants grown in all three tested substrates.
Results and Discussion

Substrate Results

Bulk density was calculated for each tested substrate. The LSU substrate was 0.56 g/cm³. The topsoil substrate was 0.275 g/cm³ and the organic substrate was 0.235 g/cm³. Overall the LSU substrate had higher bulk density than the other two tested substrates.

Water holding capacity, total porosity and airspace were measured for each substrate (Table 1).

Table 1. Airspace, Water Holding Capacity and Porosity of Tested Substrates.

<table>
<thead>
<tr>
<th></th>
<th>LSU Substrate</th>
<th>Organic Substrate</th>
<th>Top Soil Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container Capacity</td>
<td>192 mL</td>
<td>192 mL</td>
<td>192 mL</td>
</tr>
<tr>
<td>Airspace</td>
<td>14%</td>
<td>7%</td>
<td>17%</td>
</tr>
<tr>
<td>Water Holding Capacity</td>
<td>45%</td>
<td>66%</td>
<td>70%</td>
</tr>
<tr>
<td>Total Porosity</td>
<td>59%</td>
<td>73%</td>
<td>87%</td>
</tr>
</tbody>
</table>

The topsoil substrate had the highest airspace, water holding capacity and total porosity.

The organic substrate had lower airspace and more water holding capacity and total porosity as compared to the LSU substrate.

Particle size distribution of substrates calculated (Table 2). Eleven USA Standard Testing Sieves were used to sort and measure the varying physical characteristics of each substrate.
Table 2. Particle Substrate Sizes of Tested Substrates.

<table>
<thead>
<tr>
<th>U.S.A. Sieve sizes in Inches</th>
<th>LSU Substrate %</th>
<th>Organic Substrate %</th>
<th>Topsoil Substrate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.625</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>0.375</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>0.132</td>
<td>10%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>0.0937</td>
<td>4%</td>
<td>11%</td>
<td>7%</td>
</tr>
<tr>
<td>0.0787</td>
<td>2%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>0.0394</td>
<td>7%</td>
<td>19%</td>
<td>16%</td>
</tr>
<tr>
<td>0.0278</td>
<td>4%</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>0.0165</td>
<td>13%</td>
<td>15%</td>
<td>34%</td>
</tr>
<tr>
<td>0.0083</td>
<td>48%</td>
<td>21%</td>
<td>16%</td>
</tr>
<tr>
<td>0.0041</td>
<td>10%</td>
<td>89%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Bottom Pan</strong></td>
<td><strong>1%</strong></td>
<td><strong>3%</strong></td>
<td><strong>1%</strong></td>
</tr>
</tbody>
</table>

The bottom pan measurement is what was remaining after particles fell through the 0.0041 inch pan. The organic substrate was mostly comprised of material in the 0.0041 size range (89%) (Table 2). Approximately half or 48% of the LSU substrate was comprised of 0.0083 inch materials and the remaining mostly evenly distributed. The top soil substrate was pretty much evenly distributed among the particle sizes. The largest percentage in any one size of particle for the topsoil substrate was 0.0165 inches at 34%.
Plant Growth Results

Results are categorized by crop: ‘Packman’ Broccoli, ‘Snow Crown’ Cauliflower, and ‘Red Sail’ Lettuce. Broccoli heights were measured twice throughout the growing season and on the day of harvest for all three media types (Table 3).

Table 3. Mean Broccoli Plant Heights throughout Two Consecutive Growing Seasons and Final Harvest Days.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Height 1</th>
<th>Height 2</th>
<th>Final Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSU</td>
<td>13.4A</td>
<td>15.4B</td>
<td>19.6A</td>
</tr>
<tr>
<td>Organic</td>
<td>13.2A</td>
<td>17.5A</td>
<td>16.4B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>8.7B</td>
<td>11.4C</td>
<td>13.5C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at p ≤ 0.05 using SAS Proc GLM with Duncan. Means above include data from both the October 23rd, 2014 and replicated on January 26th, 2015 plantings. Height 1 measured on November 4th, 2014; Height 2 measured on December 4th, 2014; Final height measured 61 DAT and 66 DAT.

Plant height was measured throughout the study to determine if overall growth not just yield was affected by the three tested media. At the first measurements taken 12 DAT, the LSU and Organic mixes were taller (p≤0.05) than the topsoil mix. The same differences were found at the second height measurement collected 42 DAT however; the organic mix was the tallest (p≤0.05). But at the final measurement on the day of harvest, the LSU media produced the tallest plants followed by the plants grown in the organic mix and last the topsoil (p≤0.05). It appears as though the plants growing in the organic media reduced in height on the harvest date. However, this did not occur, the height measurement was taken from the soil level to the top growing point. As plant foliage became larger it also became heavier, therefore the leaves bent lower to the soil surface. Overall, it appears that the broccoli plants growing in the LSU medium grew the tallest
Along with height measurements, overall plant width was also measured to determine if plant size differed between broccoli growing in the three tested media. Broccoli plant width was measured twice throughout the growing season and on the day of harvest in all three media types (Table 4).

**Table 4.** Mean Broccoli Plant Width throughout Two Consecutive Growing Seasons and Final Harvest Days.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>November 4 Width 1</th>
<th>November 4 Width 2</th>
<th>December 4 Width 1</th>
<th>December 4 Width 2</th>
<th>Final Width 1</th>
<th>Final Width 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>18.9A</td>
<td>18.8A</td>
<td>20.4A</td>
<td>19.2A</td>
<td>20.9A</td>
<td>20.7A</td>
</tr>
<tr>
<td>Organic</td>
<td>15.4B</td>
<td>14.8B</td>
<td>17.8B</td>
<td>17.6B</td>
<td>18.9B</td>
<td>17.1B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>7.8C</td>
<td>7.9C</td>
<td>10.4C</td>
<td>10.3C</td>
<td>14.0C</td>
<td>13.6C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at \( p \leq 0.05 \) using SAS Proc GLM with Duncan. Means above include data from both the October 23\textsuperscript{rd}, 2014 and replicated on January 26\textsuperscript{th}, 2015 plantings. Width 1 measured on November 4\textsuperscript{th}, 2014; Height 2 measured on December 4\textsuperscript{th}, 2014; Final width measured 61 DAT and 66 DAT.

Plant width was measured throughout the study to determine if overall growth not just yield was affected by the three tested media. Plants in all three tested media selections grew throughout both studies. However, the LSU medium produced the widest plants at each of the three dates measurements were collected. The Organic medium produced wider plants than the topsoil medium but the growth was not as wide \( (p \leq 0.05) \) as those plants growing in the LSU medium. Overall, broccoli plants growing in the LSU medium grew the widest \( (p \leq 0.05) \). To enhance data collected, yield (weight of broccoli heads) was collected to compare plant growth response to the three tested media selections. Fresh broccoli head weight (g) was measured on the day of harvest in all three media types (Table 5).
Table 5. Mean Broccoli Head Weight (g) on Day of Harvest.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Day of Harvest Head Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>430.5A</td>
</tr>
<tr>
<td>Organic</td>
<td>313.7B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>3.3C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at $p \leq 0.05$ using SAS Proc GLM with Duncan.

