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FOOD SAFETY AND SCHOOL GARDEN PROGRAM

Valerie Calberry
University of Rhode Island, vcalberry@my.uri.edu

FOOD SAFETY AND SCHOOL GARDEN PROGRAM

BY

VALERIE CALBERRY

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MASTER OF SCIENCE THESIS

OF

VALERIE CALBERRY

APPROVED:

Thesis Committee:

Major Professor	Ingrid E. Lofgren
Co-Major Professor	Lori F. Pivarnik
	Cathy English
	Becky Sartini
	Nasser H. Zawia

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ABSTRACT

School food safety education programs have increased knowledge and promoted proper food safety practices, attitudes and beliefs of students. Supplying young children with basic food safety education is important for the development of foundational food safety knowledge and behaviors. The primary objective of the Food Safety and School Garden Program (FSSGP) was to develop an intervention curriculum that integrated food safety principles into school garden-related activities and the primary hypothesis was that there would be a significant increase in students' knowledge from pre- to post-intervention. The secondary objectives of this study were to assess knowledge changes by grade and by curriculum category, evaluate the FSSGP through student activity ratings and to assess student-to-parent interaction. The FSSGP was part of the Farm to School Project, which was coordinated by Farm Fresh RI, a not-for-profit organization with a mission to grow a local food system. The two-lesson intervention consisted of a didactic component of four major categories: bacteria, washing hands, washing produce, and washing containers and interactive activities that accompanied discussion of each category. First through fifth grade students' (n=194) knowledge was evaluated using 10-question baseline and post-intervention tests. Number of correct responses increased from 5.6±1.8 to 8.1±1.9 ($p<.001$). There was an increase in knowledge by grade ($p<.001$) and by category ($p<.05$). Additionally, the majority of students rated all activities as either satisfactory or better. Finally, over 80% of students indicated they would tell their parents about what they learned in the FSSGP and the majority of responding parents indicated that their child communicated with them about one or more topics from the FSSGP. This

study supports the importance of early education intervention on proper food safety principles in school gardens.

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PREFACE

This thesis was written to comply with the University of Rhode Island graduate school Manuscript Thesis Format. This thesis contains one manuscript entitled *Food Safety and School Garden Program.* This manuscript has been written within the requirements for the *Journal of Food Science Education.*

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Food Safety and School Garden Program

Valerie Calberry, Lori F. Pivarnik, Ingrid E. Lofgren

Department of Nutrition and Food Sciences, University of Rhode Island, Kingston, RI

Corresponding Author: Lori F. Pivarnik

Department of Nutrition and Food Sciences

University of Rhode Island

530 Liberty Lane

West Kingston, RI, 02881, USA

Phone: 401-874-2972

Email address: lpivarnik@uri.edu

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INTRODUCTION

Research has shown that incorporation of school garden-related programs in elementary and middle schools successfully increases both nutrition knowledge and consumption of fruits and vegetables in children (Heim and others 2011; Heim and others 2009; Morris and others 2002; Parmer and others 2009). However, food safety has not been a component of school garden curriculums. Food safety is especially important for school garden programs as children have a heightened susceptibility to foodborne illnesses due to underdeveloped immune systems (FDA 2013; Trusts 2014). Children are targeted for primary prevention food safety education programs because they have little existing knowledge, fewer improper food safety behaviors to unlearn (Eves and others 2010; Faccio and others 2013), and they desire to share what they learn with family and friends (Haapala and others 2004; Losasso and others 2014).

Foodborne illness affects public health and is an economic burden (Scharff 2012). An estimated 48 million people, or 1 in 6 Americans, are affected by foodborne illness annually and approximately 128,000 hospitalizations and 3,000 deaths occur each year (CDC 2013). It is estimated that foodborne illness costs the United States over $77 billion each year (Scharff 2012). Foodborne illness outbreaks, including those due to produce, have increased for the past four decades (Painter and others 2013; Sivapalasingam and others 2004; Tauxe and others 1997). Moreover, all reported foodborne outbreak data display clear trends of increases in foodborne illnesses due to produce (DeWaal and others 2006; FSMA and others 2014; Painter and others 2013).

Multiple factors are associated with the increase in produce-related foodborne illnesses including inadequate food safety knowledge resulting in unsafe food handling practices and increases in both home produce-gardens and fresh produce consumption (Kim and others 2014; McGill and others 2015; NGA 2014; Redmond and others 2003). A review of observational consumer food safety studies showed that consumers have relatively low levels food safety knowledge and when observed, exhibit risky food handling behaviors (Redmond and others 2003). While research has shown that home gardeners have inadequate food safety knowledge (Pivarnik and others 2006; Pivarnik and others 2008), 48% of home gardeners reported the reason they garden is to grow safer produce than they can buy from stores and/or farms (Butterfield 2009). The number of home produce gardens increased more than 20% since 2008 (NGA 2014) and reports of fruit consumption significantly increased in both children and adults from 2003 to 2010 (Kim and others 2014; McGill and others 2015). Therefore, increases in gardening and produce consumption could potentially contribute to the increase in produce-related foodborne illnesses.

Produce grown anywhere, commercial farms and home and school gardens, can be the source of pathogenic microorganisms, since similar food handling practices are needed to keep produce safe. Commercial farmers are involved in multiple food production practices, such as growing, harvesting, processing, and distributing. All steps in production have the potential for microbial contamination. For example, improper personal hygiene practices, unsafe water and manure treatment, and improper sanitation of equipment are all sources of microbial contamination (FDA/CFSAN 1998). Home gardeners and those involved with school gardens plant,

harvest and handle post-harvest produce, and therefore are likely to have the same microbial contamination concerns (URI 2015).

Home gardener programs have been established and implemented. Home gardeners have the opportunity for education on proper food safety principles with regards to safe planting and composting, checking for a safe water supply, safe harvesting of garden produce, and preparing and storing fresh produce (URI 2015). It is important for students participating in school garden programs to be educated on the same basic food safety principles surrounding school garden.

Since school garden-related food safety education programs for elementary school students have not been well studied, the overall goal of this study was to create a food safety program using school garden-related activities for first to fifth grade students in Rhode Island (RI). Specific objectives were to: assess students' overall knowledge change of basic school garden-related food safety principles from pre- to post-intervention; evaluate the program via students' ratings of the activities; and assess reported student-to-parent/guardian interaction.

METHODS

Program Design

The Food Safety School Garden Program (FSSGP) was developed in conjunction with Farm Fresh Rhode Island's (FFRI) Farm to School Project funded by the Food and Nutrition Service of the United States Department of Agriculture (USDA). The food safety information used in FSSGP was based primarily on the principles described in "Food Safety Tips in School Gardens" (NFSMI and others 2011). Additionally, Good Agricultural Practices regarding produce safety for

commercial growers (FDA/CFSAN 1998; URI 2015) were used and adapted for the FSSGP.

The FSSGP consisted of two 40-60 minute interactive lessons that were divided into four categories: 1) bacteria, 2) hand washing, 3) produce washing, and 4) container washing. The categories, topics and interactive activities are outlined in Table 1. The topics included within the bacteria category were "good" versus "bad" bacteria and keeping pets and animals out of the garden. The interactive activity for bacteria was Pass the Apple (Mulligan 2014), which used stickers and two apples to visually show how bacteria can spread. The topics included in the hand washing category were the proper method, when, and why to wash hands. A simulated hand washing activity was created to practice the proper method to wash hands. The produce washing category, included the proper method for washing produce, throwing away rotten produce, and not eating directly from the garden. A large activity board with laminated pictures of fruits and vegetables was created to help the students understand the concept of washing all different types of fruits and vegetables. Finally, the washing containers category contained topics such as, proper method and when to wash harvesting containers.

Student Assessment

A 10 question, multiple-choice assessment was used to test school garden-related food safety knowledge of elementary school students pre- and post-intervention (Table 2). The format of the questions and/or answers were developed from previously tested food safety knowledge assessments (Pivarnik and others 1994; Pivarnik and others 2006). The questions were divided into the categories described

above: three questions on bacteria, hand washing and produce washing, and one question on container washing. All questions had three or four answers and "I do not know" was a possible answer for every question. In an effort to reduce guessing, students were encouraged to circle "I do not know" if they did not know the answer. Knowledge-based questions were graded as right or wrong. For statistical assessment purposes, "I do not know" was considered and coded as incorrect, as it reflected a lack of knowledge (Pivarnik and others 2006). Students that scored 80% or better were considered proficient in the subject matter (Pivarnik and others 2006).

In addition to the 10 knowledge-based questions, the post-test included two program evaluation questions and one question on intent to disseminate, or tell their parents/guardians, about information learned in the FSSGP (Table 3). Program evaluation questions asked students to circle the topic they felt was most important and to rate how much they liked each activity. Students had the option to circle a smiling face, neutral face, or frowning face if they liked the activity, thought it was okay or disliked it, respectively.

The pre- and post-tests were administered to all participating students and each question was read aloud to compensate for all reading and comprehension levels (Pivarnik and others 1994). Students were assigned ID numbers for the assessments and teachers kept the student ID rosters between lessons to maintain student anonymity. Only students who completed both pre- and post-tests were included in the statistical analyses. Two educational specialists reviewed the assessments for readability and clarity and revisions were made as suggested.

Parent/Guardian Letter and Follow-up

Participating teachers sent home a letter to all parents/guardians regarding the FSSGP at the start of the first lesson. At the completion of the program, students were given a follow-up questionnaire as well as a Garden to Table - Five Steps to Food Safe Fruit and Vegetable Home Gardening Booklet to take home for their parents (Pivarnik and others 2014). A parent/guarding follow-up was used to determine the extent of child to parent/guardian interaction. The three questions on the questionnaire were: 1a) did your child communicate to you about the content of the program?; 1b) did you learn anything from your child?; and 2) do you have a home fruit or vegetable garden?; 3) what grade is your child in?. Parents/guardians were encouraged to complete the questionnaire and return it to their child's teacher within one week. Any responses indicated by parents/guardians that were unrelated to food safety or gardening were not included in the analysis.

The Institutional Review Board at the University of Rhode Island approved the protocol, assessments, and educational materials.

Program Implementation

The elementary school students who participated in the FSSGP were recruited through the existing FFRI Farm to School programs. The two lessons were conducted at least one week apart between September and December 2014. The first lesson began with the pre-test followed by instruction on the first three categories (Table 1), the second lesson included a review of the first lesson material and the fourth category, and the remainder of the lesson consisted of two review activities that incorporated all information presented to the students. All students participated in the

"What's Wrong with this Picture?" activity (Pivarnik and others 1994) and the lesson concluded with Food Safety Bingo (grades 1-3) or Food Safety Jeopardy (grades 4-5). At the end of the second lesson, students completed the post-test. Students were given an educational handout that summarized sources of bacteria from the garden and how to prevent the spread of bacteria, a "Wash Fruits and Vegetables Before Eating" pencil, and small bar of soap that used in the simulated hand washing activity.

Statistical Analysis

The statistical software, SPSS (Version 21.0, 2012, Armonk, NY), was used for all statistical analyses. Means with standard deviations and descriptive statistics (frequencies and percentages) were reported for the knowledge-based pre- and post-tests and program evaluation responses. Paired *t*-tests were used to determine mean score differences at 95% confidence interval for overall score and within grades. Differences between grades on pre- and post-tests were analyzed using analysis of variance with a Scheffe Post Hoc test. Analysis of covariance was used to determine if post-test knowledge score differences remained significant between grades when controlling for the differences in pre-test scores. Finally, Pearson's chi-square test was used to assess knowledge-by-category on pre- and post-tests.

RESULTS

A total of 203 students from four RI elementary schools participated in the first lesson and completed the pre-test of the FSSGP. Two schools were located in Providence, one in Pawtucket, and one in Newport. Approximately 94% (183/194) of students completed the program during regular school hours (n=183): 34% in first grade, 27% second grade, 9% third grade, 20% fourth grade, and 10% fifth grade

(Table 4). The remaining 6% (11/194) were of first and second grade students in an after school program.

