A Multi-Component School-Based Intervention Aimed at Increasing Vegetable Preference and Intake among Elementary-Aged Children

Elizabeth Strasser
Utah State University

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A MULTI-COMPONENT SCHOOL-BASED INTERVENTION AIMED AT INCREASING VEGETABLE PREFERENCE AND INTAKE AMONG ELEMENTARY-AGED CHILDREN

by

Elizabeth Strasser

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Nutrition, Dietetics and Food Sciences

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2010
ABSTRACT

A Multi-Component School-Based Intervention Aimed at Increasing Vegetable Preference and Intake among Elementary-Aged Children

by

Elizabeth Strasser, Master of Science
Utah State University, 2010

Major Professor: Dr. Heidi J. Wengreen
Department: Nutrition, Dietetics and Food Sciences

This study aimed to implement and assess a school-based multi-component intervention aimed at increasing elementary school-aged children’s knowledge of, preference for, and intake of vegetables. The multi-component intervention included lunchroom exposure, nutrition curriculum in the classroom, after school program vegetable curriculum, family friendly nutrition newsletter, vegetable fair and parent cooking class. Lunchtime vegetable consumption was assessed by direct observation. Changes in preference, attitude, and knowledge were assessed using a pre- and post-intervention survey.

The multi-component intervention was implemented at Canyon Elementary during the 2008-2009 school year. Classroom teachers provided 20 minutes of nutrition
education to students in grades one through five (n=450) once every month from September 2008 through May 2009. Students who participated in the after school program received additional education once a week for three weeks each month. Overall, no significant difference was observed between children’s pre- and post-intervention except for their willingness to try new vegetables.

Students in grades second and fourth (n=81) were asked to participate in a plate-waste study by allowing researchers to photograph the amount of vegetables they selected and consumed during (p=0.483) second and (p=0.467) fourth pre-intervention and (p=0.71) second and (p=0.34) fourth post-intervention lunch-period. No change in vegetable consumption was observed (p >0.05).

Although the intervention was well received by Canyon Elementary administration, teachers, food-service director, and students, we observed not significant changes in the outcomes we assessed. The results of this study are not consistent with other multi-component school-based interventions that have effectively changed diet-related behaviors among children. Additional work in this area at this school should include additional validated outcomes assessments, changes to the selection of vegetables offered to children in school lunch menus, and a stronger parent involvement.
ACKNOWLEDGMENTS

I would like to thank Dr. Heidi Wengreen for taking a chance on me as a graduate student and teaching me the importance of research in the field of nutrition. She has taught me more than I could ever imagine and has helped me apply it to fulfill my career in school nutrition. I am grateful for her continuous support and encouragement throughout the entire process. I would like to thank her for the countless hours she spent helping me with the project and editing my paper. I would also like to thank my committee members, Tamara Vitale and Dr. Sylvia Read, for their contributions to my paper, their patience in the process, and their ideas to help improve the overall project. I would never have been able to complete this project without them. A big thank you goes to my editor Sarah Velasquez, who without I would still be stuck in the draft stage of this thesis.

I would also like to thank the providers of the grant from Hidden Valley for funding this project and the faculty and staff at Cache County School District and Canyon Elementary who were willing to let me come into their school and teach the children. I would like to thank the kitchen staff at Canyon Elementary for their continuous support and encouragement and advice. I would especially like to thank my family and friends, my parents and grandparents for always believing in me and encouraging me to live up to my potential, and to the dietetic students and Nutrition, Dietetics and Food Sciences faculty and staff for their support and contributions.

Elizabeth Strasser
CONTENTS

Page

| ABSTRACT | iii |
| ACKNOWLEDGMENTS | v |
| LIST OF TABLES | ix |

CHAPTER

I. INTRODUCTION AND BACKGROUND ................................................. 1

Abstract .................................................................................... 1
Introduction ............................................................................... 2
Background ............................................................................... 5
    National School Lunch Program ........................................... 5
    Child Nutrition Reauthorization Act ..................................... 6
    Team Nutrition ...................................................................... 7
    Canyon Elementary ............................................................ 9
    Hidden Valley Ranch Grant .................................................. 11
Hypotheses ............................................................................... 14
References ................................................................................ 15

II. INADEQUATE VEGETABLE CONSUMPTION AMONG CHILDREN:
    CONSEQUENCES AND INTERVENTIONS: A REVIEW .................. 22

Abstract .................................................................................... 22
Introduction ............................................................................... 23
Background ............................................................................... 26
    Healthy People 2010 and vegetable intake recommendations .... 26
    The problems of overweight and obese children .................... 28
    Chronic diseases .................................................................. 30
    Nutrient deficiencies ............................................................ 35
    Benefits of vegetable consumption ...................................... 36
    Healthy weight ..................................................................... 36
Nutrient dense diet ................................................................... 37
    Availability .......................................................................... 40
    Personal preference .............................................................. 47
    Effect on providing children with rewards ............................ 48
    Peer influence ....................................................................... 51
    Parental influence ............................................................... 56
    Neophobia ........................................................................... 58
SUMMARY AND CONCLUSION

ELEMENTARY INCREASING VEGETABLE PREFERENCE AND INTAKE AMONG A MULTI

III. A MULTI-COMPONENT SCHOOL-BASED INTERVENTION AIMED AT INCREASING VEGETABLE PREFERENCE AND INTAKE AMONG ELEMENTARY-AGED CHILDREN

Abstract .......................................................................................................................... 102
Introduction .................................................................................................................... 103
Dietary trends among Americans .................................................................................. 104
NHANES data .................................................................................................................. 105
Preference ....................................................................................................................... 106
Barriers to vegetable consumption among children .................................................... 106
Food neophobia ............................................................................................................. 106
School-based interventions ........................................................................................... 107
Subjects and Methods ................................................................................................... 109
Study participants ........................................................................................................... 109
Components of the intervention .................................................................................... 111
Classroom curriculum .................................................................................................... 111
Cafeteria tasting experience .......................................................................................... 113
Newsletters .................................................................................................................... 113
Data assessment ............................................................................................................. 114
Interventions .................................................................................................................. 118
Statistical Analysis ........................................................................................................ 119
Results ............................................................................................................................. 120
Pre-post-intervention assessment of lunchtime vegetable intake .................................. 122
Teacher participation survey .......................................................................................... 122
Correlation between parent survey responses and children’s survey responses .......... 123
Comparison to national recommendations .................................................................... 124
Discussion ....................................................................................................................... 125
Conclusion ....................................................................................................................... 129
References ....................................................................................................................... 129

IV. SUMMARY AND CONCLUSION ................................................................................... 146
Summary .......................................................................................................................... 146
Conclusion .................................................................................................................. 151
References .................................................................................................................. 152

APPENDIX .................................................................................................................. 157
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Guidelines for School Programs from Wellness Policy ........................................ 20</td>
</tr>
<tr>
<td>1.2</td>
<td>“Vegetable of the Month” theme vegetable in correlation with months highlighted during the project ........................................................................................................ 21</td>
</tr>
<tr>
<td>2.1</td>
<td>Disorders related to childhood obesity and their impact on the bodies systems 101</td>
</tr>
<tr>
<td>3.1</td>
<td>Meal Selection for three day plate waste assessment ............................................. 136</td>
</tr>
<tr>
<td>3.2</td>
<td>Classroom curriculum.......................................................................................... 137</td>
</tr>
<tr>
<td>3.3</td>
<td>After school program curriculum........................................................................ 138</td>
</tr>
<tr>
<td>3.4</td>
<td>Characteristics of Canyon elementary students; 2008-2009................................. 139</td>
</tr>
<tr>
<td>3.5</td>
<td>Distribution of responses to pre-intervention survey (n=450)............................ 140</td>
</tr>
<tr>
<td>3.6</td>
<td>Distribution of responses to parent post-intervention survey (n=215) .............. 141</td>
</tr>
<tr>
<td>3.7</td>
<td>Mean (SD) difference in children’s survey results from pre- post- intervention when categories are ranked as an ordinal variable with a score of 1 assigned to those who strongly disagree and 5 to those who strongly agree; n=450 ........ 142</td>
</tr>
<tr>
<td>3.8</td>
<td>Average (standard deviation) amount of vegetables selected &amp; consumed in cups at the pre- post- intervention data collection periods by grade level .................... 143</td>
</tr>
<tr>
<td>3.9</td>
<td>Average ranking (range 1-5; 1= strongly disagree, 5= strongly agree) for parental vegetable survey................................................................. 144</td>
</tr>
<tr>
<td>3.10</td>
<td>Correlation between student pre-assessment survey and parent survey............ 145</td>
</tr>
</tbody>
</table>
4.1 Food items piloted during Canyon Colts Love Veggies Project and continued the following year on the district menu ................................................................. 156
CHAPTER 1

INTRODUCTION AND BACKGROUND

Abstract

Children continually fall below the recommended levels for vegetable intake in the United States. Research consistently shows children who consume the recommended amounts of vegetables are healthier, and are less prone to chronic diet-related diseases. Schools provide a convenient venue for studying factors that affect the dietary behaviors of children. Nutrition education programs in schools should aim to improve the quality of foods children choose to eat. The United States Department of Agriculture and others have launched nation-wide efforts to educate children about the benefits of consuming nutrient-dense foods, such as vegetables, fruits, whole grain. These programs aim to teach children why it is important to consume foods which are nutrient dense, and provide resources and tools needed for children to choose healthier foods. The lack of positive results in children’s food preferences and their overall health demonstrates the need for more effective strategies. Multi-component studies that include nutrition education as well as other methods targeting children’s behaviors regarding food selection are more effective. We propose a multi-component study that aims to increase vegetable intake among school-aged children and includes nutrition education as well as repeated exposure to target vegetables. Assessment measures included surveys and observations of vegetable intake. This project was carried out at Canyon Elementary School and was
funded by The Carol M. White Physical Education Grant, and a Hidden Valley Ranch Love Your Veggies Grant funded this project.

Introduction

Children, on average, consume fewer vegetables than recommended by the current Dietary Guidelines for Americans. The lack of vegetables in children’s’ diets may be associated with many leading health problems, which until recently, primarily have been seen in adults. Type 2 diabetes, hypertension and high cholesterol have increased in children over the past two decades (1-4). The school setting is a place where children consume at least one meal during the weekdays. The school environment has been used touted as an effective venue to launch programs aimed at improving the nutritional status of children including interventions that target increasing vegetable consumption.

Well-designed and well-implemented school-based nutrition programs may improve the eating behaviors of young children (5). The Centers for Disease Control established guidelines for schools in a report called School Programs to Promote Lifelong Healthy Eating (5-10) (Table 1.1). These guidelines provide a framework from which schools can draw from to develop and implement strategies, which include food policies, integrated nutrition curriculum, and training the staff on adequate knowledge of nutrition education for the students (5).

Though national programs including The National School Lunch Program (NSLP) and Team Nutrition provide resources to support schools in efforts to improve
the nutritional environment for children in schools, existing school-based nutrition programs have not shown a significant amount of success in increasing children’s intake of vegetables (5). The most effective school-based programs are multi-component programs where education correlates with dietary patterns at home and school (2). Expert’s opinions suggest school-based interventions done in elementary schools are more effective than interventions conducted at secondary schools because they impact children at a younger age. The behavior patterns of younger children are less resistant to change, making interventions in school a more positive and effective experience (11, 12).

Elementary-aged children are likely more receptive to information about the consequences of food choices than are older children. Interventions aimed at teaching children healthy habits, including choosing vegetables during snacks and meals will allow them to have improved quality of health (11, 12). A multi-component program aimed at increasing vegetable consumption among children in one elementary school was conducted in the Cache County School District in 2008-2009. The program was approved by Utah State University Institute Research Board, and Cache County School Nutrition Service Director.