Similar to both plant height (Table 3) and plant width (Table 4), yield or broccoli head weight was also heaviest in plants growing in the LSU media ($p \leq 0.05$), followed by the organic medium and the least heavy produced in the top medium.

The overall conclusion for broccoli production is that the additions of micronutrients and lime as well as the bark and sand help overall plant growth and yield. The organic medium was primarily composed of peat and little added nutrients. It seems as though the heavy peat, low nutrient content is not ideal for raised beds. The top soil had a better consistency but did not contain a pre plant fertilizer, which severely limited plant growth. Even on the second planting in January when pre plant fertilizer was added to the top soil, it was still not enough to compare to the organic and LSU media. When selling bagged media, consumers are looking for something that is ready to use. Soil companies should consider factors such as addition of fertilizer in an amount that produces quality plants and soil texture to hold water but still drain appropriately. This should all be factored into the medium product so that the consumer (who may or may not be garden savvy) does not need to amend the product in any fashion. In addition to broccoli, cauliflower plants were also grown in all three media selections to evaluate plant growth and yield.

Cauliflower heights were measured twice throughout the growing season and on the day of harvest in all three media types (Table 6).
Table 6. Mean Cauliflower Plant Height Throughout the two Consecutive Growing Seasons and on Harvest Dates.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Height 1</th>
<th>Height 2</th>
<th>Final Harvest Date Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>13.7A</td>
<td>14.5A</td>
<td>20.2A</td>
</tr>
<tr>
<td>Organic</td>
<td>8.4B</td>
<td>12.4B</td>
<td>13.7B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>7.1C</td>
<td>8.1C</td>
<td>9.4C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at \( p \leq 0.05 \) using SAS Proc GLM with Duncan. Means above include data from both the October 23\textsuperscript{rd}, 2014 and replicated on January 26\textsuperscript{th}, 2015 plantings. Height 1 measured on November 4\textsuperscript{th}, 2014; Height 2 measured on December 4\textsuperscript{th}, 2014; Final height measured 75 DAT on the first planting and 85 DAT on the second planting.

Plant height was measured throughout the study to determine if overall growth not just yield was affected by the three tested media selections. At the first measurements 12 DAT, the LSU and Organic mixes were taller (\( p \leq 0.05 \)) than the topsoil mix. The same differences were found at the second height measurement collected 42 DAT. On the final measurement day (harvest day), the LSU media produced the tallest plants followed by the plants grown in the organic mix and last the topsoil (\( p \leq 0.05 \)). Overall, it appears that the cauliflower plants growing in the LSU medium consistently grew the tallest (\( p \leq 0.05 \)). The cauliflower results are consistent with the broccoli results. Along with height measurements, overall plant width was also measured to determine if plant size differed between cauliflower plants growing in the three tested media.

Cauliflower widths were measured twice throughout the growing season and on the day of harvest in all three media selections (Table 7).
Table 7. Mean Cauliflower Plant Width Throughout the two Consecutive Growing Seasons and on Harvest Dates.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>November 4 Width 1</th>
<th>November 4 Width 2</th>
<th>December 4 Width 1</th>
<th>December 4 Width 2</th>
<th>Final Width 1</th>
<th>Final Width 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>19.7A</td>
<td>20.1A</td>
<td>19.1A</td>
<td>18.1A</td>
<td>23.7A</td>
<td>22.0A</td>
</tr>
<tr>
<td>Organic</td>
<td>10.4B</td>
<td>9.7B</td>
<td>13.8B</td>
<td>13.7B</td>
<td>14.7B</td>
<td>14.2B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>8.2C</td>
<td>8.0C</td>
<td>9.2C</td>
<td>9.0C</td>
<td>8.7C</td>
<td>8.7C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at $p \leq 0.05$ using SAS Proc GLM with Duncan. Means above include data from both the October 23rd, 2014 and replicated on January 26th, 2015 plantings. Width 1 measured on November 4th, 2014; Width 2 measured on December 4th, 2014; Final width measured 75 DAT on the first planting and 85 DAT on the second planting.

Plant width was measured throughout the study to determine if overall growth not just yield was affected by the three tested media. Plants in all three tested media selections grew throughout both studies. However, the LSU medium produced the widest plants at each of the three dates measurements were collected. On the first measurement date 12 DAT, the plant width in the LSU medium was significantly greater ($p \leq 0.05$) than the other two tested media. The LSU media seemed to gain the most growth at the beginning and whereas the other two media, organic and topsoil slowly grew over the season. However, they never caught up to the growth in the LSU medium. Overall, cauliflower plants growing in the LSU medium grew the widest ($p \leq 0.05$), same as broccoli plants growing in the LSU medium. To enhance data collected, yield (weight of cauliflower heads) was collected to compare plant growth and yield response to the three tested media selections. Mean fresh cauliflower head weight (g) was measured on the day of harvest in all three media types (Table 8).
Table 8. Mean Weight of Cauliflower Heads Harvest Dates

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Final Harvest Date Head Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>406.54A</td>
</tr>
<tr>
<td>Organic</td>
<td>160.64B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>4.14C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at $p \leq 0.05$ using SAS Proc GLM with Duncan.

Similar to both plant height (Table 6) and plant width (Table 7), yield or cauliflower head weight was also heaviest in plants growing in the LSU medium ($p \leq 0.05$), followed by the organic medium and the least heavy produced in the topsoil medium. This is extremely important as the head weight is the actual portion of the plant a consumer eats. Overall plant size increasing creates a sense that the gardener is using the correct production practices to encourage growth. But the actual head size is the reward for the plant growth. The overall conclusion for cauliflower production is that the additions of micronutrients and lime as well as the bark and sand help overall plant growth and yield. The organic medium was primarily composed of peat and little added nutrients. It seems as though the heavy peat, low nutrient content is not ideal for raised beds. The top soil had a better consistency but did not contain a pre plant fertilizer, which severely limited plant growth. Even on the second planting in January when pre plant fertilizer was added to the top soil, it was still not enough to compare to the organic and LSU media.

When selling bagged media, consumers are wanting something that is ready to use. Soil companies should consider factors such as addition of fertilizer in an amount that produces quality plants and soil texture to hold water but still drain appropriately. This should all be factored into the medium product so that the consumer (who may or may not be garden savvy) does not need to amend the product in any fashion. Both cauliflower and broccoli produced
similarly in the three tested media selections. In addition to broccoli and cauliflower plants, lettuce was also grown in all three media selections to evaluate plant growth and yield.