Knowledge Responses

Students had a mean knowledge score of 55.6±18.8% on the pre-test and 80.6±18.6% on the post-test, which was a 25 percentage point increase in knowledge ($p < .001$) (Table 5). Significant knowledge increases also occurred from pre- to post-test within all grades ($p < .001$). Second grade students (n=56) had the highest increase (31.7%) and first graders (n=67) had the least (18.2%). Most students answered between 4 and 6 questions correctly (range: 1-10) on the pre-test; whereas the majority of students answered 9 or 10 questions correctly (range: 2-10) on the post-test (Figure 1) after intervention.

First grade pre- and post-test scores were significantly lower than all other grades ($p < .05$); mean post-test score for first grade, 64.1±18.3%, versus 90.7±11.3%, 85.2±11.8%, 88.1±12.6%, and 90.6±11.1% for second grade, third grade, fourth grade, and fifth grade students, respectively. Grades 2-5 did not significantly differ from each other. Analysis of covariance determined that statistical significance was independent of the initial knowledge score variations.

Pre- and post-test knowledge scores for each category are illustrated in Figure 2. Correct baseline knowledge for container washing was the highest and produce washing the lowest, 77.6% and 12.9%, respectively. The container washing category consisted of one question, whereas the other three categories consisted of three questions. Overall, knowledge within each category improved significantly ($p < .05$) following the intervention.

Program Evaluation

The majority of the students rated each activity as okay or better in the post-test evaluation (Table 6). More than half of the students indicated that they liked the activities "very much". Results from the post-test indicated 84% (n=161) of the students indicated that they would tell their parents/guardians about what they learned in the FSSGP.

Parent/Guardian Follow-Up

A total of 59 parent/guardian follow-up questionnaires were returned to the teachers. Of those 59 returned, 76% (n=45) of the parents/guardians indicated their child spoke with him/her about the FSSGP. Two returned questionnaires that indicated, "yes", their child spoke to them about what they learned were not included in the analysis as the indicated topic(s) were unrelated to those taught in the FSSGP. Fourth and fifth grade students had the highest return rate at 44% (16/36) and 55% (10/18 students), respectively (Figure 3). First grade had the lowest return rate at 13% (8/63).

Written responses were compiled and categorized into five categories: bacteria, hand washing, produce washing, animals, and other (Figure 4). Any topic mentioned that did not fall into one of the first four categories but was related to food safety in or gardening, were included in the "other" category. The "other" topics were grouped into one category due to the low frequency and high variability of each topic. Examples of topics in the "other" category included any response about general food safety, gardening, planting, and containers. Of the 45 parents/guardians who indicated

that their child spoke to them about the program, the majority wrote one or more school garden-related food safety topics.

DISCUSSION

The goal of this study was to create a school garden-related food safety education program for elementary schools with school gardens. The hypothesis was that students' knowledge of school garden-related food safety would increase from pre- to post-intervention. Knowledge increased overall and across all grades. This finding shows that first to fifth grade students participating in the FSSGP would significantly increase their school garden-related food safety knowledge upon completion of the program.

First grade students scored significantly lower than the other four grades on both the pre- and post-test. The lower scores could be due to a lack of previous gardening experience, the complexity of the program information, lower reading levels (Ding 2012), and/or differences in school approaches. The established school garden programs, through which the FSSGP was conducted, start in first grade. Therefore, previous gardening experience could have had an impact on baseline knowledge scores, however, that does not explain the smaller increase from pre- to post-intervention of the first grade students compared to those in the other four grades. Many of the first grade students were unable to read and despite reading both assessments aloud, misunderstanding and/or misinterpretation of questions could have occurred. Lower first grade knowledge scores could be due to differences in school approaches and/or geographical area however, that cannot be confirmed, as we did not have first and second graders at the same school. The FSSGP may not be as suitable

for first graders as compared to second through fifth, although, first graders still had a significant increase in knowledge from pre- to post-intervention.

Overall, the students became proficient (>80%) in the school-garden related food safety material after the education intervention. For example, prior to the intervention, more than half of students indicated that it was acceptable to eat directly out of the garden without washing. Following the intervention, 80% of the students answered the question correctly indicating that eating directly from the garden without washing is unacceptable and unsafe. The consequence of eating directly from the garden without washing is an increased risk for foodborne illness. Since children have a heightened susceptibility to foodborne illness, food safety education prior to engaging in school garden activities is necessary.

The 10-question assessment resulted in an unequal distribution of categories. Statistically, knowledge significantly increased across all four categories however, the four categories were not equally distributed. The containers category was only representative of one question and the other three categories consisted of three questions each. While knowledge of containers appeared to be much higher than the other three categories, it was only one question and results may have been different had more questions been asked. However, based on previous food safety knowledge assessments for elementary-aged students, the short duration, and specificity of our program, a relatively short 10-question assessment was regarded as optimal (Eves and others 2006; Pivarnik and others 1994).

It has been well established that students enjoy learning and retain information better if practically or experientially applied (Eves and others 2006; Faccio and others

2013; Vygotsky 1967). In previous studies, students who participated in experiential-based food safety programs rated the activities highly (Faccio and others 2013; Losasso and others 2014; Pivarnik and others 1994). This study produced similar results: the majority of the students rated all activities as satisfactory (okay) or better while simultaneously and significantly increasing their knowledge. Faccio and others (2013) found the students in the experiential group in their study learned and retained significantly more complex and detailed food safety information compared to the students in the didactic, theoretical approach group. Similarly, students participating in nutrition education and school garden activities retained more nutrition knowledge post-intervention than those exposed only to nutrition education and those in the control group (McAleese and others 2007; Morris and others 2002; Parmer and others 2009). Therefore, the knowledge increases across all grades could be attributed to the practical application of knowledge through the interactive activities and concluding games.

Food safety education programs for students are primary prevention for foodborne illnesses (Losasso and others 2014) and are often conducted in school settings. Few food safety education programs have been conducted with students in after school programs. The one after-school class of students that participated in the FSSGP was used as a pilot test to determine whether or not the currciculum would be suitable in that type of learning environment. Though several students appeared distracted and restless throughout parts of the instruction, there were no significant knowledge differences between the first and second graders in the after-school program compared with students in the in-school classes (data not shown).

Additionally, given that the majority of the classes were in-school, there was limited time and access to hand-washing sinks and therefore, the simulated hand-washing activity was the most feasible.

Upon completion of the program, 161 students indicated they would tell their parents/guardians about the FSSGP and what they learned. Thirty percent (59/194) of all parent/guardian follow-up questionnaires were returned. Based on the number and variety of topics written by parents/guardians, the children were able to reiterate and explain a variety of the produce-related food safety topics upon returning home. Parents/guardians described multiple topics, for example, "wash your hands for 20 seconds; keep animals out of the garden; and wash your fruits and veggies before eating them." The approach and effect of children's intent to disseminate information to their families has been elucidated by the Theory of Planned Behavior (Ajzen 1991). This behavioral theory describes that intention is the strongest predictor of actual behavior. Thus, children who intended to tell their parents/guardians what they learned might be more likely to engage in proper food safety behaviors and teach what they learned to their family. Parent/guardian responses on the follow-up reflected a strong indication that students understood the information and taught their family what they learned. Additionally, students who spoke to the parents may be retaining more of the information (Losasso and others 2014).

Parents/guardians are often targeted for food safety education programs, as they are typically the primary food preparer in the home (Meysenburg and others 2014; Stenger and others 2014). However, findings from this study support existing research that children are able to gain knowledge of correct food safety principles,

start to develop proper food safety behaviors, and continue to build the fundamental foundation of food safety knowledge and behaviors (Eves and others 2006; Faccio and others 2013). The results of this current study showed that educating children on school garden-related food safety principles also allows the family to be a secondary target audience that will receive proper food safety information.

CONCLUSION

The FSSGP was successful at educating elementary school students on school garden-related food safety principles as evidenced by: the significant increases in knowledge overall, by grade and by category, and the student dissemination of information to their families. Furthermore, this curriculum was appropriate for multiple grade levels (grades 1-5). The interactive activities, rated as satisfactory or better by the majority of students, may have helped to reinforce the information taught in the program.

For future research, the FSSGP could be tested in after-school programs on a larger scale and in summer camps that incorporate gardening activities. Perhaps incorporating additional hands-on garden activities into the program may further proper food safety behavior development. The FSSGP was conducted in a primarily urban population and could be tested in first to fifth grade classes in other rural or suburban regions of the United States.

Table 1 - Categories, topics and interactive activities included in the food safety and school garden program

Category	Topics	Activities
Bacteria	Good vs. bad bacteria	Pass the Apple
	3 ways bacteria can spread	
	Keep animals out of garden	
Washing Hands	Proper wash method	Simulated hand washing activity
	When to wash	
Washing Produce	Proper wash method	Produce washing activity board
	Bruised produce	
	Do not eat produce from garden	
Washing Containers	Proper wash method	
	When to wash	
All Categories: Review	**All Topics: Review**	What's Wrong with this Picture?
		Bingo (grades 1-3) Jeopardy (grades 4-5)

Table 2 – Pre- and post-test knowledge questions for the participants in the food safety and school garden program

Questions	Responses*
1. Jason has been playing in the garden. He comes into the kitchen to eat some blueberries. Jason looks at his hands. There is no dirt on them and they look clean. Does he need to wash his hands?	**a. Yes** b. No c. I do not know
2. Do you think all bacteria in food will make you sick?	a. Yes **b. No** c. I do not know
3. You are harvesting the fruits and vegetables that are in the school garden. After you have picked them, they look great to eat. You want to see how they taste so you take a bite. What do you think?	a. This is okay to do **b. This is not okay to do** c. I do not know
4. Joe has found some bird poop on a cucumber in the garden. He knows that he should not eat poop, so he washes the cucumber and eats it. What do you think?	a. This is okay to do **b. This is not okay to do** c. I do not know
5. John found a cracked peach within the batch of peaches he picked from the garden. What should he do with the peach?	**a. Throw the whole peach in the trash** b. Ask an adult to cut off the bad part c. Eat the whole peach anyway d. I do not know
6. You can always tell if a fruit or vegetable might make you sick.	a. Yes **b. No** c. I do not know
7. Mary's mother asked her to go and pick a few peppers from the garden. Mary washed her hands before she went into the garden even though she might get dirt on them while picking peppers. Did she need to wash her hands before going into the garden?	**a. Yes** b. No c. I do not know
8. Sarah's pet dog, Barky, followed Sarah into the garden when she was going to pick some spinach for lunch. Is it okay for Barky to play in the garden too?	a. Yes **b. No** c. I do not know
9. Susan decided to pick carrots from the garden and she found a container in the garage. What should she do first?	a. Use it if it looks clean b. Shake out the dirt **c. Wash the container** d. I do not know
10. Carrie's hands were very dirty from helping her dad pick tomatoes in the garden. How long should she wash her hands with warm soapy water?	a. 5 seconds b. 10 seconds **c. 20 seconds** d. I do not know

* correct responses are bolded

Table 3 – Post-test program evaluation questions for the participants in the food safety and school garden program

Questions	Responses
11. How much did you like each of the activities? (circle one face per question)	a. Pass the apple activity b. How to wash fruits and vegetables c. Washing your hands d. Food Safety Bingo/Jeopardy d. What's wrong with this picture?
12. What is the most important thing you remember learning from this program? (circle only one answer)	a. Three ways bacteria can spread b. How and when to wash your hands c. How to wash fruits and vegetables from the garden d. How and when to wash containers e. When and why to keep pets out of the garden d. How to store fresh fruits and vegetables
13. Will you tell your parent/guardian what you learned about food safety in the garden?	a. Yes b. No d. I do not know

Table 4 – Description of student population participating in the food safety and school garden program

	Grade Level	# of Students	# of Classes
School 1 [a]	1	63	3
	4	36	2
	5	18	1
School 2 [a]	3	17	1
School 3 [a]	2	49	2
School 4 [b]	1	4	1
	2	7	
Total	--	194	10

[a] in-school classes (n=183); [b] after-school classes (n=11).