Schools face the challenge of providing nutritious meals children will eat. Children are not forced to participate in the NSLP and many choose other options such as bringing lunch from home or buying lunch from alternative sources. Research has shown meals provided by the NSLP are healthier than non-NSLP meals (13). The Third School Nutrition Dietary Assessment Study (2) showed students who participate in the NSLP have diets higher in calories, but a higher dietary quality and more nutrient dense than
lunches consumed by non-NSLP participants (2). Food Service managers must persuade children to participate in the NSLP, which provides healthier food options instead of foods high in empty calories, sugar and fat. Studies consistently show foods consumed at school provide a large contribution to children’s daily intake of nutrients (4, 14, 15).

Children’s eating habits are shaped by various influences, for example; environment, home and peers, social surroundings and personal phobias. Schools provide opportunities for children to try new foods in a social setting (15-18). Children at school learn the science of nutrition and how to develop proper nutrition and healthier consumption habits. However, this knowledge may not be reflected in personal choices and meal patterns (15, 19).

Availability of healthy food choices in the school influence children’s choices of foods in the lunchroom, throughout the school, and in the classrooms, and has some effect on their choices at home (15, 18, 20). Nutrition education enhances learning in both the classroom setting and lunchroom, allows for healthful food choices by children, and should be a top priority for schools (15). When schools teach children in the classroom about benefits of healthy foods, but offer foods that are less nutritious in the lunchroom, children receive mixed messages and may revert to social pressures or pre-determined preferences, and choose less healthy foods.
Background

National School Lunch Program

The National School Lunch Program (NSLP) is a federally assisted meal program providing meals to over 101,000 public and non-profit private schools across the United States (21). The goal of the NSLP is to provide students nutritionally balanced affordable meals. In 2007, each day over 30.5 million children were served a nutritionally balanced meal at low-cost, or for free, at public schools. The NSLP is responsible for providing free and reduced price meals to students who participate in the NSLP and School Breakfast Program (SBP). Local school authorities are responsible for determining the cost of full priced (paid) meals, and the federal government has set guidelines to determine the eligibility of children who will receive free and reduced meals, with respect to the household income (21).

Through income and household size, school officials determine if a student qualifies for free or reduced lunch based on the information provided by the student’s parent or guardian (22). Federal Government mandates schools meet nutrition requirements to receive money and commodities for lunches served. Federal guidelines require schools to offer students lunch at a reduced price or free if a student falls within the guidelines (21, 22). Special circumstances occur, but guidelines are set in place to properly provide impartial service to all students who participate in the school lunch program. Although the NSLP is a Federal Program, the NSLP is administered by state
education agencies which work with local school officials to provide the best quality
nutrition to children while at school (21). Participation in the NSLP allows schools to use
cash subsidies and donated commodities from the U.S. Department of Agriculture
(USDA). The amount provided to the school is determined by the number of meals
served daily (21).

Meals in the NSLP must meet specific nutrition requirements set by the U.S.
federal government under the current initiative. The lunches served must meet
recommendations of the U.S. 1995 Dietary Guidelines (21). These guidelines recommend
not more than 30% of a student’s calories come from fat, and less than 10% from
saturated fat. The federal government also regulates students intake of NSL meals to meet
dietary needs which include vitamins and minerals in their diet (21) the vitamins and
minerals include; vitamins C and A, iron, and calcium. Foods provided by the NSLP
must provide one-third of the Recommended Dietary Allowances, levels found to reduce
the risk of some chronic diseases and prevent deficiency. Through federal regulations
govern the amount of nutrients provided in the food serves. it is up to the individual
schools to determine how they will serve and prepare the food (21).

Child Nutrition Reauthorization Act

The Child Nutrition Reauthorization Act was signed into law June 30, 2004, by
President Bush. Improvements which come through funding from the Child Nutrition
Reauthorization Act expect child nutrition programs to expand the availability of
nutritious meals, and snacks to more children in school, as well programs that provide
meals to students during school and after school and overall enhance the quality of food in schools (23). By improving school nutrition programs, school districts are able to adopt wellness programs to improve the overall health and nutrition of students. The act delineates guidelines to adopt programs which are beneficial in allowing children better nutrition in a school environment. In addition, the act establishes course of action concerning food served during school. One such guideline pertains to developing nutritional guidelines for all foods available in schools, not just foods served as part of the NSLP meals.

**Team Nutrition**

The Team Nutrition Program, funded by the USDA, helps combat the rise in childhood obesity and early life origins to chronic diseases. The objective of the Team Nutrition is to improve children’s overall health in community, schools and homes by providing nutrition educational resources which will help reverse the trends of poor health choices among children (24). Team Nutrition goals include improving not only short-term health, but also teaching children at a younger age healthful dietary habits so they will have the knowledge and skills needed to develop healthy lifestyle habits (24). The program promotes the idea that schools are an important venue and provide opportunities for children to incorporate concepts of healthful eating habits and physical activity into daily life. Canyon Colts Love Veggies Project shares similar objectives in providing nutrition education in the school setting, and correlating with the lunchroom and the community. Canyon Colts Love Veggies Project provides education in the lunchroom, classroom, and in the community to educate children and allow them to
experience healthy meals at school. This local project, implemented the vision of Team Nutrition by providing a variety of healthy options for students in the school setting, incorporated into daily life.

Team Nutrition focuses their efforts on three main categories to help educators and administrators at schools better understand the objectives of the program.

First, they offer training and technical assistance for healthy school meals by training staff participating in the NSLP how to prepare healthy meals for children with different ethnic and cultural taste preferences. They also work to connect what is served in the lunchroom with nutrition education in the classroom. Team Nutrition trains schools to teach nutrition education to their students (24).

Team Nutrition’s second objective is to provide interactive educational tools for teaching nutrition in the school setting so that students will have a greater understanding of healthy eating. Schools can use existing core curriculum as a resource to incorporate nutrition education. For example, science allowing the children to grow vegetables or fruit may help them understand the importance of having them in their diet (24).

Last, Team Nutrition works to allow the community to promote and educate students on healthy eating. Health fairs and nutrition newsletters are examples of community educational resources that allow a connection between the community and what the schools are teaching the children. In turn, community involvement allows students to see support from local community members and provides a positive message of eating healthy (24).
Team Nutrition uses MyPyramid established by the USDA as a guideline for healthy eating across the life span (24). Many of the interventions implemented in the Canyon Colts Love Veggies Program stemmed from the objectives set in place to help train educators and the community on proper nutrition and ways to help combat childhood obesity. Team Nutrition is a valuable resource for schools to enhance the education of proper nutrition and healthier eating habits for children. The Canyon Colts Love Veggies Program implemented interventions that coincide with the objectives to allow more parents and community involvement in making healthy eating habits to improve the overall quality of life.

Canyon Elementary

Canyon Elementary is located in Hyrum, Utah, (pop. 6463) within the Cache County School District (25). Cache County School District is comprised of 22 schools, 14 of which are elementary. It serves 13,400 K-12 students, who come from various backgrounds. An upward trend shows an increasing number of the students in the district from lower income, lower-educated families from small communities throughout the county. Hyrum has seen an increase in the Hispanic population to 13.5%, compared to the local metropolitan city, which has eight point two percent. Though there are fewer Hispanic children in the county, it is ranked among the highest in the state for percentage of Hispanic children within one district. Many of the Hispanic families are first generation immigrant farm workers who speak little or no English. The county ranks among the highest in the state for percent of children living in high poverty neighborhoods a third (30%) of students qualify for free or reduced-price lunch (25, 26).
Instruction on nutrition and healthy eating is practically non-existent in the Cache County elementary schools. Individuals responsible for teaching health and nutrition in the classroom are Physical Education instructors who generally lack the background knowledge to decipher accurate nutrition information and have minimal time to research or create nutrition curriculum. Furthermore, with recent emphasis on every student meeting standardized test scores, few educators can spare time to teach nutrition in the classroom. As a result, Cache County School District (CCSD) students do not receive even minimal nutrition education. Under the Utah Education Network core curriculum (27), nutrition is included under Health Education. The curriculum taught in schools was last updated in 1997, therefore the information provided for educators is outdated and inaccurate since it is not current with the 2005 Dietary Recommended Guidelines for children (27). Elementary curriculum teaches students balanced meals, evaluating the diet, nutrients, and stresses how eating healthy will give you a better appearance. The amount of time allotted for each lesson plan is minimal since various subjects take priority over nutrition education. Students do not receive adequate nutrition education until the ninth grade where it is a small part of the general health class. Secondary students receive no further nutrition education unless they choose to take nutrition as an elective in high school. Additionally, healthy eating and good nutrition skills are not taught through the P.E. program at any grade level. As a result, Cache County students are missing out on valuable knowledge that is essential to create lifelong healthful habits.
Hidden Valley Ranch Grant

Hidden Valley Ranch’s Love Your Veggies Nationwide School Lunch Campaign provided the funding for this research project. The School Nutrition Association (SNA) partnered with Hidden Valley Ranch to fund nutrition programs in schools across the country. SNA provided nutrition education and food safety training to one school in each state. Grants were awarded to a specific elementary school to help develop vegetable programs and offer fresh produce to the children throughout the school year. The Love Your Veggies Nationwide School Lunch Campaign provided $10,000 in grants to 51 elementary schools nationwide to support increased access to, and consumption of, fresh vegetables and fruits during school meals (28).

In the wake of the Child Nutrition Reauthorization Act in 2004, the makers of Hidden Valley salad dressings, created and expanded the Love Your Veggies campaign to help children develop a life-long love of vegetables through activities at home, at school and in the community. While eating vegetables is an obvious necessity, the campaign aims to make the experience an enjoyable one, steeped in education, exploration and understanding of healthy eating (28). In its efforts to get kids eating and enjoying more vegetables, the Love Your Veggies campaign targets two important influencers of child nutrition. Parents and educators are resources to help promote change in the diets of thousands of children. In order to apply for the grant, the elementary school must have a Local Wellness Policy and full cooperation with the school’s administration to conduct the project at their school. Guidelines for the grant recipients provide specific requirements on where money can be spent (28). All evaluations of the funded program
must be communicated to the makers of Hidden Valley (28). Proposals were selected, based on the school’s need for funding, children’s nutritional needs, innovation, likelihood of sustainable impact on the students the program is serving, involvement from the community, support from local grocery stores, and parent support (28).

Research providing justification for The Love Your Veggies campaign found that children consumed more vegetables when offered vegetables with ranch dressing. Various organizations in relation to the University of California-Davis Extension conducted an unpublished study and found that children in California schools consume 23% more vegetables when paired with moderate amounts of ranch dressing (29). When these findings were released, many schools across the country were already working on complying with the Child Reauthorization Act. The act addressed the quality of school nutrition among all children, but particularly nutrition for children who come from low-income families. In many cases, children from low income families have limited access to, or knowledge of, nutrition and nutritious foods because of financial constraints (30).

Including nutrition education in core curriculum is important because school-age children who are educated about healthy eating can change their attitudes about certain foods and begin to incorporate healthier foods into their diets (30). With the vast variety of foods available to children today, they need to have a greater knowledge and understanding of healthy food options to allow them to make optimal food choices to support their health now and in the future. One of the primary goals of the wellness policies should be to ensure there is a plan in place to incorporate nutrition education into the curriculum at every grade level (30). Nutrition education in the past was seen to be a
daunting and an unnecessary task by many educators and administrators in schools.
Incorporating nutrition education into the classroom each day can be done easily by
integrating nutrition through many different subjects. Educators can incorporate nutrition
and healthy dietary habits into almost any lesson plan (30). For example, math equations
can use corn on the cob as a visual aid in problem-solving questions by having students
multiply the numbers of kernels in a row versus column. In English classes, students can
write a poem or a short story about a vegetable, describe how it grows, or explain what
they know about the particular vegetable including vegetables in the core curriculum
increases exposure. With added exposure children will associate the learning in the
classroom with what is offered in the lunchroom, where the meals being served are
balanced and promote healthy eating.