Lettuce plant heights were measured once during the growing season and on the day of harvest for all three media types (Table 9).

**Table 9.** Mean Lettuce Height Throughout the Growing Seasons and on Harvest Dates.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>14 DAT Height</th>
<th>Final Harvest Day Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(cm)</td>
<td></td>
</tr>
<tr>
<td>LSU</td>
<td>8.3A</td>
<td>16.2A</td>
</tr>
<tr>
<td>Organic</td>
<td>7.2B</td>
<td>13.4B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>6.7B</td>
<td>8.26C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at $p \leq 0.05$ using SAS Proc GLM with Duncan. Means above include data from both the October 23rd, 2014 and replicated on February 2nd, 2015 plantings. Height 1 measured on February 16th, 2015; Height 2 measured on March 6th, 2015; Final height measured 21 DAT and 32 DAT.

Plant height was measured throughout the study to determine if overall growth, not just yield, was effected by the three tested media. At the first measurements taken 14 DAT, the LSU mix was taller ($p \leq 0.05$) than the Organic mix and the topsoil mix. Yet there was no difference in the Organic mix and the topsoil mix. The same differences were found at the final height measurement taken 32 DAT however, the organic mix was the taller ($p \leq 0.05$) than the topsoil mix with the LSU mix being the tallest ($p \leq 0.05$). Overall, it appears that the lettuce plants growing in the LSU medium grew the tallest ($p \leq 0.05$). Along with height measurements, overall plant width was also measured to determine if plant size differed between lettuces growing in the three tested media. Lettuce widths were taken once during the growing season and on the day of harvest for all three media types (Table 10).
Table 10. Mean Lettuce Widths Throughout the Growing Seasons and on Harvest Dates.

<table>
<thead>
<tr>
<th>Soil Types</th>
<th>14 DAT Width 1</th>
<th>14 DAT Width 2</th>
<th>Final Width 1</th>
<th>Final Width 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>16.9A</td>
<td>16.2A</td>
<td>23.7A</td>
<td>18.7A</td>
</tr>
<tr>
<td>Organic</td>
<td>13.5B</td>
<td>12.4B</td>
<td>20.7B</td>
<td>17.1B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>11.8C</td>
<td>11.6C</td>
<td>12.4C</td>
<td>11.5C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at $p \leq 0.05$ using SAS Proc GLM with Duncan. Means above include data from both the October 23rd, 2014 and replicated on February 2nd, 2015 plantings. Width 1 measured on February 16th, 2015; Width 2 measured on March 6th, 2015; Final width measured 21 DAT on the first planting and 32 DAT on the second planting.

Plant width was measured throughout the study to determine if overall growth not just yield was affected by the three tested media. Plants in all three tested media selections grew throughout both studies. However, the LSU medium produced the widest plants at each of the three dates measurements were collected. On the first measurement date 14 DAT, the plant width in the LSU medium was significantly greater ($p \leq 0.05$) than the other two tested media. The LSU media seemed to gain the most growth at the beginning with organic following closely whereas the topsoil slowly grew over the season without much change. Either way, they never caught up to the growth in the LSU medium. Overall, lettuce plants growing in the LSU medium grew the widest ($p \leq 0.05$), same as broccoli and cauliflower plants growing in the LSU medium. To enhance data collected, yield (weight of lettuce heads) was collected to compare plant growth and yield response to the three tested media selections. Lastly, lettuce yield weights taken on the day of harvest for all three media types (Table 11).
Similar to both plant height (Table 7) and plant width (Table 8), yield for Lettuce head weight was also heaviest in plants growing in the LSU media (p≤0.05), followed by the organic medium and the least heavy produced in the topsoil medium. This is extremely important as the head weight is the actual portion of the plant a consumer eats. Overall plant size increasing creates a sense that the gardener is using the correct production practices to encourage growth. The actual head size is the reward for the plant growth. The overall conclusion for lettuce production is that the additions of micronutrients and lime as well as the bark and sand help overall plant growth and yield. The organic medium was primarily composed of peat and little added nutrients. It seems as though the heavy peat, low nutrient content is not ideal for raised beds. The top soil had a better consistency but did not contain a pre plant fertilizer, which severely limited plant growth. Even on the second planting in January when pre plant fertilizer was added to the top soil, it was still not enough to compare to the organic and LSU media.

When selling bagged media, consumers are looking for something that is ready to use. Soil companies should consider factors such as addition of fertilizer in an amount that produces quality plants and soil texture to hold water but still drain appropriately. This should all be factored into the medium product so that the consumer (who may or may not be garden savvy) does not need to amend the product in any fashion. All three vegetable crops cauliflower, broccoli, and lettuce produced similarly in the three tested media selections.

**Table 11. Mean Yield of Lettuce Heads Harvest Dates**

<table>
<thead>
<tr>
<th>Soil Types</th>
<th>Day of Harvest Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSU</td>
<td>89.5A</td>
</tr>
<tr>
<td>Organic</td>
<td>57.1B</td>
</tr>
<tr>
<td>Topsoil</td>
<td>12.2C</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at p ≤ 0.05 using SAS Proc GLM with Duncan.
Nutritional foliar tissue analysis was conducted on macro and micronutrients in the tissue of lettuce, broccoli, and cauliflower plants grown in all three tested substrates. Samples were collected after harvest, dried and submitted to the LSU Soil and Plant Testing Lab for analysis. Tissue analysis of broccoli samples revealed that the only two elements significantly different among the three tested substrates were N and Zn. Nitrogen and Zn levels in the LSU substrate were higher than the organic and topsoil substrates. In cauliflower samples, the LSU substrate was significantly higher in N, P, Ca, B, and Fe than the organic and topsoil substrates. The organic substrate was higher in K and S than the LSU substrate and topsoil substrates.

In lettuce samples N, P, K and Fe were similar in the LSU and organic substrates but higher than the topsoil substrate. Boron, Cu and Zn were higher in the LSU substrate than the organic and topsoil substrates for lettuce foliage. Overall, there were some differences in fertility in the foliage of broccoli, cauliflower and lettuce samples after harvest. The LSU substrate in most cases provides enough elements for healthy plant growth. It is probably this fertility difference that enables plant growth in the LSU substrate to yield more mass (Appendix A1-3).