Table 5 - Knowledge scores of students in all grades that participated in the food safety and school garden program

	Pre-test (% correct±SD)	Post-test (% correct±SD)	Absolute change (%)
All Grades (n=194)	55.6±18.8 [a]	80.6±18.6 [b]	25.0
Grade 1 (n=67)	45.9±17.0 [a1]	64.1±18.3 [b1]	18.2
Grade 2 (n=56)	59.0±18.6 [a2]	90.7±11.3 [b2]	31.7
Grade 3 (n=17)	63.5±19.3 [a2]	85.2±11.8 [b2]	21.7
Grade 4 (n=36)	58.6±15.0 [a2]	88.1±12.6 [b2]	29.5
Grade 5 (n=18)	67.2±17.7 [a2]	90.6±11.1 [b2]	23.4

[a,b] indicate significant differences between pre-test and post-test at $p < .001$;
[1,2] indicate significant differences between grades for the pre-test or post-test at $p < .05$.

Table 6 – Food safety and school garden program evaluation: Student's ratings of each activity

	Student Responses (# of Students)			
Activity	**Very much ☺**	**OK 😐**	**Not at all ☹**	**No Response**
Pass the apple	121	50	21	2
How to wash F/V	124	58	6	6
Hand washing	133	37	18	6
What's Wrong with this Picture?	102	52	29	11
Food Safety Bingo [a]	116	12	8	4
Food Safety Jeopardy [a]	38	12	4	0

F/V = fruits and vegetables; [a] Concluding games: Bingo (grades 1-3), Jeopardy (grades 4-5)

Figure 1 – Distribution of students who answered the knowledge questions correctly on the pre- and post-test

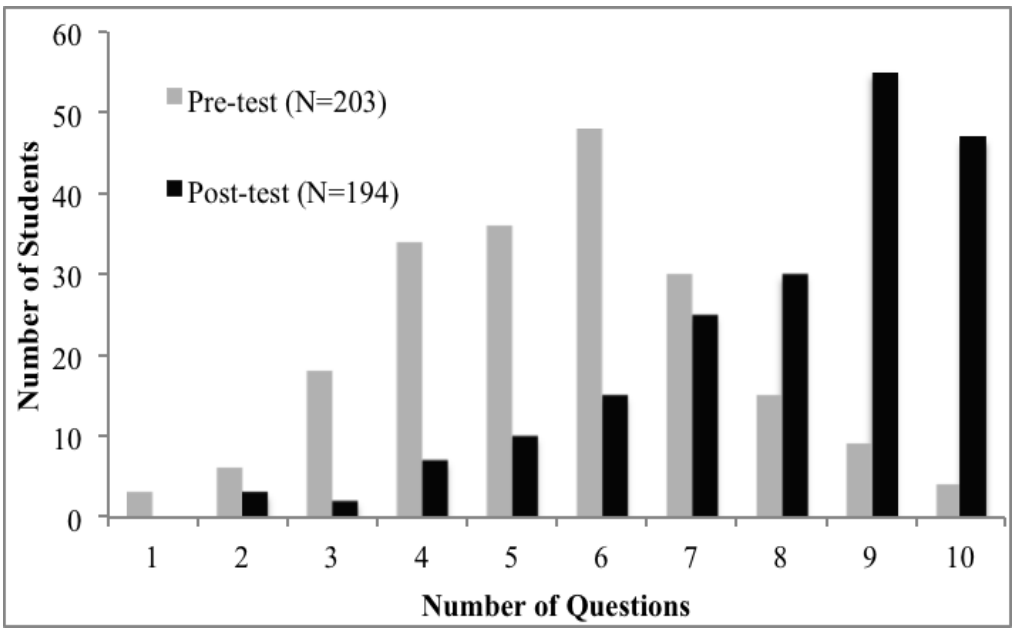


Figure 2 – Number of students who answered the questions correctly in each category on the pre- and post-test

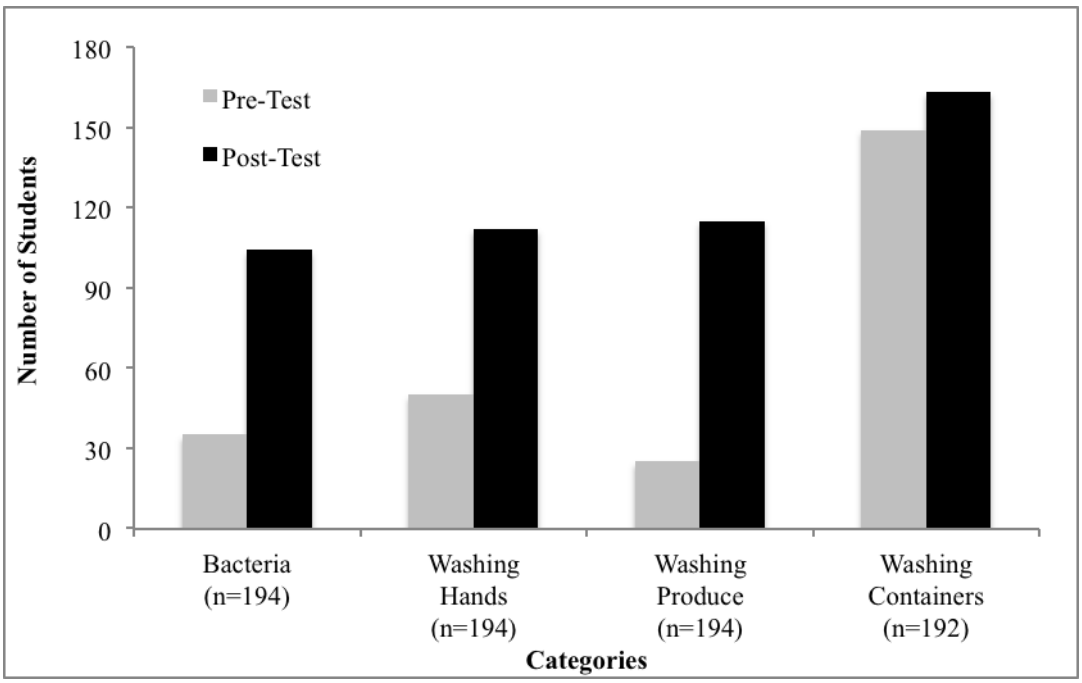


Figure 3 – Number of students in each grade that returned a parent/guardian follow-up questionnaire

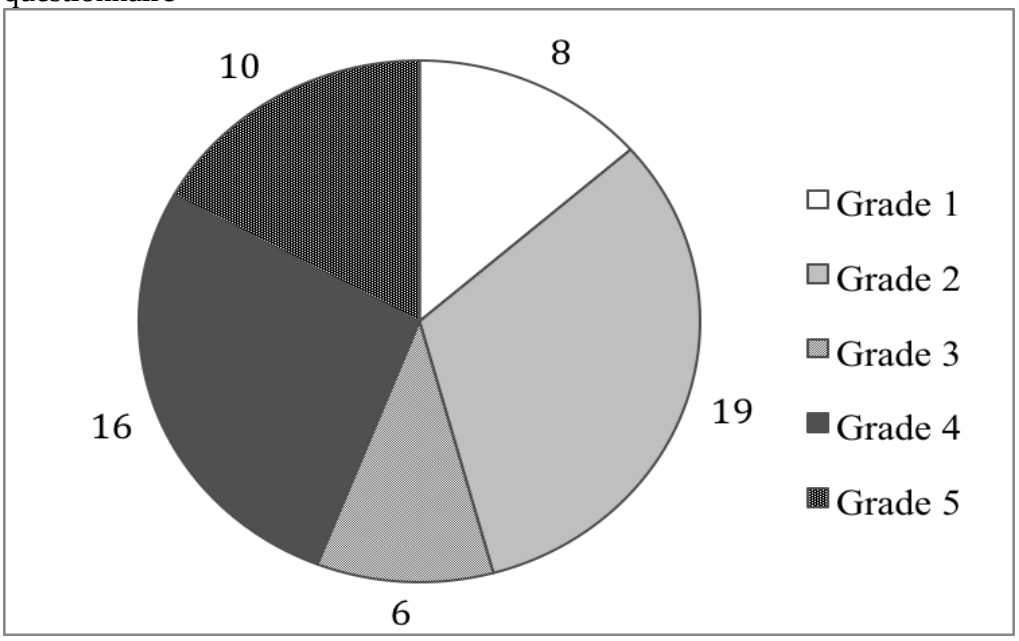
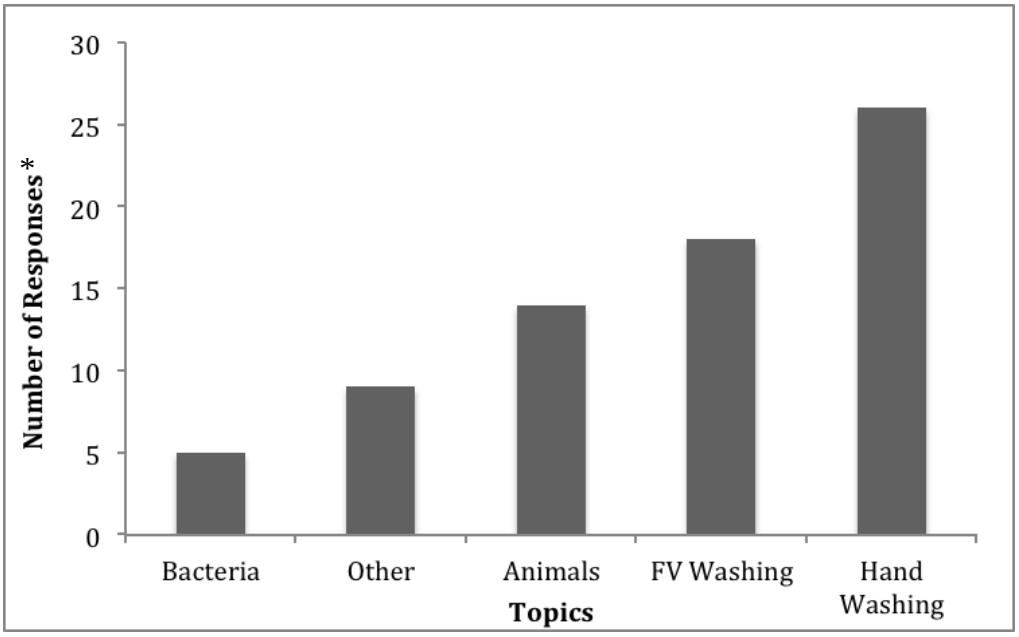


Figure 4 – Categories and topics represented on the parent/guardian follow-up questionnaire (n=45)



*Majority of responding parents indicated ≥ 1 category/topic

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REVIEW OF LITERATURE

Introduction

Foodborne illness affects an estimated 1 in 6 people in the United States (US) annually (CDC 2013). However, most foodborne illnesses are preventable. More recently, government response to foodborne illness has increased through additions to national and state-level food safety standards, stricter enforcement of guidelines (FDA 2014; FDA/CFSAN 1998), and through advances in pathogen detection technology of surveillance systems (CDC 2011a). Despite increased government response for the prevention of foodborne illnesses, the number of produce-related foodborne illness outbreaks have continued to rise (Sivapalasingam and others 2004).