The research proposed in this thesis examines the efficacy of the Canyon Colts
Love Veggies Program funded by Hidden Valley Ranch to increase vegetable
consumption among children attending Canyon Elementary. The project focuses on
various school-based interventions exposing children to vegetables through a “Vegetable
of the Month” theme. Canyon Elementary in Hyrum was selected because of past
involvement as a control school in a study measuring student intake from the fruit and
vegetable bar. A prior assessment found that only 28% of students at Canyon Elementary
selected items from the vegetable bar. Further, those students ate an average of only 0.11
cups of fruits or vegetables. Canyon was targeted as a school that could benefit from
fresh produce added to its vegetable bar to promote an increase in student selecting and
consuming of those vegetables.
The Canyon Colts Love Veggies program highlighted one vegetable each month for a year. All of the nutrition curriculum and the additional resources emphasized the target vegetable of the month. The lunchroom served the vegetable of the month in a variety of ways throughout the month to expose the students to the vegetable. The vegetable of the month was selected based on the season when the vegetable is freshest, which helps emphasize that a variety of vegetables can be eaten year round. The vegetables used for the 2008-2009 school year at Canyon are found in Table 1.1.

Cache County School District administrators were informed about strategies for increasing vegetable intake among students attending all CCSD schools. The administrators and staff were very supportive towards the project. The faculty was very accommodating with lesson plans, and helped students fill out surveys during class time. Kitchen staff was open-minded to suggestions and changes of the menus. The entire staff promoted vegetable consumption in the lunchroom throughout the year.

**Hypotheses**

The following hypotheses were examined among second and fourth grade students attending Canyon Elementary during the 2008-2009 school year.

1. Students will demonstrate an increase in consumption of vegetables in the lunchroom and in the home environment.

2. Students’ knowledge of vegetables and their benefits will increase because of curriculum and activities promoting the importance of vegetables in the diet.
3. Hands-on classes and education for parents will increase the amount of vegetables consumed in the home.

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California Cooperative Extension Butte County, University of California Berkley, School of Public Health.

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### Table 1.1: Guidelines for School Programs from Wellness Policy

<table>
<thead>
<tr>
<th>CDC Guidelines for School Programs to Promote Lifelong Physical Activity and Healthy Eating</th>
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<tbody>
<tr>
<td>1. Policy: Establish policies that promote enjoyable, lifelong physical activity and healthy eating.</td>
</tr>
<tr>
<td>2. Environment: Provide physical and social environments that encourage and enable safe and enjoyable physical activity and healthy eating.</td>
</tr>
<tr>
<td>3. Health education curricula: Implement health education curricula from preschool through secondary school that help students develop the knowledge, attitudes, behavioral skills, and confidence needed to adopt and maintain physically active lifestyles and healthy eating behaviors.</td>
</tr>
<tr>
<td>4. Health education instruction: Provide health education through developmentally appropriate, culturally relevant, fun, participatory activities that involve social learning strategies.</td>
</tr>
<tr>
<td>5. Physical education: Implement physical education curricula and instruction that emphasize enjoyable participation in physical activity and that help students develop the knowledge, attitude, motor skills, behavioral skills, and confidence needed to adopt and maintain physically active lifestyle.</td>
</tr>
<tr>
<td>6. Extracurricular activities: Provide extracurricular activity programs that meet the needs and interests of all students.</td>
</tr>
<tr>
<td>7. Integration of school food service and nutrition education: Coordinate school food service with nutrition education and with other components of the coordinated school health program to reinforce messages on healthy eating.</td>
</tr>
<tr>
<td>8. Training for school staff: Provide adequate pre-service and ongoing in-service training for teachers, coaches, food service staff, and other school staff that impart the knowledge and skills needed to effectively promote enjoyable, lifelong physical activity and healthy eating.</td>
</tr>
<tr>
<td>9. Family and community involvement: Involve family members and the community in supporting, enabling, and reinforcing physical activity and nutrition education for young people.</td>
</tr>
<tr>
<td>10. Program evaluation: Regularly evaluate the effectiveness of school programs in promoting physical activity and healthy eating, and change the programs as appropriate to increase effectiveness.</td>
</tr>
</tbody>
</table>

Adapted by CDC Guidelines for School Programs to Promote Lifelong Physical Activity and Healthy Eating (December 2008)
Table 1.2: "Vegetable of the Month" theme vegetable in correlation with months highlighted during the project.

<table>
<thead>
<tr>
<th>Month</th>
<th>Vegetable</th>
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<tbody>
<tr>
<td>August</td>
<td>Tomatoes</td>
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<tr>
<td>September</td>
<td>Corn</td>
</tr>
<tr>
<td>October</td>
<td>Peppers</td>
</tr>
<tr>
<td>November</td>
<td>Cauliflower</td>
</tr>
<tr>
<td>December</td>
<td>Winter Squash</td>
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<td>January</td>
<td>Onions</td>
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<tr>
<td>February</td>
<td>Root Vegetables</td>
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<td>March</td>
<td>Cabbage</td>
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CHAPTER 2

INADEQUATE VEGETABLE CONSUMPTION AMONG CHILDREN: CONSEQUENCES AND INTERVENTIONS: A REVIEW

Abstract

It is difficult to assess the efficacy of nutrition interventions aimed at improving children’s diet because it is difficult to obtain accurate estimates of usual dietary intake among children. Many programs have been created and implemented to help combat the increasing prevalence of children who have less than optimal diets, are overweight and have increased risk for diet-related diseases. The burden of chronic diet-related disease in children on the American’s health system is significant. The increase in health cost is the basis for recent research to help educate children about the importance of proper eating habits. Collectively, children in the United States are not meeting the recommended dietary intake of nutrient dense foods, such as vegetables, fruits, whole grains, and low-fat dairy products. On the contrary, trends show a rise in total energy intake and consumption of high fat, high sugar and energy dense foods among children. School-based interventions are of interest because they can easily combine methods that include education about regular exposure to healthy foods. Barriers, such as food marketing of high fat, high sugar foods, and the taste preference towards foods that are empty calorie compared to vegetables and nutrient dense foods are inadvertently set in place and influence children’s objectivity and preference towards vegetable consumption and
exposure. This review focuses on the recommended vegetable intake for children and the studies and interventions conducted to educate children about the importance of consuming vegetables and to promote vegetable consumption.

**Introduction**

The 2005 Dietary Guidelines reflect evidence that shows the increased need for children to consume vegetables. The Dietary Guidelines are based on scientific evidence to promote healthy and reduce the risk of chronic disease (1). The most recent version of the guidelines published in 2005 advises individuals to consume between nine to 13 servings or, on average, four and one-half cups of fruits and vegetables daily. This serving suggestion shows an increase from the previous 2000 Dietary Guidelines, which recommended five to nine servings daily without correlation to terms measure of volume (1). The change in measuring servings using cups in the 2005 Dietary Guidelines provides the general population a more specific recommendation. “Servings” was found difficult for the population to interpret, thus making the change to cups easier to understand.

Recommendations for vegetable intake vary by age and gender and physical activity. For school-age children it is recommended that they consume between two and two and one-half cups for girls, and two and one-half to three cups for boys (ages nine-18). Children ages four to eight are recommended to consume one and one-half cups of vegetable per day (1, 2).
Guidelines are divided further into subgroups and are recommended on a weekly basis. The subgroups are as follows dark green vegetables, orange vegetables, dry beans and peas, starchy vegetables and other vegetables. Children ages four to eight are recommended to consume one and one-half cup of dark green vegetables, one cup of orange vegetables, one cup of dry beans and peas, two and one-half cups of starchy vegetables and four and one-half cups of other vegetables. This results in nine and one-half cups of vegetables each week. Girls ranging from age nine to 18 have a variance in the amount of vegetables they are recommended to consume in each category. Dark green vegetables between two-three cups, orange vegetables between one and one-half and two cups, dry beans and peas between two and one-half cups and three cups, starchy vegetables between two and one-half and three cups, and other vegetables between five and one-half and six and one-half cups. Boys’ ages nine to 18 years old are recommended to consume an increased portion of vegetables from the various categories. Dark green vegetables three cups orange vegetables two cups dry beans and peas three cups starch vegetables between three and six cups and other vegetables, between six and one-half and seven cups (2).

Vegetable consumption, especially during childhood, is essential in providing the body with healthy nutrition. Vegetables provide the child with proper nutrients which will allow their body to grow adequately (3). Weekly intake of specific amounts from each of five vegetable subgroups (dark green, orange, legumes [dry beans], starchy, and other vegetables) is recommended for adequate nutrient intake because each subgroup
provides a different profile of essential nutrients. The recommendation for the amount of vegetables consumed from the various subgroups is over one week of time (3).

The Dietary Approaches to Stop Hypertension (DASH) Eating Plan and the United States Department of Agriculture (USDA) Food Guide both suggest increasing intakes of dark green vegetables, orange vegetables, and legumes (dry beans) as part of the overall recommendation to have an adequate intake of vegetables (1). On average, children in the U.S. consume fewer vegetables in their diets than the current recommended dietary guidelines for Americans. Therefore, current consumption patterns for children do not achieve the recommended intakes of many of the subgroups of vegetables. The percent of children ages two to 19 who are meeting the recommendations for vegetable intake is ~36% (4). For both male and female, the percentage of children meeting vegetable recommendations rose with age (4). The lack of vegetables in children’s diets is now associated with health problems previously only observed in adults. The majority of children in the U.S. attend school most weekdays and consume at least one meal while at school. Environmental factors and personal preference contributes to the lack of adequate consumption of vegetables in children’s diet. Personal preference is a major determinant of children’s food choices. Taste preferences developed during childhood tracks into adulthood (1, 5-7).
Background

Healthy People 2010 and vegetable intake recommendations

Healthy People 2010 is a set of health objectives for the Nation to achieve over the first decade of the new century established by the U.S. government to promote and increase healthy lifestyles for American people (8). Healthy People builds on initiatives pursued over the past two decades. The 1979 Surgeon General’s Report Healthy People, and Healthy People 2000: National Health Promotion and Disease Prevention Objectives, established national health objectives and served as a basis for the development of State and community plans (8). Healthy People 2010 is a continuation of the development of a board of consultation process built on the best scientific knowledge and design to measure programs over time. One of the main nutrition objectives for the Healthy People 2010 initiative is to increase the proportion of people from ages two years and older who eat at least three servings of vegetables daily (8). Healthy People 2010 has set health objectives to build on over the first decade of the new century. The goal of Healthy People 2010 is to build on past initiatives and continue to make improvements in the health of the American people (8).

A progress report published in 2003-2004, by the U.S. Department of Health & Human Services, was conducted to evaluate the proportion of people aged two years and older who are meeting the goal of consuming at least three servings of vegetables daily, with at least one-third of them being dark green or orange (9). The report conducted by the USDA Continuing Survey of Food Intakes by Individuals (CFSII) states that three percent of persons aged two years and older consumed at least three daily servings of
vegetables, with at least one-third of these servings being dark green or orange. Of those surveyed 49% had three or more servings of vegetables daily, and one-third or more from dark green or orange vegetables (8). The definitions for dark green and orange vegetables and for serving sizes were derived from the current Dietary Guidelines and are consistent with the USDA Food Guide Pyramid. Dietary guidelines are established to help promote healthful eating habits. The current goal of one-third servings from dark green or orange vegetables set by the USDA Food Guide Pyramid was based on an assessment of the variety of vegetable consumption needed to obtain nutrient adequacy (10). These recommendations are the basis for the analysis of the CSFII to determine the proportion of people who are consuming the recommended dietary guidelines for vegetables, particularly dark green vegetables and orange (2, 8).