The necessity of having a well-planned media mix with appropriate amendments and soil texture is key to producing quality media for raised bed grown vegetables. The topsoil media mix was the most basic garden topsoil available in the garden retailer. It had no additional amendments included in the bagged mix and did not result in greater plant growth of the three mixes. The organic media although more improved than the topsoil, did not deliver the nutritional needs of the vegetable plants to produce a quality product for the day of harvest. The previously researched growth media with micronutrients and dolomitic lime was significantly (p ≤ 0.05) superior to the previous media mixes with the desired outcome being quality vegetables. Adding amendments to growth media is common and the reasoning is that the 1:1:1 ratio of pine
bark, sand, and peat moss is lacking in micronutrients even though pine bark can result in mineralization of nutrients for plant uptake (Conover et al., 1975; Leda, 1986). Pine bark is characterized as being acidic. Therefore the addition of is beneficial in creating a suitable substrate pH for increased nutrient availability (Germishuisen, 1988; Mupondi, 2006).
Chapter 3 Assessing Potential Change in Juvenile Defenders’ Knowledge and Attitude during Garden Programming

Introduction and Literature Review

Raised bed gardening has numerous advantages for home production. Foremost their design is ideal for small or limited spaces and for gardeners with limited equipment (LSU AgCenter, 2015). Gardening with vegetables as a means of education and production in America dates back to 1891 (Subramaniam, 2002). The benefits of gardens are numerous. Gardens provide communities with fresh produce; hands on learning not only for school aged children, but work force preparation for young adults. Gardens create wildlife habitats; are environmentally friendly; and beautify urban and rural settings (USDA-People’s Garden-Impact, 2018). Not all youth learn in traditional in-school settings. A form of a non-traditional learning settings would be in long term (over a year) and short term (less than a year) juvenile detention centers. The objective of developing and evaluating a garden workshop series in a juvenile detention facility was to determine if hands-on garden activities broaden the students’ agricultural and gardening knowledge base, and to evaluate detained youths’ emotional reactions as a result of participation in the series.

Materials and Methods

Site Description

Prior to initiating the study to evaluate gardening with juveniles the project was approved by the Institutional Research Board at Louisiana State University (IRB approval number 3539). Three raised garden beds were constructed for use at the East Baton Rouge Juvenile Detention Center. The raised beds were placed in a designated outdoor recreational area. The outdoor recreation area at the juvenile detention center is a large area with multiple basketball courts and
a large green space with numerous pine trees. Unfortunately due to the proximity to the airport the established pines were removed for safety during the duration of our project. The addition of the gardens provided the sole nature components to the recreational area. The three raised beds were built on the far left hand side of the area about 3 meters (10 feet) off and along the fence. The beds were 1.2 meters (4 feet) wide by 2.4 meters (8 feet) long standing 30.48 cm (12 inches) high. The beds were spaced 1.5 meters (5 feet) apart. Irrigation was provided to the garden space. PVC pipe was trenched for an estimated 45.72 meters (50 yards) from one of the buildings on the facility to the garden and then connected to soaker hoses placed in each of the three raised beds. The soil was delivered by truck and placed in the garden by several of students at the detention center who were interested in participating in the garden workshop series. Before garden curriculum was presented, Juvenile Detention students helped amend the soil following instruction from the lead LSU AgCenter graduate student. Before the series began, one afternoon was spent with each group guiding them in planting their transplants and seeds in one of the three raised beds. Each garden had an even distribution of all the options which included: broccoli, cauliflower, carrots, shallots, and lettuce. Ant insecticide was provided to the detention center to apply on an as needed basis. Come and Get It™ with and active ingredient of Spinosad. Other than the use of ant specific insecticides, no other insecticides or fungicides were applied during this study.

Participants

One hundred and two juvenile detained students participated in the garden workshop series. The series was conducted seven times, once per month. There were eight age levels of the youth participating: 12, 13, 14, 15, 16, 17, 18, and 20. The workshop spanned over 3 days each month. During the time between the monthly garden workshop series, juvenile detained students
were allowed during their recreational time to monitor irrigation needs of the garden, and allowed to pull any weeds that were growing and evaluate vegetable crop growth. During the garden workshop series the student assisted twice in planting the raised beds. Participants were provided a garden workbook containing a pick a mood pictogram, pre and post lesson test questions, and the lessons for the day. Participants were also provided with all supplies needed to conduct each hands-on activity.

Lesson Development

A workshop workbook was created for individual students to use during the garden activities. The workbook was colorful to create interest in the students and to aid in comprehension with the use of pictures to further explain the topic being covered. The full workbook is provided in the appendix of this thesis. The format of the workbook included a student assent form (appendix) which explained to participants that the program was completely optional, that by answering the questions each day participants were providing critical information about whether or not they had previous knowledge of the subject matter and if they gained new knowledge. It also informed them that their information was recorded anonymously, they would not be forced to participate in the program and, if at any time the participants did not want to participate they could return to their normal activities inside the detention center without penalty. This project was not exempt from IRB approval as participants were both minors and detained. The IRB exemption number for this study was 3539. The next section in the workbook was a personal attitude/mood selection chart called Pick-A-Mood. This was collaboratively created by authors from Delft University of Technology and Eindhoven University of Technology (Desmet, P.M.A. et al, 2012) (appendix) Pick-a-Mood aided in gaging the initial mood of the students before the daily garden activity began. The Pick-a-Mood image was also
included following each day’s (of the 3 day garden series) lesson. This way we could evaluate the general mood of students prior to and after participation in a daily garden activity. The garden activities consisted of two pre-lesson questions, lesson objectives, material needed for the lesson, and instructions how to complete the hands on activity. After each day’s lessons were completed participants were instructed to answer the same two knowledge based questions as a post-lesson check to see if they gained new knowledge and to select how they were feeling on the Pick-A-Mood chart. Each workbook contained three days’ lessons. The workshop was conducted once a month for three consecutive days. Each day the LSU graduate student was allowed 3 hours with juvenile participants. The youth that are at the detention center attend school during the day so the workshops were conducted after 3pm till 5pm as not to interfere with their daily school work routine. The detainees were allow recreational time outdoors to either relax or play basketball, but this was limited and dependent on the weather and available staff. The addition of the garden workshop series offered the youth an additional opportunity to be able to recreate out of doors again dependent on the weather and available staff.

**Workbook Lessons**

For the garden series there were a total of six lessons, two per day that the students were encouraged to participate in. Individual garden lessons are described in the following paragraphs. The entire workbook is included in the appendix.

**Plant Parts You Eat**

The objective was to learn the different parts of a plant and to identify which parts are being consumed when you eat common vegetables and fruits. The six basic parts of a plant were discussed including roots, the stem, the leaves, the flowers, the fruit and the seed. The remainder of the lesson discussed varying vegetables and fruits brought to the workshop. Participants were
asked to identify based on the 6 parts of a plant learned which vegetable was which part of the plant. After correct identification of plant parts, participants were allowed to taste the vegetable crops. Depending on the month, some items were purchased and then some of them were harvested from the garden onsite.