Consumers have poor and unsafe food safety knowledge and food handling practices (Redmond and others 2003). Results from consumer surveys have shown that most consumers are unaware of the proper methods for washing produce (Verrill and others 2012), the correct refrigeration and cooking temperatures (AND 2011), and/or how to prevent cross-contamination (AND 2011; Nesbitt and others 2014). Additionally, observational studies confirm that individuals are more likely to self-report proper food safety practices than to perform them when observed (Anderson and others 2004).

Though reports of fruit and vegetable consumption vary, the increase in fruit and vegetable consumption as reported by the Centers for Disease Control and Prevention (CDC), United States Department of Agriculture (USDA), and National Health and Nutrition Examination Survey (Kim and others 2014; McGill and others 2015) corresponds with the increase in produce-related outbreaks (Tauxe 2009).

Possible reasons for the increase in fruit and vegetable consumption are globalization of the food supply (Tauxe and others 1997), expansion of national and statewide campaigns and nutrition assistance programs that promote fruit and vegetable intake in order to reduce rates of obesity and other chronic health conditions (Altman 2008; FNS 2012), and the increase in home gardens (NGA 2014).

The popularity of school gardens has also increased nationally in the US. Currently, 44% of schools participate in Farm to School programs, some with school gardens and 13% plan to implement a Farm to School program in the near future (USDA 2014). School garden intervention programs report significant increases in nutrition knowledge and fruit and vegetable consumption among grade school students (Hawking and others 2013; Heim and others 2009; Parmer and others 2009).

To date, food safety education programs have not been incorporated into elementary school garden programs. Students may be at an increased risk of exposure to foodborne pathogens with the implementation of more school gardens and without food safety education in place. Food safety education that target children successfully increases children's knowledge of basic food safety principles (Burney and others 2009; Burney and others 2007; Faccio and others 2013; Losasso and others 2014; Pivarnik and others 1994; Richards and others 2008). Therefore, it is hypothesized that food safety education programs can be adapted for and used in school garden programs.

Foodborne Illness

Foodborne illness affects health and is an economic burden in the US (Scharff 2012). An estimated 48 million people are affected by foodborne illness annually

(CDC 2013). Approximately 128,000 hospitalizations and 3,000 deaths occur each year (CDC 2013) and foodborne illness costs the US over $77 billion (Scharff 2012). Because most foodborne illnesses can be prevented and/or greatly reduced with adoption of proper food safety practices, government money spent on managing foodborne illness could be used to address other public health challenges (Losasso and others 2014; Soon and others 2012). Foodborne illness is a concern for all persons and especially high-risk populations such as children, pregnant women, and the immuno-compromised (Lund and others 2014). High-risk populations are more susceptible to foodborne illnesses due to their compromised or underdeveloped immune systems (Lund and others 2014).

Produce-related foodborne illness outbreaks have increased in the past forty years (DeWaal and others 2006; Painter and others 2013; Sivapalasingam and others 2004). A foodborne illness outbreak is defined as two or more people becoming ill with the same symptoms after eating the same food (Gould and others 2013). In the 1970's, produce accounted for 0.7% of all commodity-related foodborne outbreaks and rose to 6% in the 1990s. Produce was the leading cause of all commodity-related foodborne illnesses between 1998 and 2008 at 46% (Painter and others 2013).

- **Response to Foodborne Illness**

Foodborne illnesses are a significant burden on the nation's health and most are preventable by following proper food safety practices. In an effort to increase the safety of produce and reduce produce-related foodborne outbreaks, the Food and Drug Administration (FDA) and United States Department of Agriculture (USDA) developed Good Agricultural Practices (GAP) for commercial growers and producers (FDA/CFSAN 1998). These guidelines were designed to minimize the microbial

safety hazards associated with fresh produce. Good Agricultural Practices focus on the following on-farm production issues: worker hygiene, human and animal health, welfare and safety, water and manure application, crop production and protection, and post-harvest handling and storage of produce.

The Food Safety Modernization Act (FSMA) was signed into law by President Obama in 2011 (FDA 2014) with the overall goal to keep the food supply safe to eat. One of the primary objectives of FSMA is to reduce the number of foodborne illness outbreaks by preventing contamination as opposed to responding to it (FSMA and others 2014). The Produce Safety Alliance (PSA) was created separately to provide farmers with the information and training they need to ensure their produce is safe for consumers (PSA 2013). The produce safety rule under FSMA cites PSA training as the standard (FSMA and others 2014). Though there are standards and guidelines for commercial growers, home and school gardeners are not required to follow the same standardized practices despite the fact that the food safety principles in all three environments are the same.

- **Technology Advancements in Surveillance Detection**

Surveillance of foodborne illness outbreaks has increased due to technological advancements in the detection of microbial pathogens (CDC 2011a). Practitioners and laboratory staff in hospitals are now required to conduct more testing and report detection of foodborne pathogens to the National Notifiable Diseases Surveillance System (CDC 2011a). Table 1 lists the surveillance systems/networks currently in place. Each surveillance system is used to detect different pathogens and sites of contamination and most of the surveillance systems rely on data from state and local

health agencies. Because the surveillance systems now detect sources and sites of contamination more efficiently and effectively, governing agencies can better predict and monitor outbreak sources to enforce better food safety practices in areas prone to contamination (CDC 2011a).

Table 1: Foodborne Illness Surveillance Systems/Networks

Surveillance System*	**Agency/Institution**	**Description**
PulseNet (National Molecular Subtyping Network for Foodborne Disease Surveillance)	CDC; Association of Public Health Laboratories	- Performs pulsed-field gel electrophoresis on foodborne pathogens to compare the DNA with other strains in the system
FoodNet (Foodborne Disease Active Surveillance Network)	CDC: MMWR	- Tracks 7 commonly transmitted bacterial and two parasitic infections - Analyzes their etiologies to better understand the incidences and trends of foodborne diseases
CaliciNet (National Electronic Norovirus Outbreak Network)	CDC: National Outbreak Reporting System	- Established in 2009 to track the 'caliciviruses', the most common noroviruses, responsible for the majority of foodborne illness outbreaks in the US
NNDSS (National Notifiable Diseases Surveillance System**)**	CDC	- System for laboratory professionals and health care providers to report new cases - Required by law
NARMS (National Antimicrobial Resistance Monitoring System)	CDC; FDA; USDA	- Monitors antimicrobial resistance among intestinal bacteria from humans, retail meats, and food animals - Detects trends and causes

* Adapted from (CDC 2011a; FDA/CDC/USDA 2014)

Surveillance systems (Table 1) are continually improving for accuracy and sensitivity to provide enhanced detection of foodborne pathogens. For example, information collected by NARMS is critical because illnesses caused by pathogens that are resistant to antimicrobial agents might be prolonged or more severe (FDA/CDC/USDA 2014). Despite the technological advancements in the surveillance

for foodborne illness outbreaks, the statistics provided by these surveillance systems represent only a small subset of the foodborne illnesses that actually occur in the community due to underreporting and under-diagnosing (CDC 2011a).

Food Safety Knowledge and Food Handling Practices

Consumers lack sufficient general food safety knowledge (AND 2011; Langiano and others 2012; Mitakakis and others 2004; Nesbitt and others 2014; Patil and others 2005; Redmond and others 2003; Sanlier 2009). The consensus from this previous research is that in order to prevent future foodborne illness outbreaks, more food safety education programs and interventions in the community are needed.

The Academy of Nutrition and Dietetics (AND) (AND 2011) conducted a food safety knowledge and behavioral survey of 1,000 individuals in the US and found that there was a substantial lack of food safety knowledge. For example, the majority of participants were unaware of the importance of using a meat thermometer and checking for proper refrigeration temperatures. While this survey covered diverse areas of food safety, there was a lack of depth; only one question addressed produce and it was in regards to cross-contamination between raw meat/poultry and produce.

Consumers perceive that the food safety responsibility falls on those who grow, manufacture, and sell food. Because consumers have a low perceived susceptibility to home-related foodborne illness, they are more inclined to associate an incident of foodborne illness with an outside food source (Bearth and others 2014; Nesbitt and others 2014). A mere 9% of all reported foodborne illnesses between 1998 and 2008 were home-related foodborne illnesses (CDC 2013). In a report from DeWaal and others (2013), between 2001 and 2010, 922 home-related foodborne

outbreaks caused 12,666 illnesses. However, home-related foodborne illnesses are often under-reported and/or un-reported due to the low perceived susceptibility of domestic-related foodborne illness and short duration of symptoms (CDC 2013). In spite of the low number of reported domestic foodborne illnesses, research has shown that consumers lack basic food safety knowledge and have risky food handling behaviors, justifying the need to increase food safety intervention programs.

Only a small number of studies have been conducted to assess produce-related food safety knowledge (Li-Cohen and others 2002; Pivarnik and others 2006; Pivarnik and others 2008; Verrill and others 2012). Pivarnik and others (2006) conducted a random survey with 762 New England home gardeners and reported that participants scored the lowest on the food safety topics pertaining to: hand hygiene, the association of produce with pathogenic bacteria, safety of organic produce, washing produce, use of manure and compost, water supply safety, and home canning.

Verrill and others (2012) found that consumers are less likely to wash the outside skin of fruits and vegetables if they peel and cut the products since they are unaware that potential pathogens could contaminate the edible portion through cutting. A recent example of pathogens on the outer surface spreading to the inner surface was in 2011, 147 illnesses and 33 deaths were caused from *Listeria monocytogenes* on cantaloupes (CDC 2012). Produce can be susceptible to pathogen contamination and must be properly washed prior to consumption, as standard practice.

Li-Cohen and others (2002) found that consumers had poor hand hygiene. Almost 50% of consumers surveyed reported not washing their hands prior to handling fresh produce. Many foodborne illness outbreaks are the result of

contamination via pathogens of fecal origin, which is likely to occur when consumers neglect to wash their hands prior to handling "ready to eat" foods (PFSE 2010). Fresh produce falls under "ready to eat" foods if consumed raw. Consumer understanding of the reasons why hand washing is important and implications of not, is essential in the prevention of foodborne illnesses.

Because unsafe food handling is the major cause of foodborne illness outbreaks (Anderson and others 2004), the Partnership for Food Safety Education (PFSE) (2010) created the "*Fight Bac!*" initiative to educate the general public on safe food handling practices and foodborne illnesses through a website that contains printable fact sheets, multimedia, and promotes food safety campaigns. "*Fight Bac!*" outlines the four most important areas of food safety: clean, separate, cook, and chill. All safe food-handling practices fall under these four major areas. "Clean" refers to ensuring hands and surfaces are clean during the preparation process. "Separate" refers to avoiding cross-contamination of ready-to-eat foods and raw, to-be-cooked foods. "Cook" refers to ensuring all foods are either cooked or reheated, as required, to specific internal temperatures to destroy pathogens. Finally, "Chill" refers to ensuring that leftover foods are refrigerated promptly for proper cooling, as pathogens can grow exponentially between the temperatures of 40°F and 140°F. Following these safe food-handling practices can reduce the risk of pathogen contamination and/or growth.

Additionally, according to Anderson and others (2004), self-reported food safety knowledge and behaviors do not reflect actual, observed food safety behaviors. A study by Li-Cohen and others (2002) reported that 97% of survey respondents reported always cleaning surfaces during food preparation; whereas, Anderson and

others (2004) showed that only 33% of participants were observed thoroughly cleaning food preparation surfaces. Consumers inflate their own proper food safety behaviors and are often worse when actual behavior is observed.

Specifically for produce-related food handling, the same unsafe practices can occur in home and school gardens as on large-scale farms, as the basic food safety principles are the same. However, home and school gardeners do not have the same opportunities to receive food safety education and training as large-scale farmers (Pivarnik and others 2008). For example, the GAP program is in place to educate and train farmers to integrate food safety practices from harvest to distribution, and reduce risk of pathogen contamination. However, the same targeted outreach regarding produce planting, harvesting, and post-harvest handling practices is not available for home and school gardeners. Therefore, home and school gardeners may also have unsafe food handling practices due to a lack of food safety knowledge (Pivarnik and others 2008).