In a previous report from data collected in 1994-1996 3% of the population met the Healthy People 2010 objective for vegetable consumption especially for dark green and orange vegetables. The goal for vegetable intake was for 50% of the population aged two years and older to consume at least three daily servings of vegetables per day, with at least one-third being dark green or orange. In 2003–2004, dark green or orange vegetables represented about seven percent of the total vegetable consumption by children and adolescents aged two to 19 years (8).

In the various studies that show children in the U.S. do not meet current national standards recommended for their diet for proper health, the studies give special attention to the increase in young children who have diet-related disease such as Type 2 diabetes, a disease that was once rarely diagnosed in children (5). In order to combat this trend,
various organizations and groups promote a healthy lifestyle among younger children.

The USDA is committed to help the U.S. population meet the objectives of Healthy People 2010 and believes this effort will help to combat the rise of childhood overweight and related chronic diseases. With the increased attention on the obesity problem among children in the U.S. the USDA recently issued a statement on the USDA website affirming their support in improving the health and overall well-being of children.

We have a responsibility to promote knowledge, attitudes and behaviors among our school children that will develop eating patterns that improve health, intellectual development, and overall quality of life, today and into the future. To achieve this change, students, their parents and educators, school officials, community and business leaders, and local, State, and Federal program administrators must be actively involved in ensuring that school environments promote healthy eating patterns” (1).

The problems of overweight and obese children

Over the past several decades, overweight children, childhood obesity and the prevalence of diet-related diseases among children have continued to rise at an alarming rate. The rate of obesity among children ages six to 11 years has more than quadrupled over the past four decades. The increase in obesity seen among adolescents ages 12-19 has tripled over the same time period (5, 11). Many diet-related diseases are chronic diseases such as heart disease and diabetes, which account for more than half of all mortality in the United States (12).

Obesity is a risk factor for many chronic diseases. Central adiposity is associated with insulin resistance and Type 2 diabetes. Type 2 diabetes is the most common form of diabetes (13). Type 2 diabetes results when the body does not produce enough insulin, a
hormone in the body that regulates the glucose it receives through food to use for energy. Insulin can be produced in the body, but cells are not able to properly utilize it for energy (13). Obesity has been linked to causing Type 2 diabetes because an increase of fat cells in the body makes the body unable to utilize insulin to convert it to energy (13). Obesity prevention is a critical strategy for preventing mortality from chronic disease. Habits children form frequently persist into adulthood, and forming healthy habits early in life has been shown to improve overall health and increase a person’s life expectancy and lowering their medical costs (5, 14, 15). Studies have been conducted to determine the impact of obesity among children at younger ages than ever before. For example, today’s young people, on average, live less healthy lives and will ultimately live shorter lives than their parents (12).

Unhealthy eating that contributes to overweight and obesity in children has both short- and long-term consequences to both physical and cognitive health. When we consider methods of intervention to combat the rise in obesity, we must look at both long term and immediate options (15-17). Healthy eating promotes the development and optimal function of many physiological processes, which benefit the health and well-being of the body. Children who are healthy are also better prepared to learn. Others have found associations between diet and cognitive function and school performance among children (16).

Many diseases depicted in Table 2.3 have common etiologies. The metabolic disorders are likely associated with an increased risk of cardiovascular disease and diabetes in young people (12). The metabolic system is a very complex interrelated
system that controls how the body uses and stores energy (12). Type 2 diabetes used to be considered an adult-onset diabetes, but over the past 15 years, with the changes in children’s diet and their increase in obesity, Type 2 diabetes is now seen in younger children (12). Metabolic syndrome is difficult to define in adults and even more difficult to define in children. A study conducted by Cook and colleagues (18) diagnosed the metabolic syndrome in four percent of children from the study, of those four percent, 30% were obese children (12, 18).

**Chronic diseases**

Table 2.1 summarizes various disorders related to childhood obesity in different systems in the body. These conditions can are categorized into the following areas: cardiovascular problems with hypertension, metabolic disorders, and pulmonary, gastrointestinal, skeletal and psychosocial disorders. Additional evidence shows the dietary patterns of children at a young age may be a predicting factor for their overall health status as adults, particularly the occurrence of obesity and adult cardiovascular diseases, as well as adult diet-related cancer (7).

Recent national epidemiological studies suggest today’s children and adolescents have higher blood pressure than did their counterparts in past decades (19). Obesity and other dietary factors are associated with increased risk for hypertension, which is due to the trends for increased number of overweight people (12). As children on average have become more overweight, their blood pressure on average has increased. High blood pressure in a child can likely become hypertension in adulthood (12, 20, 21).
Left ventricular hypertrophy is an independent risk factor for cardiovascular disease in adults. Left ventricular mass is lean body mass, due to the fact that the heart’s development matches the development of the body’s muscles (12). When a child has increased fat mass the correlation between Basal Metabolic Index (BMI) among children and high blood pressure increases (12, 22). Obesity is a key factor in developing high blood pressure. High blood pressure was previously seen primarily in adults but high blood pressure due to obesity is now becoming a problem among children (12, 23). Appel, and colleagues (24) studied the effects of vegetable consumption on blood pressure. Over an eight year period, the group studied follow-up visits of 95 children ages three to six. The yearly assessments included a series of five measures of blood pressure and a three-day food diary (24). Results showed children ranging in age from six to 12 who consumed four or more servings of vegetables and fruit per day had a lower systolic blood pressure and a slightly lower diastolic blood pressure in early adolescence (24). The results from the study show strong correlations between the preschool-age children’s blood pressure at the beginning of the study blood pressure, and the same children’s blood pressure over the eight year course. These findings conclude diets high in vegetable fruit and low-fat dairy consumption may have positive effects on adolescents’ blood pressure (24).

High levels of vegetable intake have been shown to be protective against heart disease among adults and children. Children who consumed four or more servings of vegetables per day from ages six to 12 had lower systolic blood pressure and slightly lower diastolic blood pressure in childhood, resulting in the reduction of heart disease in
adult years (25-28). Recommendations to consume at least five servings of fruit and vegetables a day support research in this area find associations between vegetable consumption and long-term benefit related to health (26, 27, 29). The recommended guidelines are also applicable to youth because chronic disease is now being identified at younger ages (29, 30). Risk factors for chronic diseases are elevated among some children with poor dietary habits and lack of exercise (29). Children who are overweight and obese have been seen to have risk factors that have been linked to poor health in adult years (29, 31). Childhood may be the easiest time to learn and develop healthier eating habits which will translate into a healthier lifestyle (29, 32-35) thereby minimizing risk of chronic disease (29, 34).

Asthma is the leading pulmonary complication seen among children. Several studies have identified an association between asthma and overweight/obese children (12). It is not clear why obesity increases the risk of asthma among children, but the prevalence and severity of childhood asthma has increased in the past two decades paralleling the increase in the prevalence and severity of childhood obesity (12). A study conducted by Rodriguez and colleagues found children with a BMI above the 85\(^{th}\) percentile had an increased risk of asthma independent of age, sex, ethnicity, socioeconomic status and exposure to tobacco smoke (12, 36).

Sleep Disordered Breathing, an additional pulmonary disorder, has also increased among children. Sleep disordered breathing may be one of the most under-recognized medical complications in overweight children (12).
Recent data has shown obesity is related to liver disease. For example, nonalcoholic fatty liver disease (NAFLD) is now a more common complication of obesity (37). There is also a correlation between obesity and a combination of alcohol or hepatitis C but is the sole cause of NAFLD (37). Increased consumption of fatty acids in the diet has been shown to increase the amount of fat accumulation seen in the liver, when excess weight is a problem. Excessive fat can build up in the liver and disrupt the normal functioning of hepatocytes. This will lead to cirrhosis, which is defined as the scarring of the liver and poor liver function as a result of chronic liver disease (37, 38).

Wanless and Lentz (39, 40) focused in a specific area of liver disease termed “NASH” or nonalcoholic steatohepatitis, which is also termed nonalcoholic fatty liver disease (NAFLD). In their research they found NAFLD to be the most common of all liver disorders, with 70% of obese patients had class 1 NAFLD (39, 41-48). A number of reports at the conference addressed the severity of the disease and the relationship between NAFLD and obesity and diabetes. Among Type 2 diabetes patients it was estimated that 75% had some form of fatty liver (38, 39, 49, 50). NAFLD is becoming common in obese children and is a growing problem, given the increase in prevalence of obesity. Increase in adiposity has been associated with fatty liver, which can lead to fibrosis, cirrhosis and liver failure (37). It is difficult to determine the prevalence of NAFLD because many are asymptomatic and diagnosis requires a biopsy for confirmation (39). Patients with advanced stage of NAFLD are poor candidates for transplantation due to co-morbid conditions such as obesity and complications of diabetes (39). A prospective study conducted by Sagi, and colleagues (51) investigated the
prevalence and characteristics of NAFLD in the overweight pediatric population. The study consisted of 58 overweight young patients attending a pediatric obesity clinic. The children had clinical and biochemical assessment and liver ultrasonographic exams instead of the standard liver biopsy because of the invasiveness of the procedure and the risk of complication. Children in the study were found to have a 60% prevalence of NAFLD, and there was a highly significant association between the severity of the child’s obesity and the presence or absence of liver steatosis (37, 51). The study concluded that the prevalence of NAFLD in overweight children is relatively high. Children with elevated liver enzymes, which are seen in NAFLD are at risk for other obesity complications (51).

Depression, the most studied psychosocial problem in the United States, has been hypothesized to be associated with childhood obesity (12). Although risk factors for depression in adolescents are not well known, body dissatisfaction has been well studied, particularly in girls. A study conducted by E Stice and colleagues (52) found dietary restraint and body dissatisfaction were linked to depression (12, 52). Weight issues can often cause body dissatisfaction. Children are more vulnerable to peer-influence and criticism about their body image. Many obese children have been found to seek treatment for their depression (12, 53). Determining the relationship between obesity and depression is difficult because there are many factors to take into consideration. Although many scholars have observed an association between obesity and depression among adolescents and young adults, the overall impact obesity has on depression among children is yet to be determined (52).
Over the past ten years, research has begun to provide clues about the mechanisms associated with obesity’s role in depression (54-59). Researchers are looking in the endocrine system of the brain to determine the cause of depression. The endocrine system is made up of small glands in the body, which create hormones that regulate functions and emotions in the body (60). It has been found that a large number of people who suffer from depression have abnormal levels of some hormones. The endocrine system is also connected to bodily activities such as appetite (60). Ghrelin is a hormone found in the stomach that increases the intake of food, and can directly act on neurons to regulate food intake in the body. Recent research provides evidence stating the central nervous system (CNS) senses and processes peripheral metabolic cues including ghrelin, (55, 56) coordinating with energy homeostasis (61, 62).

Nutrient deficiencies

No single food provides all of the vitamins and minerals the body needs to stay healthy (1). Vegetables are nutrient rich foods that provide a broad array of essential vitamins, minerals and other beneficial phytochemicals. Some vegetables are more nutrient dense and provide more nutrients, but all vegetables have some nutrient value. Therefore, it is important to consume vegetables from each of the subgroups on a regular basis.
Benefits of vegetable consumption

Eating vegetables contributes to an overall healthy diet and has the likelihood to reduced risk of some chronic diseases and are beneficial for health and maintenance of the body \((1, 2)\). Consumption of a diet rich in vegetables as part of an overall healthy diet may reduce risk for Type 2 diabetes and protect against certain cancers. Vegetables are nutrient dense and contain fiber, which may reduce the risk of coronary heart disease \((8)\). Eating vegetables rich in potassium as part of an overall healthy diet may reduce the risk of developing kidney stones and may help to decrease bone loss. Vegetables being high in fiber and water are a relatively poor source of energy, so increasing vegetable intake may help to decrease overall energy intake. Vegetables are also low in calories per cup, and eating them instead of some other higher-calorie food may be useful in helping to reduce calorie intake \((2)\).