**Creative Recycling**

The objective was to expose the students to creative ways to reuse common items that are easily accessed and incorporate horticulture. Grow cards were discussed and how they are used. Then the materials were discussed and directions were given to complete the task at hand.

Everyone was able to participate in creating their own grow card that would be brought back the following day after proper drying. The students were allowed to keep them with their personal affects until they left the facility. Grow cards are made from newspaper blended with water. The mixture is formed into a shape, seeds added and mixture pressed to expel excess water. Once dried they are ready for use. To use a grow card, shallowly plant it in the soil and keep moist till seeds sprout, then water as needed.

**What Can Worms Do?**

The objective was to introduce the students to the amazing things worms do (i.e. compost) and to create a Vermiculture compost box. Beneficial attributes of worms were discussed and their importance. The bin was constructed using 2 plastic containers and the lid. Students added numerous strips of newspaper topped off with a one inch layer of potting soil. Using the vegetable and fruit scraps from the previous day’s lesson and a cup of water, the bin was ready for the worms. The youth were encouraged to add the live worms to the completed bin.
Soil: What is it Made of?

The objective was to give participants a general lesson on the components of soil. Discussion of different components that make up soil occurred along with visual comparisons to understand the particle sizes. For example a pea represented clay, a ping pong ball represented silt, and a basketball represented sand. Clay is the smallest of soil particles, silt falls in the middle, and sand is the largest in particle size. A soil mixture was placed into a glass jar, filled with water and shook to reveal the layers once settled. Participants were able see to the layers forming almost immediately.

It’s an Herb, Herb!

The objective was to expose the youth to common herbs that are used in everyday foods and some not so common. Multiple types of herbs were brought for the students to touch, taste, and smell. Each herb was identified and it uses discussed. After the lesson, the students used bread to taste a dry herb mixture blended with olive oil.

Taste Testing

The objective of this lesson was to highlight the senses used to taste and select food. Multiple varieties of apples were brought and prepared for a basic taste evaluation. Discussions were had about the five senses people possess, the ones we use to taste food and the ones we use to select food. Each participant was asked to pre-judge the apples based on their appearance, then to judge them again after tasting. The students rated the apples overall on appearance, taste, texture, and sound. Full lessons are included in the appendix.
Pre and Post Test Questions

Each day there were 2 questions that were asked pre and post the garden workshop series. Each question was multiple-choice and was worth 16 points. Tests are included with the workshop in the appendix.

Table 12. Questions and Objectives in the 2014-2015 Juvenile Detention Center Garden.

<table>
<thead>
<tr>
<th>Day and Question Number</th>
<th>Questions</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1 Q 1</td>
<td>What part of the plant do we eat when we eat a carrot?</td>
<td>To see if they knew that carrots are roots and to get them started thinking about the different plant parts we eat.</td>
</tr>
<tr>
<td>Day 1 Q 2</td>
<td>How deep do you plant a seed?</td>
<td>To see if they knew the proper depth to plant a seed and to get them thinking about the differences in seeds sizes and how that might affect the depth.</td>
</tr>
<tr>
<td>Day 2 Q 1</td>
<td>What positive effect(s) do worms have on plants?</td>
<td>To see if they could pick some of the features of a worm and to get them thinking about worms in a positive light for the benefit</td>
</tr>
<tr>
<td>Day 2 Q 2</td>
<td>What are the three main components of soil?</td>
<td>To see if they could pick the three things that make up soil and to alert them that there are only three things that create soil.</td>
</tr>
<tr>
<td>Day 3 Q 1</td>
<td>How are herbs used?</td>
<td>To see if they knew any uses and to get them thinking about what herbs are and how could they be used.</td>
</tr>
<tr>
<td>Day 3 Q 2</td>
<td>You have five senses, sight, hearing, touch, taste, and smell. Which three senses do you use to taste food?</td>
<td>To see if they could identify all of the senses needed for tasting food. Continued to try and get the students to think outside of the obvious senses choices.</td>
</tr>
</tbody>
</table>

All test questions with answer choices are located in the appendix. Q= Question.
Pre- and Post-Test Attitude Evaluation

A collaborative effort between Delft University of Technology and Eindhoven University of Technology lead to the development of the Pick-A-Mood chart utilized by participants in this study to determine their emotional state prior to and after the garden activities (Desmet, P.M.A. et al, 2012). The 9 states were: Neutral, Relaxed, Cheerful, Excited, Calm, Bored, Sad, Tense, and Irritated. The students were asked to circle one of the mood section choices before the workshops began and at the completion of the workshops. The selection fell before and after they were asked to answer their pre and post test questions. The objective here was to see if the garden workshop series was beneficial to their overall feelings.

Figure 4. Pick a Mood Chart Developed by Delft University of Technology and Eindhoven University of Technology
Lesson Implementation

The garden workshop series consisted of three days of lessons. The series was conducted three consecutive days of the week each month and started at 3:00 pm when the youth ended their JD school day. The first day included the “Plant Parts You Eat” and the “Creative Recycling” lessons. “What Can Worms Do” and the “Soil: What is it Made of” Lessons were taught on the second day. The final day of the workshop series included ”It’s an herb, Herb” and the “Taste Testing” lessons. Before each lesson was conducted, participants would answer a preknowledge question related to the two lessons and rate how they felt on the Pick-a-Mood chart. Participants were divided into two smaller groups, sometimes three. As a group, the lesson objective was discussed. The Graduate student explained the procedure for the lesson and the hands-on activity commenced. If the hands-on lessons ended early and weather permitted, the group was allowed to go to the raised bed gardens to weed, water and monitor plant growth.

Results and Discussion

Each day before the garden series began and after the workshop was completed for the day the students were requested to rate their overall mood. In each replication, participant mood elevated on the first and third days of the gardening series from the beginning of the lesson to the end. On day two, student mood elevated but not to a significant degree.
Table 13. Students Self-Identified State of Mood both Before and After Garden Activities.

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre Score</strong></td>
<td>6.23B</td>
<td>6.39A</td>
<td>6.46B</td>
</tr>
<tr>
<td><strong>Post Score</strong></td>
<td>6.78A</td>
<td>6.69A</td>
<td>7.24A</td>
</tr>
</tbody>
</table>

Columns with different letters are significant at \( p \leq 0.05 \) using SAS Procedure GLM with Duncan.

The Pick a Mood facial expression chart included 9 states of emotion. Each state is ranked from 1 to 9 with 9 being the most happy or joyful.