Although many individuals are involved in food production, such as growers, producers, manufacturers, distributors, and preparers, the consumer is the last person involved and is still critical for preventing foodborne illnesses (Redmond and others 2003). Therefore, consumer education of risks associated with foodborne illnesses and preventive measures to protect themselves and others are important in order to reduce the number of foodborne illness outbreaks.

Fruit and Vegetable Consumption

Fruit and vegetable consumption per capita has increased (Casagrande and others 2007; Kim and others 2014; McGill and others 2015) although other sources

report that fruit and vegetable consumption has declined (CDC 2011b). Kim and others (2014) report that fruit consumption increased 13% from 2003 to 2010 among children. Tauxe (2009) found with the increase in fruit and vegetable consumption, there was an increase in produce-related foodborne illness outbreaks. Globalization of the food supply, combating health conditions, prevalence of federal and statewide nutrition assistance programs, and an increasing number of home produce gardens are possible contributors to the increase in produce consumption and thus, potentially to the increase in produce-related foodborne illness outbreaks.

- **Globalization**

The increase in importing and exporting goods/services has resulted in the globalization of the food supply (FDA 2015). Globalization of the food supply increased 27% from 1990 to 2005 and is continuing to increase (FDA 2015). The global food supply of diverse commodities may be a contributing factor to the increase in fresh produce consumption (Tauxe and others 1997). Prior to importing fruits and vegetables from other countries, fruits and vegetables were only available in certain areas of the country during specific times of the year. From 1970 to 2007, fresh produce availability increased 28%, partly due to globalization (Tauxe 2009). With the increase in globalization in the past three decades, contamination of the food supply can have a worldwide impact. Companies in the US now import from countries all over the world and need to ensure purchases are made from safe food supplies to decrease the risk of foodborne illness (Scharff 2012).

- **Health Conditions**

Obesity, cardiovascular disease (CVD), and type 2 diabetes are three globally prominent public health challenges (Bazzano 2005). The global obesity rate has doubled since 1980 (WHO 2014). As of 2008, 35% of the world's adult population was overweight and 11% was obese. Currently in the US, 69% of adults are overweight and 36% are obese (NIH 2014).

The prevalence of overweight and obese individuals has had a major impact on the US economy. Obesity cost the US an estimated $147 billion in 2008, which almost doubled from the estimated $78.5 billion in 1998 (Hammond and others 2010). Although the obesity rate in the US has remained stable since 2008, obesity still affects over one-third of the population and has significant financial ramifications (Hammond and others 2010).

National campaigns in the US, such as the most recent campaign, MyPlate, have sought to decrease obesity and the risk of other obesity-related health conditions through health eating (USDA/CNPP 2011b). MyPlate is a visual representation of a plate of food that includes healthy portions of protein, grains, fruits, and vegetables. One of MyPlate's recommendations is to make "half of your plate fruits and vegetables" (USDA/CNPP 2011a).

The American Heart Association (AHA) as well as the American Diabetes Association (ADA) have specific diet recommendations to reduce the risk of CVD and type 2 diabetes, respectively (ADA 2015; AHA 2015). The AHA recommends consuming a variety of fruits and vegetables to control weight, cholesterol, and blood pressure. The ADA's recommendation is to fill your plate with a variety of non-

starchy vegetables and smaller portions of starchy foods and meats. In an effort to prevent health conditions such as obesity, CVD, and type 2 diabetes, national campaigns and associations recommend to consume a healthy diet, higher in a variety of fruits and vegetables.

- **Health Promotion Programs**
    - **Supplemental Nutrition Programs**

Participants receiving benefits from the Women Infants and Children (WIC) assistance program and/or the Supplemental Nutrition Assistance Program (SNAP), can participate in nutrition education sessions as part of their monthly benefits (Altman 2008). These two programs share a similar goal: to improve the likelihood that participants receiving benefits will purchase healthier food options, such as fruits and vegetables in place of low-nutrient, high calorie options (Altman 2008).

- **National School Lunch Program**

The standards for the National School Lunch Program (NSLP) have recently changed to ensure that fruits and vegetables are offered in schools daily (FNS 2012). In addition to enforcing the new changes of the NSLP, the goal of schools that have school gardens is to serve the produce grown as snacks and/or as part of meals. Incorporating fresh produce grown in school gardens into daily snacks and meals is an efficient way to expose students to new kinds of fruits and vegetables, increase fruit and vegetable intake, and reduce cost. While there are many benefits to school gardens, food safety issues are likely to occur without implementation of a food safety plan including proper food safety knowledge about planting, harvesting and post-harvest handling.

- **Shape Up Somerville**

Shape Up Somerville is a successful community-based childhood obesity prevention program in the city of Somerville, Massachusetts. The goals of Shape Up Somerville are to promote healthy eating and physical activity for children before, during and after school, at home, and in the community (Chomitz and others 2013). The healthy eating objectives included promoting the USDA-supported fruit and vegetable program in the school cafeterias and school gardens (Chomitz and others 2013).

- **Home Gardens**

According to the National Gardening Association (NGA) survey, home produce gardening increased 17% from 2008 to 2013 (NGA 2014) and consequently, could have contributed to the increase in fruit and vegetable consumption. Survey respondents indicated that the reason for starting their own produce gardens were: better taste and higher quality, better cost efficiency, and increased perception of safety (Butterfield 2009). Although most households claim to grow produce for safety, research has shown that gardeners have little knowledge of produce-related food safety (Pivarnik and others 2006; Pivarnik and others 2008).

Fresh fruits and vegetables are sources of vitamins, minerals and fiber, and have significant health benefits (ADA 2015; AHA 2015). Globalization, national health associations, national and statewide health campaigns, and more home gardens may have contributed to the increase in fresh fruit and vegetable consumption and thus, to the increase in produce-related foodborne illness outbreaks.

School Gardens and Education

Currently, school gardens are used as an educational tool and/or food source to enhance academic instruction for scientific principles taught in classrooms such as general science, environmental studies, and nutrition (Graham and others 2005). School gardens allow students access to fresh, nutritious produce, enhance academic performance, and are effective in increasing nutritional knowledge and healthy eating behaviors (NGA 2014). Nationally, 44% of the schools participate in Farm to School programs, which may include school gardens and an additional 13% have committed to implementing a Farm to School Program in the near future (USDA 2014). Farm to School programs provide schools with the opportunity to partner with local farms and support the local food movement, serve students fresh produce, and start a school garden that can provide students with educational opportunities in addition to fresh produce (USDA 2014).

The USDA and National Food Service Management Institute (NFSMI and others 2011) created a document entitled "Food Safety Tips in School Gardens" that describes proper food safety principles for those involved in school gardens. The food safety issues that need to be considered when starting a school garden include: site selection and water, fertilizer, compost, and manure use. For those involved in the garden, personal hygiene and hand washing, clean harvesting equipment, and washing produce prior to consumption are critical food safety principles.

The majority of school-garden related research has focused on nutrition education and promotion of fruit and vegetable consumption. School gardens often supplement existing nutrition education programs (Heim and others 2009;

Lautenschlager and others 2007; McAleese and others 2007; Morris and others 2002; Parmer and others 2009). Multiple experimental designs have been used looking at nutrition education and gardening (Heim and others 2009; Lautenschlager and others 2007; McAleese and others 2007; Morris and others 2002; Parmer and others 2009).

Morris and others (2002) conducted a nine-lesson, garden-based nutrition education curriculum with fourth-grade students from three schools. School 1 was the control (CO) school (n=61 students), school 2 received nutrition education only (NE) (n=71 students), and school 3 received nutrition education and hands-on gardening activities (NEG) (n=81 students). Overall, nutrition knowledge scores significantly increased in both NE and NEG compared to CO from pre- to post-test and knowledge was retained at a 6-month follow-up. Vegetable preferences were highest in the NEG group following the intervention but also improved significantly in NE students.

Heim and others (2009) conducted a nutrition education, garden-based pilot intervention in collaboration with a 12-week YMCA summer camp with 93, 8-11 year old children. All children reported baseline fruit and vegetable preference and consumption, received weekly produce-related nutrition education and participated in gardening activities twice per week. At the end of the camp, the post-test showed an increase in the children's preference for and consumption of fresh fruits and vegetables.

Lautenschlager and others (2007) conducted a 10-week garden-based nutrition education intervention in Minneapolis, Minnesota with 66, 8-15 year old participants to assess participant's eating and gardening behaviors. A survey and 24-hour food recall were used to evaluate the Theory of Planned Behavior (TPB) constructs (Ajzen

1991). The TPB postulates that actual behavior is almost entirely determined by intention, which is guided by three independent constructs: perceived behavioral control (beliefs about the amount of control they have over changing the behavior), subjective norms (beliefs about what others want them to do), and attitudes (beliefs about the consequences of a behavior). Participants' fruit and vegetable consumption increased. This study also found that attitude was the highest predictor of intentions related to gardening behaviors at pre- and post-intervention for both boys and girls. However, girls were less likely to follow-through with the intended behavior change compared to the boys. The authors' speculated that either the girls may not have developed the appropriate skills for behavior change and/or differences in cognition between girls and boys were not considered during the program.

Another 12-week garden-based nutrition education program was conducted to improve fruit and vegetable consumption with 95 sixth grade elementary school students (McAleese and others 2007). Students either received NE (n=25), NEG (n=45) or neither (CO) (n=25). At the completion of the program, there was a significant increase in fruit and vegetable consumption along with increases in vitamin A, vitamin C, and fiber in both the NE and NEG groups.

Finally, Parmer and others (2009) conducted a 28-week garden-based nutrition education curriculum with 115 second grade students. The students were assigned into three groups: NE, NEG, and CO. The students were tested for baseline produce-related knowledge, preference, and consumption and again at the end of the 28 weeks. Results of the post-test indicated that the students in the NEG and NE groups had significant improvements nutrition knowledge and taste ratings than those in the CO.

In conclusion, school gardens have a positive impact on nutrition knowledge and consumption of fresh fruit and vegetables. However, school garden-related food safety has not been addressed in any previous school garden research. Since students actively participate in school garden-related activities, it is important they learn pertinent school garden-related food safety principles. If students remain unaware of food safety risks in the garden, they put themselves and their peers at risk for foodborne illness.

Food Safety Education with Children

Food safety education programs are important for all ages, from children to older adults (Kendall and others 2003). Previous research has primarily targeted adults and parents for food safety education programs, as they are often the primary food preparers in the home (Meysenburg and others 2014). However, children have shown a lack of food safety knowledge and poor food handling behaviors when handling and preparing food, which justify the need for food safety education programs with children (Eves and others 2006; Eves and others 2010; Haapala and others 2004; Ovca and others 2014). Moreover, food safety education programs with children have been successful at increasing food safety knowledge and behaviors (Burney and others 2007; Faccio and others 2013; Losasso and others 2014; Pivarnik and others 1994; Richards and others 2008). As children get older and become more independent, a strong foundation of food safety knowledge and habitual proper food handing behaviors become increasingly important, as these individuals are more likely to start preparing their own food and food for others.

Children are a critical population for food safety education as they have little existing knowledge of food safety and fewer improper food safety behaviors to unlearn, are at an increased risk for foodborne illness (Trusts 2014), and are more likely to disseminate information to their families (Heim and others 2011).

- **Food Safety Knowledge and Behaviors**

Children have little existing food safety knowledge and can easily learn and apply basic information (Eves and others 2006; Faccio and others 2013). Children's knowledge of basic food safety principles was assessed in several studies (Eves and others 2006; Eves and others 2010; Haapala and others 2004; Ovca and others 2014) and improved in other intervention studies (Burney and others 2007; Faccio and others 2013; Losasso and others 2014; Richards and others 2008).