Healthy weight

The Body Mass Index (BMI) is an index of height divided by weight used to calculate the proportion of a person’s weight and height. The BMI that is used for children is determined by the percentage and is considered the most reliable indicator of too much body fat for children. The BMI does not measure fat directly but there is a strong correlation between BMI and direct measures of body fat in children and young adults \((63, 64)\). Children in active periods of growth may change height and weight rapidly, making it difficult to assign measures of adiposity determined from these measurements. An accurate long-term measurement of a child is often difficult to provide since children are continually growing in both height and weight. Professionals at the
Centers for Disease Control have determine measurements to best determine what weight is healthy for children (63). The person using the BMI must measure the child’s accurate weight and height each time they interpret the BMI. The BMI is calculated through a standard formula, with the percent of BMI differing with age and the BMI percentage being determined by both age and sex specific for children (63). There are two main reasons that age and sex are considered for children; first, the amount of body fat changes with age. Second, the amount of body fat differs between girls and boys (63). Categories provide measurement of children to determine their weight and whether or not they fall in the healthy category (63).

**Nutrient dense diet**

Each sub-group of vegetables has differing nutrients that are beneficial can decrease the risk of diseases. Cruciferous vegetables such as cabbage, cauliflower, broccoli and Brussels sprouts contain a variety of phytochemicals such as glucosinolate and isothiocyanate hydrolysis products, which are well known protectors against the development of cancer (65). Dark leafy greens are beneficial in reducing the risk of cancer, heart disease and Type 2 diabetes since they are low in fat, high in dietary fiber and rich in folic acid, vitamin C and other phytochemicals (65). Orange vegetables have vitamin K, A and C as well as potassium which has been beneficial for blood sugar regulation and protection against certain types of cancer (65).

High water and high fiber content of foods, such as vegetables, may provide satiety over a longer period of time than energy dense foods, which provide empty calories and few nutrients. Nutrient density refers to the amount of nutrients in a given
volume of food. Nutrient-dense foods provide a good amount of nutrients relative to the amount of energy provided by the foods. Vegetables are rich in nutrients and other compounds which make up healthy benefits such as fiber, phytochemicals and essential fatty acids. Many of the nutrients that are lacking in American children’s diet can be found in vegetables, and an increase in vegetable consumption among children can help children meet the recommended dietary guidelines and provide them with the nutrients found to help with proper growth. Nutrients that are lacking in today’s diets include calcium, potassium, fiber, magnesium, and vitamin E. Vegetables are shown to be the most nutrient-dense in these areas. Calcium can be found in leafy greens, such as broccoli and kale (66). Potassium is found in potatoes and tomatoes. Fiber is found in the skins and flesh of vegetables. Some of the richest sources of magnesium are found in green leafy vegetables, such as broccoli and squash. Good food sources for vitamin E include plants like asparagus (66). Vegetables including carrots, tomatoes, broccoli, kale, spinach, squash are served in school lunch to provide the body with the nutrients that children are lacking (67).

Certain vitamins are also determined as beneficial for growth and healing of the body. Vitamin A helps cell reproduction, increases the quality of vision, and promotes bone growth and tooth development. Vitamin B3 (niacin) assists in the functioning of the digestive system, skin, and nerves. Niacin also helps as an important vitamin to convert food into energy. Vitamin B5 (pantothenic acid) is found in a variety of vegetables and helps the metabolism of food, and in the formation of hormones and good cholesterol. Vitamin B9 (folate/folic acid) are found in vegetables. Folate occurs naturally in fresh
foods, whereas folic acid is the synthetic form. Folate is necessary to produce red blood cells, and folate also functions as a component of the nervous system. Folic acid is vital for proper cell growth and development. Vitamin C is in a variety of vegetables and has shown to be one of the more important vitamins for the body because of its significant role as an antioxidant. Vitamin C protects the body tissue from the damage of oxidation. Vitamin K is a fat soluble vitamin and plays a critical role in blood clotting (65). Children are now consuming fewer dark green and orange vegetables than the U.S. recommendations for children. Recommendations are to consume one-third of total vegetables as dark green and orange vegetables consumed (8). USDA shows on average children consume 0.2 daily servings of the recommended dark leafy green and orange vegetables (68). Fiber in vegetables helps the body protect the body from diseases. Fiber enhances the health of organs in the body to help with fat absorption and it prevents certain cancers. A large study of diet and cancer to date conducted by Bingham, Day, Luben (69) examined the diets of over a half million people in ten countries for four and a half years found an inverse association between dietary fiber and colon cancer. People who ate the most dietary fiber (the recommended 35 grams per day) reduced their risk of colon cancer by 40% compared with those who ate the least fiber (15 grams per day) (69).

Dark leafy greens (such as spinach and, lettuce) and orange vegetables, such as carrots, high amounts of vitamin A. Vitamin A is used in the body to promote vision, participation in protein synthesis and cell differentiation, thereby maintaining the health and epithelial tissues and skin, and support reproduction and growth of the body (65).
Dark leafy greens are also loaded with vitamin C. Vitamin C has been associated with many positive factors in helping the body heal. Vitamin C helps the body defend against free radicals. Vitamin C is also used in the body as a cofactor in collagen formation, it helps synthesis several other compounds in the body, and in disease prevention (65). Vitamin C may help in preventing or treating cancer, heart disease. Vegetables, especially dark green and orange colored vegetables, contain antioxidants which may help prevent certain cancers. Antioxidants are proven to be beneficial to the body’s overall maintenance and prevent free radicals seen in the body. Free radicals can cause cell damage which contribute to the development of cardiovascular disease and cancer (65). Antioxidants can be produced by consuming vegetables and are used in the body to neutralize reactive oxygen species and protect DNA and proteins from damage caused by oxidative stress (65).

Availability

Children’s eating behaviors are strongly influenced by the foods available to them in their immediate environments. The school environment is a key setting which impacts a child’s diet and make foods available to children (5). The availability of vegetables is one of the most important environmental factors known to impact children’s consumption of vegetables (5). Preference, variety and knowledge are also factors in children’s consumption.

Blanchette and Brug (70) recently reviewed 38 publications aimed at increasing vegetable intake among children and identified availability as a significant predictor of vegetable intake. Twenty-one were on determinants and 15 were on interventions, and
were school-based. Interventions aimed at measuring vegetable intake compared results from different studies aimed at increasing vegetable intake among children ages six-12 years old (70). Keywords such as, *vegetable, children, interventions, availability* and *schools* are all helpful in searching for available literature to acquire studies that are compatible with the criteria of the study.

Of the 19 studies reviewed, a majority of them implemented interventions based on the Social Cognitive Theory of behavior change (SCT). SCT is recognized as the complex and reciprocal inter-relationships between dietary behaviors, environmental and personal factors. SCT is a learning theory that may be applied to dietary behavior change and recognizes both influences of dietary behavior with environmental and personal factors (70, 71). SCT has emerged as one of the dominant models for understanding and modifying health habits (71). SCT is a framework for dietary interventions to help influence children’s preference toward vegetables (71, 72). According to the summary of this review, availability and accessibility of vegetables play a role in children’s consumption of them. Parental influence was also shown to influence vegetable consumption among children.

Blanchette and Brug continue in the study stating that the availability and accessibility of vegetables are the most important determinants of vegetable intake among children ages six to 12 years old (70). Availability and accessibility of foods in the home and outside the home either inhibit or enhance consumption of vegetables (73, 74). Results of the intervention showed increases from zero to 2.54 daily vegetable consumption servings, with 14 of the 15 studies which focused on interventions found an
increase in vegetable intake. The 12 school-based interventions reviewed included multi-component curriculum, parent activities, and school meal modification. Results from all of the school-based interventions were positive, with vegetable intake increasing by 0.2-1.68 servings per day.

Previous research supports the importance of schools in influencing children’s intake of vegetables. Cullen and colleagues found in their studies that the National School Lunch Program meals contribute to children’s consumption and availability of vegetables nationwide (73, 75). Baranowski’s study aimed to determine the difference in children’s consumption of vegetables by day of the week and meals during the day. His results showed that vegetables were consumed most frequently at weekday lunch. He determined that participation in school lunch accounted for a substantial proportion of vegetables consumed at lunch (75). Schools participating in the NSL program have the responsibility to make vegetables available to children on a regular basis allowing them to receive greater exposure to vegetables that may translate into increased consumption of vegetables.

Cullen and colleagues (73) studied the availability of vegetables inside and outside the home environment, and how that can facilitate or inhibit consumption. The study examined three areas: 1) the relationship between child-reported vegetable availability to child-reported vegetable consumption; 2) the relationship between parent-reported vegetable availability and child reported availability; and 3) a combined model tested including both parent-and-children reported vegetable availability with measures tested. Cullen and colleagues used Food Records (FR) to record and identify foods the
children consumed, the number of servings and methods with which they were prepared. The results were coded to servings from the Food Guide Pyramid serving size, and this been shown to be a valid method of assessing vegetable intake among ten to 12 year old children. The researchers used questionnaires to measure the availability of certain vegetables in the home over a week with a yes/no answer.

The first set of results assessed the ratio of a sample of child-reported availability of vegetables to their consumption of vegetables. The assessment indicated that availability of vegetables in the home accounted for about ten percent variance in children’s consumption as was seen as significant predictors of child vegetable consumption (p<0.05). The second assessment analyzed the influence of parent-reported availability on children’s consumption. The sample size accounted for eight percent variance, and was a significant predictor (p<0.05) of child vegetable consumption. The final assessment was a combination of parent-child reported vegetable availability with child consumption. The variance accounted for 12% of the variance and the reported availability was significant (p<0.05). This study noted that vegetable availability influenced child dietary behavior, and an increase availability was associated with increase consumption (73).

Changes in overall dietary patterns over the past 20-30 years parallel the increased rates of overweight and obese people. Many dietary factors are likely contributors to obesity and diet-related disease among children. Dietary fat intake, higher intake of sweetened beverages, increased energy intake due to increase portion sizes, or inadequate intake of water and vegetables—both of which lead to the feeling of fullness, are all
factors that have developed over the past several decades. Children also have increased their fast food/restaurant consumption and snacking on foods with discretionary calories and minimal nutrient content (62). The increased consumption of discretionary calories, along with lack of exercise demonstrates an association between the type of food children consume and the increase of rates of obese children.

Many professionals in the field of nutrition are concerned about high levels of consumption of refined and processed sugars that children consume. The current Dietary Guidelines for Americans (2, 8) include recommendations to decrease refined sugar in the diet with limited intake access amounts (1). The guidelines have suggested the amount of refined sugar consumed per day be cut in half (76). In a study that Wardle and colleagues (77) conducted they found a consensus among researchers who studied the effect of nutrients obtained in the diet and the prevention of chronic diseases. They found that nutrients obtained from healthy food such as vegetables can contribute to the prevention of cancer and cardiovascular disease and may displace other foods from the diet, thereby indirectly reducing fat consumption (77, 78).

Data from the USDA’s 1989-1991 Continuing Surveys of Food Intakes by Individuals (CSFII) showed that white children were more likely to meet the recommendations for vegetable intake than either Hispanic or black children (4). The National Health and Nutrition Examination Survey (NHANES) of 1999-2004 conducted a survey to determine the quality of American school-age children and their diets according to school lunch participation. Overall, 36% of school children consumed one or more discrete servings of vegetables at lunch (reported separately, not as part of a salad
or mixed dish) (79). Of the vegetables children eat, almost half of them are potatoes, and 25% of the potatoes consumed are fried (79). This information reaffirms that children’s eating habits have changed over the past several decades. Instead of consuming dark green and orange vegetables, children are consuming more fried potatoes, which are cooked in high amounts of fat, and increase the children’s intake of fat, counteracting the intake of the vegetable.