The first and third day’s lessons included taste testing fruits and vegetables which may explain the correlation of the increase in mood, whereas the second day was dedicated to soil and worms. Participants in this study were serving a sentence or in waiting periods for a judges’ decision on their crime. Living in a juvenile detention center is not much different from living in an adult jail. Snacks are not freely given and sweet deserts or sweet items are limited in the allowed menu. This curriculum provided students with a chance at tasting various locally grown items. Even though the second day’s results are not significant the score did not decrease. Thus confirming the hands-on garden activities decreased tension and provided participants with pleasant and meaningful activities in a rather mundane and dull environment (Sandel, 2004).
Table 14. Students Pre and Post Test Question Analysis

<table>
<thead>
<tr>
<th></th>
<th>D1Q1</th>
<th>D1Q2</th>
<th>D2Q1</th>
<th>D2Q2</th>
<th>D3Q1</th>
<th>D3Q2</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre</strong></td>
<td>9.4B</td>
<td>6.4B</td>
<td>4.1B</td>
<td>6.6B</td>
<td>5.9B</td>
<td>9.2A</td>
<td>43%B</td>
</tr>
<tr>
<td><strong>Post</strong></td>
<td>12.7A</td>
<td>11.5A</td>
<td>6.0A</td>
<td>10.7A</td>
<td>7.1A</td>
<td>9.7A</td>
<td>60%A</td>
</tr>
</tbody>
</table>

Numbers in columns with different letters are significant at p≤0.05 using SAS Proc GLM with Duncan.
D = Day; Q = Question

Pre and Post Lesson Test Questions

In addition to Pick-A-Mood chart, participants answered pre and post test questions to identify their garden knowledge level before and after each day of the workshop. Each question was multiple-choice with a value of 16 points totaling 96 possible points. Knowledge was gained after participating in the hands-on activity in all but one lesson.

The significant knowledge increase for all but one test question may be attributed to the students having no prior gardening exposure. Lack of garden exposure is likely due to participants’ residing in an urban settings that may not conform to traditional gardening. Many of the participants come from disadvantaged backgrounds, lacking resources to initiate a garden; these are similar to findings from Pigg et al. 2006 where kids fill in the blank. Overall test scores increased by 17% indicating that hands-on garden curriculum helps students engage at a deeper level in basic science materials. Day 3, question 2 was (inert question). Now say why you think there wasn’t a significant increase here. Maybe kids already seemed confident in this concept?
The benefit of the garden workshop series was not only felt by the students, but by all who were involved, including those giving the lessons and JV staff. The “good feeling from the workshop is a commonly reported benefit of extracurricular activities in solemn settings. A study conducted in a hospital setting in New York with nursing students and psychiatric patients, reported viewing the patients as not just a person with a mental illness, but as a person with a disease (Smith, D 1998). The students were able to view patients first as people, then second as patients. This garden series project created a feeling that the students were first and foremost, kids, not simply juvenile delinquents. This feeling was not only vocalized by the chief graduate student working on this project but also through the on-staff counselor working on a daily basis with these detained youth.
Chapter 4 Conclusions

The raised bed media study results of broccoli, cauliflower and lettuce growth and yield favored a media mix that had been amended with micronutrients and lime. Purchasing commercial garden soil media in retail stores with no advertised add-ins and leaving them ‘as-is’ proved to not be appropriate for producing quality vegetables because they lacked the micronutrients that plants need to prosper. The researched LSU AgCenter media mix with Micromax™ and dolomitic lime was found to be a well-balanced media that supported the growth needed for the plants to produce a quality product in a raised beds setting.

The goal for creating the garden workshop series at the juvenile detention center was to determine if hands-on agricultural based lessons would be beneficial academically and emotionally for the students and based on the tangible results, the series was a success. Citing the success this project or a similar project could be recommended to other juvenile detention centers as well as to school garden leaders. The garden workshop could be adapted by multiple groups such as after care school settings, boys and girls clubs and summer camps. The lesson can also easily be modified to fit the needs of younger or older students. The garden portion could be added upon or adjusted and the lessons could be tailored to other programs.
Literature Cited


LSU AgCenter. 2016. Louisiana Summary: Agriculture and Natural Resources. LSU AgCenter. Pub. No. 2832


Sinnes, A.C. 2014. Food gardening in the U.S. and the highest levels in more than a decade according to new report by the national gardening association. 26 February 2018. <https://garden.org/learn/articles/view/3819/>


Appendix Media Nutritional Results and Lessons

Plant foliar samples were harvested in the first growing season to determine if nutritional differences existed among broccoli, cauliflower and lettuce plants growing in the 3 tested substrates. Results are listed below in the three appendix tables.
Table A1. Broccoli Nutritional Analysis Post-Harvest in Year 1 of the Substrate Study

<table>
<thead>
<tr>
<th>Species</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>S</th>
<th>B</th>
<th>Cu</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Soil</td>
<td>2.8 b</td>
<td>0.85 b</td>
<td>4.4 a</td>
<td>2.3 b</td>
<td>0.75 a</td>
<td>2.0 a</td>
<td>24 b</td>
<td>3.7 ab</td>
<td>74 b</td>
<td>162 a</td>
<td>59 a</td>
</tr>
<tr>
<td>LSU Soil</td>
<td>6.4 a</td>
<td>0.93 a</td>
<td>2.8 b</td>
<td>3.3 a</td>
<td>0.73 a</td>
<td>1.2 b</td>
<td>53 a</td>
<td>5.2 a</td>
<td>102 a</td>
<td>199 a</td>
<td>74 a</td>
</tr>
<tr>
<td>Top Soil</td>
<td>1.3 c</td>
<td>0.32 c</td>
<td>2.5 b</td>
<td>0.9 c</td>
<td>0.13 b</td>
<td>0.8 c</td>
<td>16 c</td>
<td>1.7 b</td>
<td>34 c</td>
<td>54 b</td>
<td>14 b</td>
</tr>
<tr>
<td>Normal Range</td>
<td>3.3-4.5</td>
<td>0.33-0.8</td>
<td>2.6-4.2</td>
<td>2.0-3.5</td>
<td>0.24-0.5</td>
<td>ND</td>
<td>30-200</td>
<td>4-15</td>
<td>30-200</td>
<td>25-250</td>
<td>20-250</td>
</tr>
</tbody>
</table>

Table A2. Cauliflower Nutritional Analysis Post-Harvest in Year 1 of the Substrate Study