Haapala and others (2004) conducted a survey to assess reported food safety perceptions, food handling behaviors, and food safety knowledge of 178 seventh and eighth grade students. The Protection Motivation Theory was used to assess students' food safety perceptions. While students had a good understanding of the severity of foodborne illness and 20% indicated having been ill due to foodborne illness, their perceived susceptibility to foodborne illness was relatively low. There appeared to be a disconnect between knowledge and risk among these students. Despite knowing the risks of improper food safety, students perceived their own risk to be low. The food handling section of the survey consisted of 15 questions classified into five key categories. Students had the option to skip questions if they had not engaged in any of the behaviors specified. Of the five categories, students reported washing their hands and chilling foods promptly after consumption most often. Students scored 7.2 ± 1.6

out of 10 general food safety knowledge questions. In conclusion, Haapala and others (2004) believed that these findings justify the need for education programs on proper food handling behaviors for students in order to reduce the risk of foodborne illnesses, as they will eventually become more involved in food preparations.

Eves and others (2006) surveyed 2259, 4-14 year olds in the United Kingdom (UK) regarding reported food hygiene knowledge and attitudes, food handling behaviors, and barriers to practicing proper food handling behaviors. Students were divided into three groups based on grade levels in the UK: Key Stage I (~4-7 years olds), Key Stage 2 (~7-11 year olds), and Key Stage 3 (~11-14 year olds). All students had very good knowledge of when, how, and why to wash hands (over 90% of students answered most hand washing questions correctly). Approximately 64% of the 4-7 year olds, 52% of the 7-11 year olds, and 31% of the 11-14 year olds reported "always" washing hands before eating. In general, food safety knowledge increased with age; however, many of the reported behaviors, such as hand washing, decreased with age. These findings were similar to those found in the study by Haapala and others (2004). Finally, unpleasant and inconvenient hand washing facilities at the schools were noted as barriers to more frequent hand washing, and some students reported avoiding the facilities completely.

Eves and others (2010) reported results of the 732, 5-7 year old subset data that was collected by Eves and others (2006). The same knowledge, attitudes, behavioral, and barrier results were reported in addition to in-depth analysis of qualitative interview data that were previously only briefly reported. Students had relatively good knowledge of the importance of washing produce; over 90% of the students identified

that fruits and vegetables needed to be washed prior to consumption. Furthermore, 96% of students answered the hand washing before eating question correctly but only 64% reported “always” washing hands before eating. The interviews revealed that the students who understood the reasons for proper food handling were more likely to engage in the proper food safety behaviors. Additionally, Students were able to verbalize the concept of microorganisms and how they relate to the humans, food and illness. The authors conclude that children as young as 5 years old have good knowledge of food safety but may need reinforcement from educators, health promotion professionals and parents in order to practice proper food handling behaviors more often.

Ovca and others (2014) found similar results to the previously described studies (Eves and others 2006; Eves and others 2010; Haapala and others 2004). Perceived risk of foodborne illness was assessed by 6 statements with which students had to either “agree” or “not agree” and students reported personal experiences with food preparation and foodborne illness. General food safety knowledge was assessed by 18 true-false questions and self-reported behaviors were assessed using a 5-point Likert scale. Out of the 1272, 10-12 year old students surveyed in Slovenia, the majority had high perceived severity and low perceived vulnerability of foodborne illness. Knowledge scores related to hand washing and food preparation were also much higher than the corresponding reported behaviors. The results of this study suggested that food safety education programs should be implemented in elementary and middle schools for children to establish a foundation of proper food safety practices.

A food safety education program was pilot tested by Burney and others (2007). *Food Safety in the Classroom* curriculum was developed in an effort to combine food safety principles with other core middle school curriculum subjects such as math, science, social studies, and language arts. Food safety extension personnel taught the 7^{th} grade teachers the food safety curriculum and the teachers then taught their students in 5-7 lessons. Preliminary results showed increases in knowledge for both teachers and students as well as increases in hand and contact surface washing behaviors.

Richards and others (2008) used the *Food Safety in the Classroom* curriculum previously pilot tested by Burney and others (2007) with 233 seventh grade students. This study evaluated the impact of the curriculum on the student's food safety knowledge and reported behaviors. The assessments were given at pre-intervention, post-intervention, and six weeks post-intervention (follow-up). Students scored 51±4.9% on the pre-test, 72±5.4% on the post-test, and 69±6.3% on the follow-up test. Students had a knowledge retention rate of 86%, which was a significant increase in overall knowledge from pre- to 6 weeks post-intervention ($p < .001$). As for self-reported behaviors, students scored 73.4±5.1% on the pre-test, 80.5±5.5% on the post-test, and 81.9±4.9% on the follow-up test. Similar to the findings of the knowledge surveys previously discussed, self-reported food handling behaviors do not coincide with food safety knowledge scores (Eves and others 2006; Eves and others 2010; Haapala and others 2004; Ovca and others 2014). The curriculum tested in this study population successfully increased students' food safety knowledge and self-reported

food handling behaviors. However, self-reported behaviors can be inflated and may not be indicative of true behaviors when observed (Anderson and others 2004).

Faccio and others (2013) conducted an experimental food safety education program with 249 fifth grade students at 12 schools. The goal of this study was to increase students' understanding of microorganisms, to explain how bacteria relates to humans, food and illness, and to improve students' overall food safety knowledge. The students were assigned to either an experiential group or a theoretical group. Students in the experiential group participated in actual microbiological experiments, whereas students in the theoretical group received the same conceptual information although it was through a didactic approach. Students were evaluated by drawings (249 pre-intervention and 243 post-intervention) and 141 interviews (71 pre-intervention and 70 post-intervention). Students were asked to draw a picture based on the title "The Microorganism and I" and the definition of a microorganism. Approximately 5 students per class were then chosen for an interview, during which the students were asked series of questions about how to interpret their drawings. Student's drawings in the experiential group were more detailed, accurate, displaying causal linkages between actions of microorganisms and subsequent consequences on humans. The results of this study showed that a practical, hands-on approach was more effective at educating children on microorganisms and food safety than a didactic approach. Due to the complexity of the study design and the inclusion of both quantitative and qualitative variables, this methodology would be difficult to replicate. This study involved a team of researchers, educators, and statistical experts from different disciplines.

Losasso and others (2014) used the same data collected by Faccio and others (2013) with the addition of a parental component. This study analyzed the changes in food safety knowledge and proper food handling behaviors of the 249 fifth grade students through pre- and post-tests. Students were either in the experiential group or the theoretical group. Parents' perceptions of the student's behaviors were measured and compared to the students' self-reported behaviors at pre- and post-intervention. The results showed that overall, student's knowledge increased from pre- to post-intervention. However, student's knowledge stayed the same in the fruit and vegetable handling category, hand hygiene, and insight into the flu virus. The students demonstrated a high baseline knowledge of fruit and vegetable handling and hand hygiene whereas, knowledge regarding the flu virus remained the same following the intervention, likely due to the difficulty of the information presented. Self-reported food handling behaviors of the students significantly increased from pre- to post-intervention and more so in the experiential group compared to the theoretical group. There was a "fair" agreement pre-intervention between the parent's perception of the student's behaviors and it increased to a "slight" agreement post-intervention.

Based on previous knowledge surveys and intervention studies (Burney and others 2007; Eves and others 2006; Eves and others 2010; Faccio 2013; Haapala and others 2004; Losasso and others 2014; Ovca and others 2014; Richards and others 2008), there are varying results of students' food safety knowledge scores and reported behaviors. Students in the US have poor knowledge but report good food handling behaviors (Burney and others 2007; Richards and others 2008), whereas in the UK, students have good knowledge but report poor food handling behaviors (Eves and

others 2006; Eves and others 2010). Most studies used surveys with a relatively low number of questions and studies with a younger population (5-7 year olds) used either pictures or drawings to appropriately and more effectively assess knowledge and behaviors. Furthermore, there is a disconnect between food safety knowledge and reported food handling behaviors. However, it is evident that students as young as 5 years old can and should be educated to recognize and understand unsafe food-related situations to protect themselves from foodborne illness.

- **Disseminate Information**

Targeting children through education programs increases the likelihood of reaching a larger audience, as children are more likely to disseminate information to their families (Heim and others 2011). Additionally, when children share new information with their families and friends, they are better able to retain the information (Losasso and others 2014).

In a garden-based nutrition education program for children, parents were involved to assess nutrition knowledge, fruit and vegetable consumption, and the extent of dissemination of information from child to parent (Heim and others 2011). Heim and others (2011) included parents in their pre- and post-assessments and sent home weekly newsletters and recipes. The child's pre- and post-assessments included questions regarding fruit and vegetable availability in the home and how often they asked for fruits and vegetables. To coincide, one of the questions on the parent's assessment was if and how often their child asked for fruits and vegetables at home to assess the child's asking behavior and intake of fruits and vegetables. At the end of the

intervention, parents reported that their child was asking for fruits and vegetables more often.

Parents were involved in the food safety study conducted by Losasso and others (2014) to assess their perceptions of their child's food handling and hygiene behaviors. On the pre-test, parent's perceptions of their child's behavior were low-to-moderately correlated with their child's reported behaviors. On the post-test however, it was evident that awareness of behaviors and child-to-parent interaction increased based on the correlation between the parent's perceptions of the child's behaviors and the child's reported behaviors.

- **High Risk**

Children are at a higher risk for foodborne illness (Trusts 2014). The increased risk is partly due to children's low body weight, less acidic stomach, underdeveloped immune system, and increased vulnerability to infection (Faustman and others 2000; FDA 2013; Trusts 2014). Children are also considered more vulnerable to infection due to their dependence on others to prepare their meals (Buzby 2001; Trusts 2014). Moreover, children may not have been previously targeted for food safety education programs, as they are not as active in the preparation of their own food.

Conclusion

Even though most foodborne illnesses are preventable, foodborne illness remains a health and financial burden in the US (Scharff 2012). Furthermore, produce-related foodborne illnesses have been on the rise since the 1970's, potentially due to the increase in government response to foodborne illness through advancements in foodborne illness surveillance detection systems/networks (CDC 2011a) and stricter

enforcement of guidelines for producers, manufacturers, and other food-handlers (Sivapalasingam and others 2004). The rise of produce-related foodborne illness could also be due to the increase in fresh produce consumption (Kim and others 2014; McGill and others 2015), poor food safety knowledge and unsafe food handling practices (Redmond and others 2003), and/or the increase in home and school gardens (NGA 2014; USDA 2014). However, definitive conclusions cannot be made.

With the increase in school gardens, it is imperative that students learn food safety principles surrounding school garden activities. Food safety education has not yet been implemented into school garden programs and therefore, the goal of this study was to integrate school garden-related food safety principles into school garden programs in Rhode Island elementary schools. The primary objective was to assess students' knowledge change from pre- to post-intervention. The secondary objectives were to 1) assess students' knowledge change by grade and by each of the four categories, 2) evaluate the program via students' ratings of the activities; and 3) assess reported student to parent/guardian interaction.

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APPENDICES

APPENDIX A. SCHOOL LETTER

To whom it may concern,

- *School Name* - has graciously allowed Farm Fresh RI to conduct school garden programs in our school. The students at our school have benefited from learning about local foods, farming, and nutrition through school garden activities during the regular school day and/or in after-school programs.
I understand that Valerie Calberry, a graduate student at the University of Rhode Island, will be developing and delivering a food safety school garden program to multiple classes in our after school program as a compliment to the Farm Fresh RI programs. As food safety is an equally important part in maintaining the health of our students, we welcome the food safety school garden program to the students that are already participating in the Farm Fresh RI Farm to School program.