According to Munoz and colleagues (4) results from USDA CSFII, approximately 36% of children meet the recommendations of six-11 servings of vegetable intake per day (4), (70, 80). The average amount of vegetables children in the U.S. consume per day is 5.8 servings. Vegetable intake increases in older children from children ages two-five. They consume 5.2 servings daily, whereas children ages 12-19 consume 7.3 servings. (4, 70, 80).

This study also found a difference in vegetable intake among children of different racial and socio-economic statuses. White, non-Hispanic children consumed 5.9 servings of vegetables, compared to blacks who consumed 5.5 servings and Hispanics who consumed 5.4 servings. The distribution of intake differed by socio-economic status. Children who fell below the poverty index <131% consumed 5.7 servings. Where children between 131 to 350% consumed 5.8, children >350% consumed 5.9 servings. This data also examined vegetable consumption by gender. The trend of increased vegetable consumption with age was similar between both males and females, but on average males consumed more servings of vegetables per day, ranging from two-five
years of age 2.5 servings, to 12-19 years 7.3 servings, whereas females consumed fewer; ages two-five consuming 4.9 servings and ages 12-19 consuming 5.1 servings.

Appel and colleagues (24) conducted a study demonstrating that an increase in vegetable consumption in the diet can not only decrease the incidence of early mortality from various chronic diseases in children, but may help reverse the effects of chronic diseases (24). Diets from this study were characterized by high intakes of vegetables as prescribed by the Dietary Approaches to Stop Hypertension (DASH) diet (24, 81), which emphasizes a diet rich in fruits and vegetables, along with low-fat dairy products. Children in this study were followed over an eight-year period, with yearly clinical visits that included assessments of blood pressure. To obtain a pre-study assessment of dietary intake, four sets of three-day diet records were taken during the initial year of the study, and one-two sets of three-day diet recalls were taken each additional year (24). The study followed the USDA Food Guide Pyramid for accurate collection of the dietary recall (24). In this study, a child’s vegetable intake at ages three to six years of age correlated strongly with the same child’s intake at six-12 years of age (Pearson correlation = 0.74)

Children who consume four or more servings of fruits or vegetables a day had a lower diastolic and systolic blood pressure in early adolescence. Although the research showed that a diet high in fruits and vegetables is associated with lower blood pressure, the mechanism by which it produces a lower blood pressure is unclear. Vegetables are high in rich minerals such as calcium, magnesium and potassium, all of which have been associated with the reduction in blood pressure.
Personal preference

Over the past 20 years a growing number of studies have also been conducted to determine the association between children’s food preferences and the increased prevalence of overweight and obesity among children (82-85). Results from a recent survey of 3,302 children ages two to 19 years-old showed that 45% of children’s total energy intake came from discretionary sugar and fat. It also found that the intake of only one percent of children met all dietary guidelines (4, 82). Generally, children prefer to consume foods that they know and are more comfortable with. When children are frequently exposed to vegetables they are more willing to consume them. Research supports children’s taste preference as the reasoning for both negative and positive consequences for vegetable consumption (71). Children are more likely to prefer sweet flavors. Vegetables are found to be less preferred because of their lack of sweetness, especially a lot of common vegetables that children are accustomed to such as broccoli, carrots, peas, lettuce and green beans. Most raw vegetables do not have a sweet flavor, so additional ingredients may need to be added to make the sweetness come out in the vegetable (70).

Most evidence suggests that it takes between six to ten exposures to a food before children achieve clear changes in their preferences (82). Several different studies examine how food preferences develop. One theory used to explain the development of children’s food preferences is the development systems perspectives theory. This perspective, derived from evolutionary biology, views development as a result of the interaction of genetic predispositions with environmental factors (82). Birch suggests that these
environmental and genetic relationships are most important in a child’s early life when the child’s eating environment is created, making it difficult to separate the genetic and environmental factors (82).

**Effect on providing children with rewards**

Food is often used as a reward for encouraging specific behaviors; for example, some parents reward children for good behavior with high-sugar treats. Parents additionally often promise “treats” for eating less preferred foods like vegetables. Children are offered rewards for eating their vegetables, and so the vegetables become less preferred to the child and are eaten as a means to obtain the reward (76, 82, 86, 87). Evidence shows that over an extended period of time, parental attempts to control the eating behavior of their children may have a negative effect on the quality of the child’s diet by reducing the child’s preference for foods they were coerced to eat (82).

When food is used as a reward often the food item is high in sugar and fat. Lepper and Greene’s (83) Over-justification Theory suggests that offering a reward for an action devalues it for a child. It can also cause the child to associate food high in sugar and fat with rewards. Children who are rewarded with high sugar high fat foods will associate good behavior and being rewarded for an action with a certain type of food. This lessens the value of consuming vegetables because it is not usually associated with a reward. Often children are less likely to self-select and prefer vegetables when they are rewarded for eating them because they associate the act of eating them with something negative and thus worthy of a reward (77, 88).
Gonzalez and colleagues (89) conducted a study to determine whether elementary children would increase their vegetable consumption if they restricted the type of snack they provided to them. The Early Childhood Longitudinal Study-Kindergarten cohort supplied the data, and they included 10,285 fifth grade children attending elementary schools. Children completed a questionnaire about their overall daily consumption of vegetables over the past seven days excluding fried potatoes in any form. The surveys were coded into two binary indicators of whether the children responded to consuming vegetables in the last seven days, occasionally or rarely or more often. Administrators provided assessments of snack availability at school and the amount of restriction placed on what students were allowed to consume as a snack during school. 50% of the children were male almost 60% were white, and 50% of children lived in households with an income higher than $50,000. In general, as also seen with the other studies, children did not consume the recommended vegetable intakes. Nearly 40 to 61 percent of children reported consuming vegetables less than one time per day. Consumption differed by school according to school policy on restrictions of snacks available to students. Findings showed that children who attend schools where snacks were not restricted were more likely to report consuming fewer vegetables at school. It showed that if other foods were available, children would choose other foods over vegetables. When other foods were not available it appeared that children consumed more vegetables (89).

Another study was conducted by Wardle and colleagues (77) at three schools to determine if exposure and reward would increase children’s consumption of vegetables. The study evaluated two interventions: one was reward-based and the other was
exposure-based, with a control group as the third group of children. The interventions occurred on eight daily sessions, during which the participants in the exposure group were offered a taste of sweet red pepper and instructed they could eat as much as they liked. Participants in the reward group were shown a reward and told they could have the reward on the condition they consumed at least one piece of red pepper. The researchers then compared these interventions against the no-treatment control group. Participants were randomly assigned to one of the intervention groups (exposure or reward) or no treatment control. They were assigned for a 2-week period. The study used only one vegetable to determine if exposure or reward increased the liking for the vegetable after the two-week period. The liking of the red pepper was assessed at baseline and then again at the end of the two weeks. The research team measured consumption by counting the number of small pieces of raw red pepper each child consumed. They assessed the liking of the vegetable by a five point hedonic ‘face’ scale ranging from “I like it a lot” to “I dislike it a lot” (scored 2 to -2) (77). The reliability of this measure of preference has been demonstrated by Birch (90).

The results were positive for the exposure group. Changes in liking form pre- to post- treatment, indicated that the children liked the red pepper better after treatment, which was confirmed by the significant effect of time in the repeated measures analysis of variance (p<0.01). The reward group had an intermediate level of change, which was not significantly different from either the exposure or the control groups. However, linear effects in the extent of change in liking were observed across the three groups (p<0.005), with the change in the reward group being intermediate between the others. Paired t-tests
indicated that participants in both intervention groups showed increased liking for red peppers over the study period exposure group (p<0.001) reward group (p<0.05). The control group participants did not significantly change in their liking over the study period. The post analysis showed the exposure group had a significant change compared to the control group (mean difference= 1.79, P<0.01). Results of the study support the hypothesis that repeated exposure to the taste of a target vegetable is effective strategy for increasing preference for the vegetable. This research supports previous findings in this area suggesting exposure is a promising technique for improvement in children’s liking and choosing of vegetables (77). Researchers from this study found that over the eight periods of repeated exposure, children increased in their reported preference for the target vegetable. Children were encouraged to try the new vegetable, but could eat as little or as much as they liked at each exposure occasion. They found that gently persuading the child without much emphasis on how much they eat of the vegetable was a good strategy for promoting liking (77).

Peer influence

The school environment is a place for children to interact and develop social skills with other children. Children’s behavior is influenced by the way their peers accept that behavior. Peers can also influence the food choices of children. Eating is a social experience; therefore, the eating behavior of peers can serve as behavior models which could have an impact on the young child’s preference (71). Elementary-school aged, are found to be more influenced by their peers than older school aged children. The need for social acceptance influences children to make food choices that are comparable to their
peers’ choices (71). Blanchette and Brug (70) recently reviewed the current literature about the potential associations between peer influence among children six to 12 years-old and the increased consumption of vegetables. Evidence from this and other studies (25, 68, 69, 71) are not conclusive and there are conflicting results on the extent of the negative influence peers have of the food choices of young children.

Many of the reviewed studies used focus groups to garner information on how peers influence behavior in children. Students reported negative peer responses for eating vegetables but claimed that such negative comments would not make them eat differently. Blanchette, Brug, and others found in focus group discussions that students reported their perception of negative peer responses for eating vegetables (25, 70, 71, 73, 91). In a study conducted by Resnicow and colleagues (71), 1,398 children measure children’s selection of vegetables in a group setting. Data was collected from third graders who participated in the “Gimme 5 Program” funded by the National Cancer Institute and designed to increase vegetable intake in elementary schools. To assess participants’ vegetable preference, respondents were asked to indicate how much they liked ten frequently consumed vegetables using three response categories ranging from “I do not like this” to “I like this a lot.”

Peer attitudes and influence were assessed with a four-item scale, asking if students asked about or mentioned vegetables to the students within the last two weeks. Children were also instructed to record the number of servings of all food and beverages they had consumed. An intra-class correlation was done to determine the total intake of
vegetables during the school week compared to the weekend. Results from the study used separate analyses to compare weekday and weekend vegetable consumption.

The meal-level analysis for preference showed a significant interaction between consumption on weekends and the child’s preference for vegetables (p<0.01). The association between preference and with the increased vegetable consumption shows that children are more likely to choose vegetables on the weekend than weekdays at school lunch, although the study did show that the availability of junk food increased on the weekends as well. Results were interpreted as peer influence being a determining factor in why children were less likely to consume vegetables at school. Often children will not consume certain vegetables because it does not conform to what their peers are eating (71). A study Birch conducted (90) examined associations in a study of 39 children varying in age from two to 11 and four to ten at the beginning of the study, with a median age of three to ten. Children were divided into two groups representing older (four to ten) and younger (two to 11) children. At the beginning of the study, the participants were assessed on their preference for nine vegetables. The vegetables included raw carrot sticks, celery sticks, cooked green bean pieces frozen, cooked corn frozen, cooked peas frozen, cooked beets canned, cooked broccoli fresh, raw cauliflower, and raw mushroom slices. Children were to rank the vegetables using a three-point cartoon face hedonic scale.

According to cartoon faces, children were to determine if the vegetable the tasted was “good,” something they liked to eat, “bad,” something they did not like to eat, or “neutral,” a vegetable they neither liked nor disliked. Children were asked to taste the
vegetables one at a time and rank those in the order of their liking. The social-influence situations took place in the school cafeteria during lunch time over a nine-week period. Each week children were seated at tables according to the children’s ranking and liking of vegetables. Seventeen children were targeted to determine if peer influence was a factor in causing children to make changes in food choices. If student one liked vegetable A over B (where vegetable A was ranked first or second and vegetable B was ranked eighth or ninth) the most, then student one was placed at a table with three to four peers who chose vegetable B (student one’s non-preferred vegetable) as their first or second choice. Each child’s experiment lasted for four consecutive days. To assure randomness of the study all of the social-influence groups were composed of both younger and older children of both sexes.