<table>
<thead>
<tr>
<th>Species</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>S</th>
<th>B</th>
<th>Cu</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Soil</td>
<td>3.6 b</td>
<td>0.58 a</td>
<td>4.1 a</td>
<td>1.1 b</td>
<td>0.38 ab</td>
<td>1.3 a</td>
<td>13 b</td>
<td>4.3 b</td>
<td>62 b</td>
<td>91 b</td>
<td>69 b</td>
</tr>
<tr>
<td>LSU Soil</td>
<td>7.3 a</td>
<td>0.72 a</td>
<td>2.2 b</td>
<td>2.9 a</td>
<td>0.56 a</td>
<td>1.3 a</td>
<td>40 a</td>
<td>7.2 a</td>
<td>115 a</td>
<td>178 a</td>
<td>126 a</td>
</tr>
<tr>
<td>Top Soil</td>
<td>1.9 c</td>
<td>0.30 b</td>
<td>2.1 b</td>
<td>1.3 b</td>
<td>0.21 b</td>
<td>0.8 a</td>
<td>13 b</td>
<td>2.7 b</td>
<td>40 b</td>
<td>66 b</td>
<td>24 c</td>
</tr>
<tr>
<td>Normal Range</td>
<td>3.2-5.5</td>
<td>0.3-0.75</td>
<td>2.0-4.0</td>
<td>1.0-2.5</td>
<td>0.23-0.75</td>
<td>0.3-0.75</td>
<td>30-100</td>
<td>4-15</td>
<td>70-300</td>
<td>0.3-0.5</td>
<td>20-200</td>
</tr>
</tbody>
</table>
Table A3. Lettuce Nutritional Analysis Post-Harvest in Year 1 of the Substrate Study

<table>
<thead>
<tr>
<th>Species</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>S</th>
<th>B</th>
<th>Cu</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>mg/kg dwt</td>
<td>ppm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic Soil</td>
<td>5.3</td>
<td>0.88 a</td>
<td>7.0 a</td>
<td>2.0 a</td>
<td>0.51 a</td>
<td>0.37 b</td>
<td>24 b</td>
<td>14 b</td>
<td>228 a</td>
<td>291 ab</td>
<td>109 b</td>
</tr>
<tr>
<td>LSU Soil</td>
<td>5.6</td>
<td>0.99 a</td>
<td>5.6 a</td>
<td>1.4 a</td>
<td>0.69 a</td>
<td>0.47 a</td>
<td>33 a</td>
<td>27 a</td>
<td>678 a</td>
<td>555 a</td>
<td>248 a</td>
</tr>
<tr>
<td>Top Soil</td>
<td>1.9</td>
<td>0.26 b</td>
<td>2.9 b</td>
<td>2.0 a</td>
<td>0.42 a</td>
<td>0.20c</td>
<td>19 b</td>
<td>10 b</td>
<td>206 a</td>
<td>136 b</td>
<td>44 b</td>
</tr>
<tr>
<td>Normal Range</td>
<td>4.0-5.0</td>
<td>0.4-0.6</td>
<td>6.0-7.0</td>
<td>2.3-3.5</td>
<td>0.5-3.5</td>
<td>ND</td>
<td>25-60</td>
<td>8-25</td>
<td>50-100</td>
<td>15-250</td>
<td>25-250</td>
</tr>
</tbody>
</table>
Get It Going & Growing
Garden Series
Name: _____________________  Age: _________

**Student Assent Form**

I, ____________________________, agree to let my answers on the Garden Lesson Questions be used for the sole purpose of the study conducted by Dr. Kathryn Fontenot, Dr. Edward Bush and Mrs. Stephanie Gravois from the LSU AgCenter. I understand my answers on this survey will remain anonymous. My counselor will not see the results, nor will the scores reflect any grades or conduct behavioral reports that I receive. I can stop participating in this garden project at any time without getting into trouble.

**Student’s Signature** ____________________________

**Date**_________
Plant Parts You Eat!

Before we start let’s ask a question...

Circle the correct answer. There may be more than 1 correct choice.

1. What part of the plant do we eat when we eat a carrot?
   A. Stem
   B. Root
   C. Flower
   D. Leaf

2. How deep do you plant a seed?
   A. 1 foot deep
   B. 5 times as deep as the seed is wide
   C. 2-3 times as deep as the seed is wide
   D. Always as deep as your thumb

Do you eat vegetables? Yes or No, if yes, list a few:

_____________________________________________
_____________________________________________
_____________________________________________
_____________________________________________
**Lesson Objective:** Discover the many plant parts that we eat.

**Materials Needed:**
- Plates
- Carrots
- Celery
- Lettuce
- Spinach
- Peppers
- Bananas
- Sunflower Seeds
- Corn
- Broccoli
- Cauliflower
- Ranch Dressing
Directions:

First we will learn the six basic parts of a plant.

Discuss the various parts of the plant that people eat.

Let’s look at all the plant items I brought and decide which part of the plant they came from.

Taste the different plant parts!!

Examples of Edible Plant Parts:

Six basic parts of the plant are: Roots, Stems, Leaves, Flowers, Fruit, and Seeds.

We eat all six plant parts from different plants. Sometimes we even eat more than one part from one plant.

Some people eat grape leaves and grape fruit (encases the seed).

Some people eat turnip roots and others eat the turnip greens, which are the leaves of the plant.

Some people eat pumpkin flesh (fruit) in pumpkin pies and others eat the pumpkin seeds roasted.
1 leaves
2 flower
3 fruit
4 stem
5 seed
6 roots
Lesson Objective: Learn a creative way to recycle newspaper by making greeting cards you can plant!

Materials Needed: 
- Newspaper
- Screen
- Blender
- Plastic Bin
- Paper Towels
- Ziploc Bags
- Blended Newspaper
- Cookie Cutters
- Water
- Seeds
- Beach Towel
- Permanent Marker

Directions:

- Tear the newspaper into strips and then into little squares. (About the size of a stamp)
- Fill the blender half full of the scraps.
- Fill the blender ¾ full with water and blend it up till it has an oatmeal-like consistency.
- Choose a cookie cutter in your favorite shape.
- Place your cookie cutter on the screen and pour some of the newspaper mixture into your cutter.
Choose your flower seeds and press them gently into the newspaper mixture in your cookie cutter.

Place the screen on top of the beach towel. Carefully remove the cookie cutter and place a paper towel on top of the card.

Press down on the card to remove excess water.

Allow the card to dry for as long as possible. Place your card in a plastic bag with your name on it and I will return your card to you when they are dry!!

Please Answer the Questions Again
(It is ok to change your answer or choose a new one.)

Circle the correct answer. There may be more than 1 correct choice.

3. What part of the plant do we eat when we eat a carrot?
   A. Stem
   B. Root
   C. Flower
   D. Leaf

4. How deep do you plant a seed?
   A. 1 foot deep
   B. 5 times as deep as the seed is wide
   C. 2-3 times as deep as the seed is wide
   D. Always as deep as your thumb

Do you eat vegetables? Yes or No, if yes, list a few:

___________________________________________
What Can Worms Do?

Before we start let’s ask a question...

Circle the correct answer. There may be more than 1 correct choice.