Sincerely,

Teacher Principal

APPENDIX B. FSSGP CURRICULUM

Grades 1-5
(Updated: Spring 2015)

Materials

- Food Safety Props
    - Petri dishes poster
    - Cheese, pickles, yogurt
    - Hand soap
    - Dirty harvesting container
    - Clean harvesting container
    - Air-tight storage container
- Pass the Apple Activity
    - 2 – Apples
    - Small stickers, 2 per student
- How to Wash Fruits and Vegetables Activity
    - Activity board
    - Laminated pictures of fruits and vegetables
- What's Wrong with this Picture Activity
    - 2 - 24x36" Posters
    - 2 - Dry erase markers (black, red)
- Food Safety Bingo (Grades 1-3)
    - Bingo card for each student
    - Bingo chips
    - Clues
- Food Safety Jeopardy (Grades 4-5)
    - Jeopardy board
    - Clues
- Handouts
    - Parent/Guardian Letter
    - Black ID roster (for teacher to keep)
    - Educational/summary sheet (for student)
    - Garden to Table Booklet (for parent/guardian)
    - Parent/Guardian Follow-up Questionnaire
    - Wash FV before eating pencils
    - Pre/post tests labeled with ID #'s

LESSON 1:
Introduction – Instructor to students and brief description of program

Teachers:
- Hand out parent/guardian letter
- Distribute and collect pre-tests
- Write students' names on ID roster
    - ID rosters are provided and ID #'s written on pre- & post-tests prior to the start of the program

Pre-test instructions:
- Read all questions aloud to the students and allow time for them to answer questions

Unit 1- Bacteria

Objective: Students will recall basic information about bacteria and food safety including the difference between good and bad bacteria

Materials:
- Pass the Apple Activity
    - 2 - Apples
    - Small stickers, 2 per student
- Food Safety Props
    - Petri dishes poster
    - Cheese, pickles, yogurt

Activity- Pass the Apple. This activity shows how easily bacteria can spread without knowing it
- Give two stickers to each student, one will be for them to keep and the other they will place on one of the apples that are being passed around. Pass around the two apples and make sure everyone in the class places their stickers on one and touches the other.

? Did the apple change at all as it was passed around the room?
- There were stickers placed on the apple
- The stickers show how bacteria can spread from child to child, from child to apple, and apple to child

? Has anyone ever heard of bacteria?
- Bacteria cannot be seen all the time because they are micro-organisms meaning they are very small living cells that can only be seen under a microscope

? Has anyone ever used a microscope? (Show picture of bacteria under a microscope and petri dishes poster)

- Even if a food, looks, smells and tastes good to eat, that does not mean there aren't any bacteria on it!
- Bacteria are everywhere!

? Do you know that there are "good" and "bad" types of bacteria?

- Good bacteria are in some of our favorite foods like yogurt, cheese and pickles
    - Show yogurt, cheese, pickles props
- Bad bacteria are not suppose to be in our food and can make us sick

There are a couple reasons bacteria grow in our food…

- First, they can grow in our food through moisture and warmth. For example, if we leave our food out in the sunlight for a couple hours
- Second, they can be put on our food if it is touched with a dirty object. Like our hands or containers if they are not cleaned the right way

Unit 2- Hand Washing

Objective: Students will learn how to properly clean their hands and when to do so

Materials:

- Food Safety Props
    - Hand soap

? How can we make sure bacteria doesn't get on our food when touching it?

- Wash our hands

? Does anyone know how to properly wash your hands?

- Use warm water to wet hands
- Rub hands with soap while reciting the ABC's slowly
- Rinse hands with warm water and be sure and remove all of the soap
- Dry hands with a clean paper towel

? When are other times we should wash our hands?

- After using the bathroom
- Before eating or drinking
- Before preparing food
- After touching a pet
- After coughing or sneezing into our hands or blowing our nose
- After touching a cut
- After playing outside
- Before and after working in the garden

Activity- How to correctly wash your hands using proper hand washing

- Pass out a small soap to each student.
- Pretend to turn on a sink for warm water.
- Let's rub our hands together with the soap until bubbles appear.
- Start singing the ABC's slowly or happy birthday twice.
- When finished rinse off hands and dry with a clean paper towel

Students may keep the soap

Unit 3- Fruit and Vegetable Washing

Objective: Students will understand how to clean their fruits and vegetables. Also, they will understand when a fruit or vegetable should be thrown out

Materials

- How to Wash Fruits and Vegetables Activity Board
- Laminated pictures of fruits and vegetables

We know that it is very important to wash our hands before touching our fruits and vegetables

? Do you think we need to wash our fruits and vegetables that we pick from the garden too?

- Yes!

? Does anyone know how to properly wash our fruits and vegetables?

- Wash with cool running water, no soap!
- If we have a banana we should still wash the outside because the peel may have bacteria on it. If we don't wash the skin, the bacteria from our hands could get on the part we are eating!
- If we are picking potatoes from the ground we will need to wash and scrub the outside to make sure all the dirt and bacteria come off

? What if you pick fruit, for example, a peach or an apple that is bruised and has a crack in it?

- Do not eat it
- Remember even if the outside looks clean, bad bacteria can be growing inside that could make us sick

? What can we do to make sure bacteria don't get on our fruits and vegetables in the garden?

- Do not allow pets or animals in the garden
- We don't want them going to the bathroom in the garden and spreading bad bacteria
- Just like if we see bird poop on the fruits or vegetables, we want to throw it away

Activity- How to Wash Fruits and Vegetables

- Place the activity board in front of the class.
- The board contains three different categories that include, cool running water and peel, cool running water and, cool running water and scrub.
- Pass out the laminated fruits and vegetables to each student. Have the children go up one at a time to place their fruit or vegetable on the board in the correct section; proper method for it to be washed.
- ANSWERS:
    - Cool running water and peel: banana, orange, grapefruit
    - Cool running water: lettuce, strawberries, squash, cucumber, peach, peppers, raspberries, blueberries, tomato
    - Cool running water and scrub: carrots, cantaloupe, potato

LESSON 2:
Unit 4- Clean Containers… At harvest and storage

Objective: Students will be able to describe the appropriate methods from storing their garden produce

Materials

- Food Safety Props
    - Dirty harvesting container
    - Clean harvesting container
    - Air-tight storage container

We have learned about how bacteria can spread and how to properly wash our hands and fruits and vegetables. We also remember that pets and animals should stay out of the garden!

? How should we properly clean our containers we use for harvesting (picking) our fruits and vegetables from the garden?

- With soap and water before and after placing the fruits and vegetables in them
- Show clean and dirty containers – ask which container would be best

? What is the proper way to store our fruits and vegetables after we have cut them up so bacteria can't get at them?

- Make sure the container has a lid that fits airtight so no bacteria can get in (show air-tight container)
- Place in the refrigerator so the bacteria don't grow as fast – remember, bacteria need warmth to grow!

Concluding Activities

Objective: Students will apply what they learned by answering questions from all areas of the curriculum in the concluding activities

Materials

- What's Wrong with this Picture Activity
  - 2 - 24x36" Posters
  - 2 - Dry erase markers (black, red)
- Food Safety Bingo (Grades 1-3)
  - Bingo card for each student
  - Bingo chips
  - Clues
- Food Safety Jeopardy (Grades 4-5)
  - Jeopardy board
  - Clues

Activity- What's Wrong with this Picture?

- Two pictures will be shown containing improper food safety methods in the garden and in the kitchen. Ask the students to identify what is going wrong in the picture and why they think it's wrong.
- Garden: Animal/pet in the garden, dirty containers (2), eating directly from the garden/not washing fruit/vegetable before eating, eating without washing hands
- Kitchen: Washing vegetables in a sink full of soap, eating without washing hands, eating without washing fruit/vegetable, holding pet while handling food, dirty container

Activity- Bingo (grades 1-3)

- Distribute one bingo card and several bingo chips to each student.
- Read clues aloud until someone calls bingo.
- Play 2-3 games depending on time.

Activity- Jeopardy

- Divide students into 4-5 groups.
- Each group will compete against one another in a Jeopardy game that is based on the information they have learned.
- Determine which group will go first and ask them to pick a category, once the question is read anyone in the class can answer.
- Call on whoever raises their hand first, if they get it wrong, call on someone from a different group. Whichever group answers the question correctly gets the points and then gets to pick the next category.

Wrap up: Ask the students if they have any questions with anything they have learned

Teachers will distribute and collect the post-tests according to student ID roster

- Read all questions aloud to the students and allow time for them to answer questions

Upon completion of the post-test, distribute handouts to students

- Handouts
    - Educational/summary sheet (for student)
    - Garden to Table Booklet (for parent/guardian)
    - Parent/Guardian Follow-up Questionnaire
    - Wash FV before eating pencils

ID #

Pre-test – Grades 1-5
(Correct answers are boxed)

<u>Instructions:</u> Please DO NOT put your name on this paper. Please circle the correct answer.

1. Jason has been playing in the garden. He comes into the kitchen to eat some blueberries. Jason looks at his hands. There is no dirt on them and they look clean. Does he need to wash his hands?

[Yes]

No

I do not know

2. Do you think all bacteria in food will make you sick?

Yes

[No]

I do not know

3. You are harvesting the fruits and vegetables that are in the school garden. After you have picked them, they look great to eat. You want to see how they taste so you take a bite. What do you think?

This is okay to do

[This is not okay to do]

I do not know

4. Joe has found some bird poop on a cucumber in the garden. He knows that he should not eat poop, so he washes the cucumber and eats it. What do you think?

This is okay to do

[This is not okay to do]

I do not know

5. John found a cracked peach within the batch of peaches he picked from the garden. What should he do with the peach?

Throw the whole peach in the trash

Ask an adult to cut off the bad part

Eat the whole peach anyway

I do not know

6. You can always tell if a fruit or vegetable might make you sick.

Yes

No

I do not know

7. Mary's mother asked her to go and pick a few peppers from the garden. Mary washed her hands before she went into the garden even though she might get dirt on them while picking peppers. Did she need to wash her hands before going into the garden?

Yes

No

I do not know

8. Sarah's pet dog, Barky, followed Sarah into the garden when she was going to pick some spinach for lunch. Is it okay for Barky to play in the garden too?

Yes

No

I do not know

9. Susan decided to pick carrots from the garden and she found a container in the garage. What should she do first?

Use it if it looks clean

Shake out the dirt

Wash the container

I do not know

10. Carrie's hands were very dirty from helping her dad pick tomatoes in the garden. How long should she wash her hands with warm soapy water?

5 seconds

10 seconds

20 seconds

I do not know

Post-test – Grades 1-5
(Correct answers are boxed)

ID#

<u>Instructions</u>: Please DO NOT put your name on this paper. Please circle the correct answer.

1. Do you think all bacteria in food will make you sick?

Yes

[No]

I do not know

2. Joe has found some bird poop on a cucumber in the garden. He knows that he should not eat poop, so he washes the cucumber and eats it. What do you think?

This is okay to do

[This is not okay to do]

I do not know

3. Jason has been playing in the garden. He comes into the kitchen to eat some blueberries. Jason looks at his hands. There is no dirt on them and they look clean. Does he need to wash his hands?

[Yes]

No

I do not know

4. Sarah's pet dog, Barky, followed Sarah into the garden when she was going to pick some spinach for lunch. Is it okay for Barky to play in the garden too?

Yes

[No]

I do not know

5. You are harvesting the fruits and vegetables that are in the school garden. After you have picked them, they look great to eat. You want to see how they taste so you take a bite. What do you think?

This is okay to do

This is not okay to do

I do not know

6. Mary's mother asked her to go and pick a few peppers from the garden. Mary washed her hands before she went into the garden even though she might get dirt on them while picking peppers. Did she need to wash her hands before going into the garden?

Yes

No

I do not know

7. You can always tell if a fruit or vegetable might make you sick.

Yes

No

I do not know

8. Carrie's hands were very dirty from helping her dad pick tomatoes in the garden. How long should she wash her hands with warm soapy water?