Trained observers watched how much each child took of the specified vegetable. Vegetable selection and intake was measured in tablespoons. After the nine-week social influence periods, the data was collected and assessed to determine if the hypothesis was correct, and peer influence had an effect on children’s food choices and intake. Information on the effects of social influence was obtained from three measures: first, children’s food choices before and after peer modeling second, consumption data, and third, preference data before and after peer modeling (90).

Food choices provided immediate information on the effects of peers’ behavior on food choices; consumption data were indicative of the degree to which target children imitated eating the non-preferred food. The preference data indicated whether the effects of social influence were limited to conforming to the choices of others in the influence
situation or whether there were also long-term changes in preferences in the absence of peers. The results from children’s choice selections of vegetables showed a significant level of change between the first day’s choice and the fourth day’s choice with a significant level of (p< 0.05).

Of the 17 children, 15 chose their preferred food on day one. By day four, ten children had switched to the non-preferred food item. When looking at the associations by age group, younger children with a mean age of three to four were more influenced by peers than were older children with a mean age of five to six (p< 0.05) by the social setting than older subjects (90). Measurement data collected from the children’s consumption data showed a decrease consumption of their preferred food over time. In contrast, the pattern of results for the non-preferred food was very different. The target subjects ate more of their non-preferred food than their peers, but this result was not statistically significant (p<0.07).

Both the target child and the peers saw a decrease in consumption in preferred vegetable over time (90). The measurement of the preference data showed 15 of the 17 targeted children showed a decreased preference for the item after the peer influence intervention, with the median decrease in preference equaling three positions in the rating scale. For non-preferred food, the younger target children saw a larger increase in preference. They increased their ranking of preference by seven positions whereas the older children only saw an increase in one position.

All three measurements collected from this study support the hypothesis that children’s food choices, preferences, and consumption patterns are strongly influenced by
those of their peers. A majority of the target children by the end of the social-influence situation were consuming non-preferred vegetables. Target children were eating vegetables indicated as being their least preferred vegetable of the grouping of nine vegetables tested. A decrease in overall consumption of vegetables was seen among the target children. It was concluded the lack of variety in the vegetables the children were consuming over the study caused the satiation effect and decrease in consumption, not the disliking of the vegetable (90). The study showed when children are exposed to a variety of vegetables different from their initial liking they will have a larger acceptance of the vegetable exposure (90).

Familiarity of a food was found to be more influential on preference than flavor of a food among younger children aged two to 11, but sweetness was an intrinsic factor for preference for older children. Although both intrinsic factors have an influencing effect of children’s vegetable intake, the extrinsic factor studied influenced children’s choice of vegetable consumption. This extrinsic factor has been found to play important roles in development of children’s food preferences. Eating in a social setting with others who have different food choices could have an impact on the young child’s preference (90).

Parental influence

Children’s food preferences are major determinants of food consumption patterns and current evidence has begun to reveal that preferences are linked to dietary patterns, which in turn influence current and subsequent risk for obesity and chronic diseases (92). Nearly all food preferences are learned via children’s early experiences with food and eating. The influence of parental food preference on children’s food choices includes
both environmental and genetic factors. From birth parents influence the eating habits of their children by providing food to them without input from the child until they are older and able to voice their opinion about the food (92). As children are raised in a household, parents make decisions about what food the child eats until they are old enough to choose for themselves, or vocalize their food preferences. Parents most often provide to their children foods that they find appealing and include in their own diets (92). What parents who model unhealthy practices choose to eat and serve for meals within the home greatly influences children’s preference for food (82). These habits, learned early in life, have a sustained impact on eating patterns even as children mature and make more autonomous decisions about what they chose to eat.

Parents have a larger impact on their children’s overall health than health care professionals who understand and educate the general population on the importance of balanced healthy eating habits. First, as children grow older they have a longer shared environmental history; children have lived with their parents and the food that is provided in the home for an extended period of time and are influenced and accept the food that is provided for them in the home. Second, children become more similar to parents in their taste sensitivity and taste preferences. This occurs because children are accustomed to the eating patterns and habits of their parents and others they observe and they begin to adopt similar taste preferences. Third, children and parents reach a similar degree of acculturation with respect to food and eating, as parents and children are surrounded by similar societal influences the types of food chosen become similar between the parent and child (82). Parent-child interactions in context of food selection and feeding are
important in determining children’s food preference (82). Children grow the relationship between the parent food preferences and the child’s food preferences increase (82, 93-95).

Birch (92) performed one study in which the researchers found children’s preferences for high fat foods are predictors of dietary patterns. The researchers examined children’s and parents’ consumption patterns and they found a link when parents offered children foods that were higher in fat content to children having a preference for high-fat foods. With respect to links among fat preference, fat intake, and adiposity, fatter children preferred high-fat foods and had parents with the highest body mass index. This suggests that children’s food environment has an effect on their body composition as children, and that this association is sustained into adulthood (92).

Neophobia

Attaining food preferences among children can be explained by Rozin’s concept of food ‘neophobia’ (77, 94, 96). Neophobia literally means fear of the new, or fear of eating unfamiliar or new foods. Humans show interest but avoid or are reluctant to try new foods (82, 96). Humans are omnivores, during infancy, we are nourished exclusively by milk usually occurs and during this period food preference is not an issue. In the U.S. the weaning of milk (breastmilk, formal) is during the second half of the first year, and solid foods are introduced. Early experience and learning can reduce the neophobic response to new foods. Exposing young children to a variety of foods can enhance dietary variety. Parents often indicate the reason behind the lack of vegetable consumption among a child is the dislike of vegetables, but neophobia can be attributed to the lack of
consumption of vegetables in a child’s diet. With children who have neophobia, the degree of neophobia often increases as the infant matures into a young child.

The protective function is not really necessary in today’s world, so instead of a protection it becomes a hindrance. Neophobia serves as a protective function to guard the body from the potential harmful effects of eating unknown foods. In infants, one exposure to a new food item was sufficient to increase intake of that item at a subsequent feeding (97). In contrast, anywhere from five to ten exposures of a food item is required to increase preference of that food in young children (97). Early exposure to new food items may reduce the neophobic response. Findings from recent studies suggest interventions among children involving multiple exposures to unfamiliar food promote acceptance of new foods and enhances the variety and healthfulness of the diet (82, 92). Findings show children who are exposed to new foods multiple times, are found to be more likely to overcome food neophobia (82).

A study conducted by Hursti and colleagues (98), in Sweden with a sample size of n=722, reported a moderate relationship of the degree of neophobia between children and their parents. In the study, males showed greater neophobia than did females, both among children and adults. Hursti and colleagues (98) recruited participants by random selection. Twelve families with 57 children ages two to 17 participated in the study. The study included interviews and questionnaires concerning food habits for the children, mealtime practices and attitudes toward foods. Results from the study were based on data from the Neophobia Questionnaire and a Food Frequency Questionnaire (FFQ). The FFQ lists 99 foods/brands available for purchase and posed questions at the subject’s liking of
the food and their consumption of the food at mealtimes. Families were instructed to indicate the extent of their agreement with each item on a seven-point scale (endpoints: disagree strongly, strongly agree). A higher rating in this scale indicates more neophobia. The overall levels of food and general neophobia were relatively low for both children and parents. Researchers identified a strong positive correlation between the degree of a mother’s neophobia and degree of her child’s neophobia, particularly a female child (p<0.05). If a mother had a high neophobia for foods, fewer food choices were available in the home, correlating with the children’s high neophobia. The opposite effect was seen as well, which suggest that during childhood the neophobic response decreases with age (82, 98).

Learning through experience and exposure can effectively change neophobia among children (82). The neophobic response is naturally reduced when a child is repeatedly exposed to new foods. The predisposition to prefer sweet and reject bitter can be readily altered via exposure (97). Exposure is only beneficial when it corresponds to the desired outcome. For example, if you desire to change a child’s palate, you must expose the child to that particular taste in order for any change to take place. Exposure through taste has been found to be the most effective in changing children’s neophobia for food (99).

Although exposure to trying new foods has been shown to reduce neophobia and increase intake of a target food, various other factors influence child’s food preferences such as environmental factors which include peer influence, familial influence, and as children age, their own personal taste preference. Important factors influencing food
selection of young people include which foods are easy for them to obtain, what friends are eating and what parents eat and serve. Birch found that through repeated exposure children, as they age, will have decreased neophobia towards food (71, 82, 100).

**Vegetable exposure**

The NSLP provides lunch to over 31 million children each school day in the U.S. and has been in existence since 1947. The NSLP offers a unique opportunity to provide healthy food to children in a controlled environment and on a regular basis. The food the schools offer to children as part of the NSLP may be different than the foods parents serve at home, and thus may offer the children repeated exposure to foods they may otherwise not have access to (101, 102). The NSLP provides students with healthy balanced meals that promote the consumption of all food groups. The NSLP does not require schools to provide a vegetable at each meal but the regulations set in place to meet the nutrients are often found in vegetables. Schools in order to comply with the federal regulations with nutrients, vegetables contain nutrients such as vitamin C, vitamin A, and calcium to improve meals the NSLP provides. Children who are served vegetables in a variety of ways may increase their vegetable consumption because of their familiarization with the variety of vegetables being offered (103).

By the time children enter elementary school they have already developed awareness for food and personal preferences for what they like and dislike. Although children have developed the awareness of what they enjoy eating, the students have the opportunity to try food they may otherwise not have exposure to, such as certain vegetables (101, 104). Elementary schools provide an interesting opportunity for reaching
large numbers of children in the general population because although by the time kids enter school they have acquired knowledge about eating and have developed food preferences they continue to eat daily at school and so food preferences and food acceptance are continually modified. Schools are exceptional in increasing children’s food preferences by providing children with continuous exposure to nutritious foods. When a student is exposed to healthful foods by the school that exposure gives the student a continuous support to eat nutritious food outside the home (101, 102).

A key finding in the Third School Nutrition Dietary Assessment Study was that NSLP participants consumed more nutrients at lunch than matched nonparticipants (5). Providing fresh vegetables to students in the school setting can help expose children to vegetables and increase their availability to vegetables, but it will not ensure that children will eat them. Continuous exposure and efforts need to be made with foodservice managers and workers to encourage consumption of vegetables in a school-setting (5).

Children at a young age are more impressionable and are more likely to accept new ideas taught to them. Exposing children to more vegetables and offering larger variety will help expose children to different vegetables and will lead to a greater consumption of vegetables in children’s diets. According to studies, continuous exposure to one vegetable increases the child’s preference for the particular vegetable. Resnicow focused on exposing children to a variety of target vegetables showing a positive relationship between the children’s intake total of vegetables, including those not targeted in the intervention, and the exposure to the particular vegetables (71, 103). The study looked at the contribution of parental vegetable consumption, availability and
accessibility of vegetables in the home, exposure to vegetables and habit. The participants ranged in age from four to 12 years of age. Researchers asked parents of the children (n=1739) to complete a questionnaire assessing psychosocial and additional factors regarding their children’s vegetable intake. Children’s vegetable intake was measured by three questions in the questionnaire; how many times a week the child eats 1) cooked or baked vegetable dishes, 2) mixed dishes 3) extra salad Portion sizes were assessed by means of a photograph of plates filled with different amount of vegetables.

Results showed a significant correlation between children’s vegetable intake and various forms of exposure, range from -0.05 to 0.57 (p<0.05) for students overall intake. The study found that psychosocial factors also contribute to vegetable consumption, but additional factors such as availability, exposure, parental consumption and habit explain the variance of vegetable consumption among children in the study. The study operationalized exposure as a number of different kinds of vegetables and tastes. This shows that only a moderate association with preference, but also contributed to explaining that mere exposure is not only a method for the development of preference, but may influence consumption (103).