1. **What positive effect(s) do worms have on plants?**
   A. Fertilize the soil
   B. Make the soil loose so roots can grow
   C. Worms eat the roots
   D. Worms help prevent plant disease

2. **What are the three main components of soil?**
   A. Sand, rocks, leaves
   B. Moss, clay, sticks
   C. Sand, clay, peat
   D. Sand, silt, clay

**Lesson Objective:** Discover a fun way to recycle and compost table scraps.
**Materials Needed:**

Plastic bin with lid  
Newspaper  
Water  
Soil  
Table Scraps  
1 lb. of red wiggler earthworms  

**Directions:**

- Sprinkle a thin layer of soil in the bottom of the bin.
- Tear 1 inch wide-strips of newspaper (not the shiny ads). Make enough strips to fill the bottom of the bin 6 inches deep.
- Dip strips into water before placing them in the bin.
- Add the table scraps on top of the newspaper.
- Sprinkle soil over the newspaper and scraps to create a 1 in layer on top of the newspaper.
- Slightly water the soil, just enough to make it damp.
- Add your earthworms
- In a few days the earthworms will start to recycle the food scraps and newspaper. How does this work?
Interesting Facts about Worms:

- Worms help plants out by aerating the soil – Which means they add oxygen to the soil.

- Worms loosen the soil around plant roots giving them more room to grow! This makes it easy for plants roots to grow deeper.

- Worms fertilize the soil by adding organic matter (Worm poop is called castings) and they help prevent diseases.
Soil: What is it Made of?

**Lesson Objective:** Know the three main components of soil and their sizes.

**Materials Needed:**
- 16oz. Jar with lid
- Scoop of dirt
- Water

**Directions:**

- What are the three main components that make up soil?

- Let’s discuss the size of the clay silt and sand particles.

- Fill the jar half way with soil.

- Add water to the other half of the jar.

- Shake vigorously until all clumps of soil are broken up and let it sit for one to five minutes!

**Facts about Soil:**

- The three main components of soil are Clay, Silt, and Sand.

- Sand is the heaviest component of soil and it is the largest of the three components, so it sinks to the bottom of the jar first.
Silt falls somewhere in the middle of particle size and weight, so it is in the middle layer of the jar.

Clay is the smallest particle size and therefore it is the lightest and it forms the top layer.

If there is anything floating in our jar, it is organic matter.
Please Answer the Questions Again

(It is ok to change your answer or choose a new one.)

Circle the correct answer. There may be more than 1 correct choice.

3. **What positive effect(s) do worms have on plants?**
   A. Fertilize the soil
   B. Make the soil loose so roots can grow
   C. Worms eat the roots
   D. Worms help prevent plant disease

4. **What are the three main components of soil?**
   A. Sand, rocks, leaves
   B. Moss, clay, sticks
   C. Sand, clay, peat
   D. Sand, silt, clay
It’s an herb, Herb!

Before we start let’s ask a question...

Circle the correct answer. There may be more than 1 correct choice.

1. How are herbs used?
   A. Seasoning food
   B. Medicine
   C. Natural pesticides
   D. Soaps, perfumes, and oils

2. You have five senses, sight, hearing, touch, taste, and smell. Which three senses do you use to taste food?
   A. Sight
   B. Smell
   C. Taste
   D. Touch
   E. Hearing

Lesson Objectives: Discover the many uses of herbs!

Materials:  
Dried herbs  
Dried Rosemary  
Small drawstring bags  
Olive Oil  
Bread
Directions:

- Discuss the many uses of herbs.
- Discuss the difference between an herb and a spice.
- We will create our own natural air fresheners.
- Take some of the dried herbs and place them in the bags and tie them closed. Voila! We’re done! Practice creating the perfect scent by combining different herbs together.
- Let’s discover how herbs flavor our food by tasting olive oil and bread with and without seasonings (dried herbs).
- Who uses herbs to cook? What are your favorite kinds of food to eat? Let’s think about the herbs and spices used in those dishes.

Herb Facts:

- Herbs have many uses. Herbs can be used for seasoning, medicine, soaps, perfume, oils to scent houses, and natural pesticides.
- The difference between an herb and a spice is that an herb comes from the leaves of a plant and a spice comes from the roots, bark, or seeds.
- Some plants can be both an herb and a spice depending on which portion of the plant you use! Cilantro is the leaf of the plant, while Coriander is the seed if the Cilantro plant.
Lesson Objective: Conduct an apple taste test to discover the four senses we use when determining what kinds of food we like and do not like to eat.

Materials: Score sheet 4 Apple Varieties
Blindfolds Pencils
Plastic cups or bowls

Directions:

- First we will discuss which apple varieties we will taste.
- Next you pick which apple you think will be your favorite before tasting.
- Then we will ask that you put your blindfold on and we will conduct the taste test.
- Finally we will discuss the results.
Using Your Senses:

How many senses do we have? Five! They include: sight, smell, touch, taste, and sound. We use three senses to taste our foods and four to choose our foods.

After eating the apple while wearing a blind fold, Did you still like the taste of the apple you choose without a blind fold?

This goes to show that sometimes our choices by sight alone are not always the correct choice! We should try new and different foods because we may find that we like them!

Fun fact: Can we grow apples in Louisiana? Yes both ‘La-96’ and ‘Anna’ (two cultivars of apples) grow very well here. We have to select apple trees that do not need a lot of chilling to produce fruit.
Please Answer the Questions Again
(It is ok to change your answer or choose a new one.)

1. **How are herbs used?**
   A. Seasoning food
   B. Medicine
   C. Natural pesticides
   D. Soaps, perfumes, and oils

2. **You have five senses, sight, hearing, touch, taste, and smell. Which three senses do you use to taste food?**
   A. Sight
   B. Smell
   C. Taste
   D. Touch
   E. Hearing

**Do you eat vegetables? Yes or No If Yes, List a few:**

__________________________________________
__________________________________________
__________________________________________
__________________________________________
__________________________________________
Diagram used to determine juvenile detention participant emotional state before and after each lesson

Circle The Person That Best Describes How You Feel Right At This Very Moment
Vita

Stephanie Hutchinson Gravois is first and foremost a wife and a mother. She has been married to Matthew Gravois, a sugarcane farmer for 8 years and they have three children. Her oldest is a little boy of six named Peyton, her middle is a little lady of four named Lorelei, and her youngest is a sweet baby girl of 10 months named Savannah. She’s a native of Baton Rouge, but now resides in St. James Parish with her family. Stephanie has been a full time Assistant 4-H Agent in Ascension Parish for the past 5 years. She graduated with her bachelor’s in Science from Louisiana State University Agricultural & Mechanical College in 2009. Her major was in Animal, Dairy, & Poultry Science with a minor in Wildlife Ecology. Stephanie’s hobbies include working in her yard and garden with her children, reading, and fishing with her husband.