5 seconds

10 seconds

20 seconds

I do not know

9. John found a cracked peach within the batch of peaches he picked from the garden. What should he do with the peach?

Throw the whole peach in the trash

Ask an adult to cut off the bad part

Eat the whole peach anyway

I do not know

10. Susan decided to pick carrots from the garden and she found a container in the garage. What should she do first?

Use it if it looks clean

Shake out the dirt

Wash the container

I do not know

11. How much did you like the activities? (Circle one face per question)

a. Pass the apple activity

Very much **OK** **Not at all**

b. How to wash fruits and vegetables

Very much **OK** **Not at all**

c. What's wrong with this picture?

Very much **OK** **Not at all**

d. Washing your hands

Very much **OK** **Not at all**

e. Food safety bingo/jeopardy

Very much **OK** **Not at all**

12. What is the most important thing you remember learning from this program? **(Circle your answer)**

Three ways bacteria can spread

How and when to wash your hands

How to wash your fruits and vegetables from the garden

How and when to wash your containers

When and why to keep pets out of the garden

How to store your fresh fruits and vegetables

Other: _____

13. Will you tell your parent/guardian what you learned about food safety and the garden?

Yes

No

I do not know

APPENDIX D. PRE/POST TEST ID ROSTER

Teacher: _____

Number	**Student Name**
106	_____
124	_____
111	_____
149	_____
134	_____
109	_____
126	_____
117	_____
145	_____
139	_____
102	_____
123	_____
115	_____
142	_____
135	_____
103	_____
129	_____
118	_____
143	_____
132	_____
104	_____
122	_____

APPENDIX E. PARENT/GUARDIAN LETTER

Dear Parents/Guardians,

Farm Fresh Rhode Island (FFRI) has been teaching your child about school gardening, local farms and farming, and introducing them to new fruits and vegetables. As a compliment to the ongoing FFRI program, FFRI has invited me, Valerie Calberry, a graduate student from the University of Rhode Island to develop and present a Food Safety School Garden Program, which will include 2 activity-based lessons on food safety for school/home gardening.

Farm Fresh RI's mission is to grow a local food system that values the environment, health and quality of life of Rhode Island's farmers and eaters. Their goals include building a healthier community and increasing access to fresher, tastier food. Food safety related to freshly grown produce (fruits and vegetables) is another very important aspect to learn and practice. Teaching food safety to your child through activities centered around the school garden allows for a great way for them to learn about keeping produce safe to eat.

This Food Safety School Garden Program will take place during or after school. The topics that will be covered are hand hygiene and the ways to ensure safe planting, harvesting, and handling of fresh produce. As with the FFRI programs, we will be asking your child some questions before and after the program to see if he or she understands food safety information and enjoys the lesson and activities. We are hoping to expand this opportunity to other schools with gardens. These questions will not be used as a grade for your child.

At the end of the Food Safety School Garden Program, your child will receive a handout of the food safety and gardening topics and also a very short and simple 4-question questionnaire for you to fill out, which will be voluntary and anonymous. When you receive the handout and questionnaire, please fill out your answers and send it back to school with your child within one week if you would like to provide answers.

Thank you in advance for your time and effort. Please contact your child's school teacher if you have any questions.

Sincerely,

Valerie Calberry

APPENDIX E. PARENT/GUARDIAN FOLLOW-UP

Dear Parents/Guardians,

As you may remember, we sent home a letter with your child describing the Food Safety School Garden program conducted by Valerie Calberry, a graduate student from the University of Rhode Island. If you would like to and have the time, please fill out the short questionnaire below about the Food Safety School Garden Program in which your child participated. This evaluation will help make the program better. Please return the questionnaire to your child's teacher within one week. Responses are not required but encouraged. Thank you in advance for your time and effort.

Please circle the answers to the questions listed below.

1a. Did your child tell you anything they learned in the Food Safety School Garden Program? **Yes / No**

1b. Please write below what your child told you about.

2. Do you have a fruit/vegetable garden? **Yes / No**

3. What grade is your child in?

1 2 3 4 5 6

APPENDIX F. FSSGP MATERIALS

Student Handout

Food Safety and School Gardens

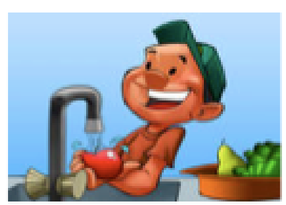
Let's keep garden fruits and vegetables safe to eat by lowering the risk of eating "bad" bacteria!

Bacteria: A very small organism (microorganism) that cannot be seen with the human eye (can only been seen under a microscope)

3 ways bad bacteria can spread

- From food to people or animals
- From people or animals to food
- From one food to another

Wash your hands!

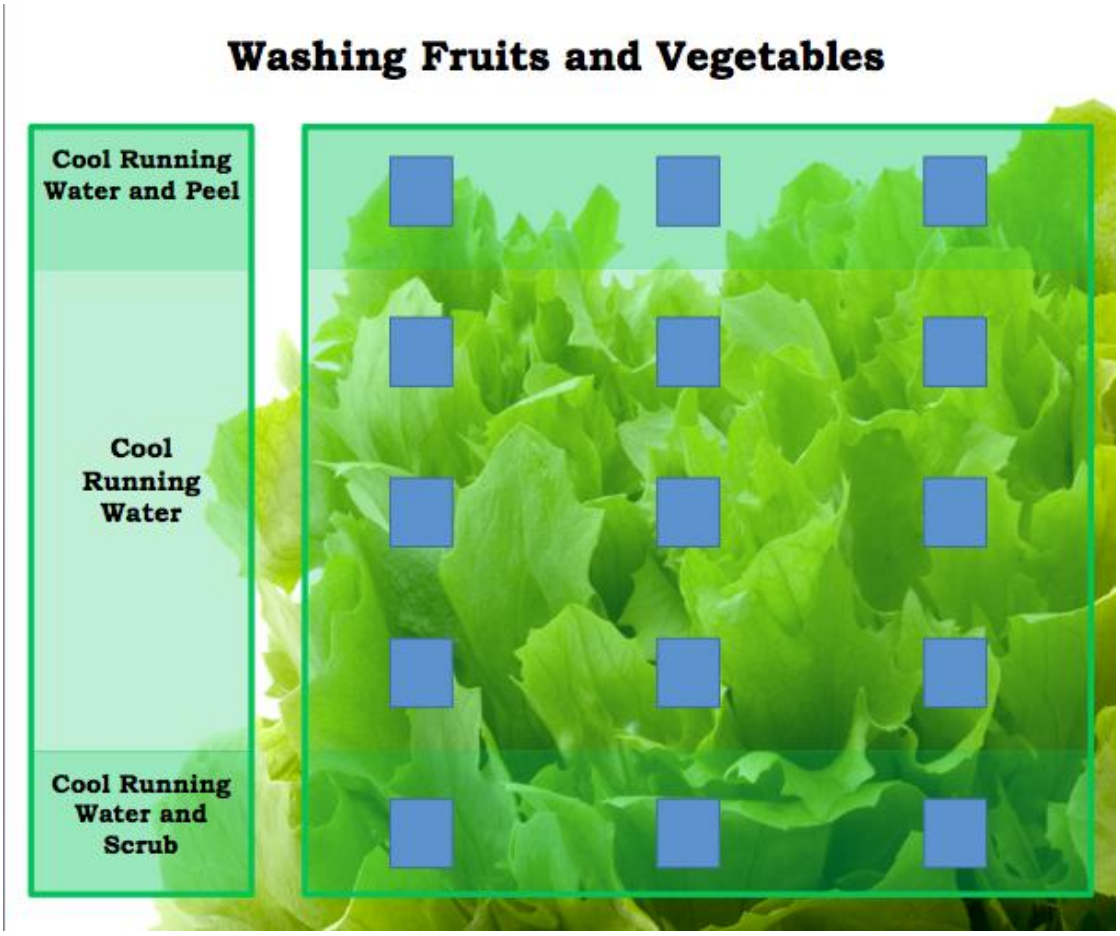


Wash your fruits & veggies!

Don't eat right out of the garden!

Keep animals out of the garden!

How to Wash Fruits and Vegetables Activity Board



How to Wash Fruits and Vegetables Activity Board Pieces

What's Wrong with this Picture? – Garden

What's Wrong with this Picture? – Kitchen

Food Safety Bingo Card (Grades 1-3)

Food Safety Bingo Clues

Seeds – Things that you plant in the soil that grow into plants

Banana – Yellow fruit that you need to wash before peeling and eating it

Potato – Vegetable you need to scrub the dirt and bacteria off

Cantaloupe (melon) – Fruit you need to scrub the skin before cutting it up

Strawberry – Red fruit that you need to wash with cool, running water

Dirty radishes – Red vegetable that has dirt on it

Spinach – Green leafy vegetable that you will pick and wash right before you eat it

Orange – This is a fruit that you need to wash and then either peel or cut into slices before you eat it

Bruised Peach – Fruit that you would not eat because it is bruised and cracked

Cracked Tomato – Red vegetable that you would not eat because it is cracked and damaged

Peppers & tomato – These vegetables are being washed with cool, running water

Watering can – This is used to water the vegetables at the root

Clean container – This is the proper container to harvest fruits and veggies

Dirty container – You must first wash this before you can use it to harvest fruits and veggies

Hand washing – You do this with warm soapy water for 20 seconds

Bar soap – The bar form of the thing that you must use to wash your hands properly. It becomes bubbly when you scrub your hands with it

Petri Dish – This is the growth of bacteria from unwashed fingers

Rake – This is a gardening tool used to scrape and soften the soil

Spade (pointy hand shovel) – This is used to dig small holes in the soil to plant seeds

Shovel – This is used to dig big holes in the ground to plant things like trees

Soil – This is the stuff that you plant fruit and vegetable seeds into

Raccoon – Wild animal you need to keep out of your garden

Dog – Pet that may want to follow you into the garden but should be kept out of it

Fence – This is used to keep pets and animals out of the garden

Food Safety Jeopardy Board (Grades 4-5)

Bacteria	Hands	Harvesting	Eating
1000	1000	1000	1000
2000	2000	2000	2000
3000	3000	3000	3000
4000	4000	4000	4000
5000	5000	5000	5000

Food Safety Jeopardy Clues & Answers

Bacteria

1000 - This is the type of bacteria that can make us sick
Answer: bad bacteria

2000 - This is a food that is white, creamy and yummy, and has good bacteria in it
Answer: yogurt

3000 - This is what we can use to see the bacteria
Answer: microscope

4000 - This is another name for bacteria
Answer: microorganism

5000 - These are the 3 things that bad bacteria need in order to grow
Answer: food, warmth, and moisture

Hands

1000 - This is what you would do first before you go out to the garden to pick some vegetables
Answer: wash hands

2000 - This is what you need to do after you have finished planting or harvesting in the garden
Answer: wash hands

3000 - This is how long you should wash your hands for
Answer: 20 seconds

4000 - This is the best thing that **you** can do to help prevent the spread of bacteria
Answer: wash hands

5000 - This is used sometimes to clean bacteria off of your hands but cannot replace washing with soap and water before or after gardening
Answer: hand sanitizer

Harvesting

1000 - This is the first thing you should *do* when you find a container and want to use it
Answer: check if it is clean

2000 - This is what you need to do after you are done with the container
Answer: wash it

3000 - This is the main reason to keep pets out of the garden
Answer: So they don't poop in it

4000 - This is what you should **not** do while you are harvesting produce even if the produce looks clean
Answer: eat it.

5000 - You need to use this item that becomes foamy when washing your containers
Answer: soap

Eating

1000 - This is what you need to do before you eat any produce from the garden
Answer: wash it

2000 - This is how you would wash a strawberry
Answer: cool, running water

3000 - This is a yellow fruit that you peel but still need to wash it
Answer: banana

4000 - This is what you must store your left over produce **in** after you have cut it up and eaten some of it
Answer: air-tight container

5000 - This is how you would wash a potato
Answer: cool, running water and scrub