Recent campaigns to increase vegetable consumption have often targeted children. One might expect that intervention early in a person’s lifecycle might yield maximum health benefits (77, 80). However, even large scale interventions aimed at increasing vegetable consumption have had limited success. For example the ‘5-A-Day’ program in the U.S. has focused its efforts to increase U.S. public knowledge of vegetables, as well as change attitudes. Both objectives have seen reasonable success.
Achieving significant changes in behavior has proved more challenging, however and it is possible that significant barriers to behavior change lie elsewhere. An alternative perspective focuses on hedonic factors, e.g., affective reactions to taste, texture or appearance. Attempts to explain why vegetable consumption is so low in adults and children have often highlighted taste preference as a significant barrier. Children’s liking for vegetables has been shown to be the most significant predictor of their intake. If liking rather than disliking is a major deterrent, then interventions aimed at increasing vegetable consumption need to modify their design to make vegetables more appealing to children and increase their liking, causing them to change their intake and accept vegetables (77).

The definition of exposure to a variety of vegetables is the number of different types of vegetables a child has tasted (71). Exposure to vegetables has been shown to improve children’s overall preference of a target vegetable. However, the broad goal of this area of research extends beyond increasing the intake of single vegetables to increasing children’s preference for and intake of a variety of different vegetables.

A study Wardle and colleagues (96) examined associations between the effectiveness of an exposure-based intervention carried out by parents in the home in increasing children aged two-six years’ liking for a previously disliked vegetable. The study provided further evidence to support the hypothesis that exposure to a particular vegetable over an extended period of time is needed for an increase in children’s preference of a particular vegetable. In the study, caregivers were asked to expose the children to a target vegetable every day for 14 consecutive days, suggesting that they
encourage the child to taste the vegetable being offered. It took two weeks of daily consumption for the child to be adequately exposed to the vegetable. Two sets of analyses were carried out, and the results reported no significant differences between groups in gender or age. Furthermore, no significant effects of age or gender were observed on the change in rating, ranking or intake of the target vegetable. There was a significant overall increase in rated liking from the first to the second visit (p<0.001). Within-group contrasts showed that the rated liking increased significantly in both the exposure group (p < 0.001) and the control group (p<0.001), but not in the information group. Of the children in the exposure group increased their liking for the target vegetable compared with 48% of the control group and 31% of the information group. No children in the exposure group decreased their liking compared with nine percent of the control group and 15% of the information group. At post-intervention, 65% of the exposure group placed their target vegetable in the liked category.

Barriers to vegetable consumption

Viewing television and other screen time have been reported to influence children’s overall eating habits. The studies conducted showed the amount of time a child spent viewing television directly correlates with the child’s request, purchase and consumption of foods advertised on television. Boynton-Jarrett and colleagues conducted a study over a 19 month period to determine the correlation of children’s television viewing and vegetable consumption. Children who were on average 11.7 +/- 0.8 years of age showed that a negative correlation between hours of television viewing, and vegetable consumption. Children reported an average consumption of 4.23 servings...
of fruits and vegetables a day, which is below the recommendation of five servings per day (105). Follow-up measurements indicated mean total fruit and vegetable servings per day decreased from baseline by 0.33 serving per day or eight percent. This change in total servings of fruits and vegetables per day was statistically significant (p=0.007). The data showed that for each hour of television a child viewed per day, that child’s vegetable servings per day decreased by 0.16 servings per day at baseline, and decreased further by an additional 0.14 servings per day for every hour increase in television viewing between baseline and follow-up (105). In addition, this study documented which advertisements were broadcast during children’s television programming and determined that the majority of advertisements are contradictory to the current Dietary Guidelines for Americans (106).

According to a recent report by Boynton-Jarrett and colleagues (105) U.S. children are viewing an alarming amount of television. Children aged two to five years are watching television an average of 27 hours per week, while children ages five to 11 are watching 23.5 hours per week (97). In the study conducted by Boynton-Jarrett and colleagues (105), the researchers found that children had an increase in BMI from baseline to follow-up. The average BMI for participants was 20.7 at baseline, follow-up two years later showed that average BMI was 22.2, when television were reported to have decreased (105). Although participants’ television viewing was reported to decrease over the study, the BMI for children continued to increase.

Many people are concerned about the amount of time kids are spending watching television instead of doing physical activities, and are also about the type of television
advertising is targeted at children. Television viewing has been linked to obesity among children in cross-sectional and prospective observational studies. Since the majority of food commercials viewed by children are for foods high in sugar and fat, children are consuming more of these types of food items, and fewer vegetables. Although the viewing of television and its link to health outcomes is only moderately understood, a correlation with consumption of less nutrient-rich foods, and time spent watching television is linked to the advertisements during children programming (105, 106).

AK Kotz, a student at the University of Minnesota, and M Story conducted a studies to determine the types of food advertising and the messages portrayed in the advertisements during Saturday morning television (106). The study was conducted to correlate the relationship between the amount of time children view food commercials, and the amount of healthy foods children consumed. The children were assessed between 7 AM to 10:30 AM on Saturday morning because all major networks reserve this period for children’s programming. Food and beverage advertisements and Public Service Announcements (PSA) were recorded. All advertisements were recorded and placed in categories relating to their message in comparison to the food guide pyramid. The researchers found the results of the study to show on average, of the 19 commercials advertised per hour, 11 were advertisements for food products. This means that children in this study viewed a food advertisements every five minutes (106). Vegetables were not included in any of the commercials during the three hour block of Saturday morning programming. The researchers found a negative correlation between the amount of advertisements children viewed and vegetable consumption among the children studied.
Of the 997 commercials and 68 PSA’s, more than half 56.5% (n=564), of them (564) were food advertisements. Among those commercials, 43.7% were for foods classified as fats, oils and sweets. The next highest group was 37.5% which was for foods in the grain food group, of which 23% were for high-sugar cereal (105, 106). Most of the advertising seen by children was for high-sugar products. Not only was the majority of advertising not congruent with recommendations of the Food Guide and Dietary Guidelines for Americans, but the advertisements often portrayed children eating the product alone or with friends. Rarely was the child seen eating the high-sugar product with a parent.

The overall message advertisers are sending children is not consistent with recommendations for a healthy balanced diet. The kids in the advertisement are seen eating foods high in sugar and having fun. This encourages children to associate foods higher in fat and sugar with social satisfaction, rather than encouraging eating healthy food options that are superior in nutritional value. The high volume of high-sugar products and the practically nonexistent vegetable advertising influences children’s eating patterns. Children’s dietary behaviors have been studied to determine if the amount of time watching food commercials translates into children asking their parent(s) for the particular food item, parents purchasing the food item and the actual consumption of the food item viewed on television (106-111).

Taras and colleagues (107) conducted a study which interviewed mothers of children to assess children’s viewing habits and request for a particular food item advertised on television. Taras and colleagues found the food item most requested by children was repeatedly seen during their television viewing. The study also saw a
significant correlation between the number of hours of television viewed during a week, and the reported number of times a child requested their parents purchase the food item (107). In a different study, advertisements were related to vegetables, children did infrequently request vegetables to their parents (106).

Snack foods that are often high in sugar and or fat are advertised on television more often than are vegetables or other healthy foods. Children often choose high sugar or fat snacks over more nutritional options, and there may be a correlation between those two observations (71). The decline in the quality of children’s dietary intake over the past 20 years is well documented (4, 75); most notable the intake of food products high in sugar and fat and inadequate intake of vegetables, fruits and whole grains have contributed to decrease total diet quality among children (4, 75, 89, 113-116). The Institute of Medicine has issued a report to assist in the effort to improve the quality of children’s diets and includes recommendations to substitute high sugar and fat foods with vegetables as snacks in school. The Institute of Medicine’s report, Nutrition Standards for Schools: Leading the Way to Healthier Youth, recommends that elementary schools do not offer snacks other than fruit and vegetables. A comparable association to the Institute of Medicine’s report was noted for elementary children who attended schools where desserts were offered more than once per week in NSLP lunches (117). In the Third School Nutrition Dietary Assessment Study, they found children who attended schools serving dessert and French fries more than once a week were significantly more likely to be obese than children who attend schools offering fewer desserts (5, 89, 117).
The role of the NSLP and School Breakfast Program (SBP) are uniquely assessed by the national School Nutrition Dietary Assessment (SNDA III) studies, which is supported by the USDA. It provides a comprehensive picture of the food and nutrient content of school meals, provides a national benchmark for determining how well school meals meet nutrition-related standards, and examines trends over time. The SNDA III study design and data collection methods are impressive. The study sample represented all public schools participation in the NSLP in the 48 contiguous states and Washington, D.C. The program collected data from 130 school authorities in 36 states, 398 schools and approximately 2,300 students. They collected detailed menu data about meals the schools offered and served. The researchers collected 24-hour dietary recalls from the student participants. They also collected in-person or phone interviews with the 2,300 students’ parents (5). Results of SNDA-III show that many schools have improved the nutritional quality of the NSLP and SBP school meal program. However, there is much more room for improvement. Schools need to do even more to reduce the availability of high-calorie, low nutrient foods and make school meals more nutritious (5).

A cohort study done among 10,285 fifth grade children in 2,065 different elementary schools which restricted snacks to vegetables found that children would rather consume the vegetable snack than not have a snack at all. The difference in the consumption of vegetables between the schools with and without restricted snack policies was modest. The results showed that restricting snacks in schools did not have a significant increased consumption of vegetables. When snacks were restricted to just vegetables being offered one to three times per day with no consumption or snack
restrictions an increase in consumption was seen (p=0.446), compared to (p=0.00) vegetables offered less than three times per day vs. no consumption. These differences were greater for vegetable consumption than for fruit consumption, (p=0.003). When fruit was offered one to three times per day with no offering of snacks (p=0.007) the vegetable consumption was less than three times greater per day vs. no consumption or snack restriction. This suggests that when given the option to choose between vegetables and another food group, children will choose a food item other than the vegetable. However, when children are not given the choice and only vegetables are available, children appeared to consume more vegetables. This study found consistencies with the Institute of Medicines restrictive snack policy as a multi-faceted approach to improving children’s diet quality, because it will positively influence the development of a palate that prefers vegetables among elementary aged children. This will encourage children to choose vegetables in other settings and support a lifelong appreciation for vegetables (89).

**National School Lunch Program**

The NSLP criteria are based on input from the U.S. government and are set in place to assure that balanced and nutritious meals are provided to all children attending public schools in the U.S. (118). The NSLP has been targeted as a means to help prevent or slow down the rise in childhood obesity among young school-age children. Children spend a large amount of their time in a school setting, so prevention on a school level seems to be a feasible goal. The National School Lunch Program (NSLP) is a federally funded assisted meal program. It provides low cost, nutritionally balanced meals to students daily during the school year. The NSLP has placed responsibility on schools to
provide students with appropriate foods that meet the recommended levels for all nutrients and food groups targeted by the NSLP criteria. Regulations are set in place at a national level, but it is up to individual school districts to determine how the food commodities are prepared and served to the children. Schools that receive food commodities are able to determine on a district level how to use the commodities in their menus. In return for the commodities, the school districts must meet federal regulations and guidelines pertaining to the meals served.

Team Nutrition is an initiative of the USDA Food and Nutrition Service to support the Child Nutrition Program. Through Team Nutrition (119), the USDA provides schools with training and assistance to help schools better utilize the commodities they provide and to serve healthier meals to the students (118). Team Nutrition’s Goal is to improve children’s lifelong eating and physical activity habits by using the principles of the Dietary Guidelines for Americans and MyPyramid (120). By better utilizing the USDA commodities schools will be able to provide nutritious meals to students while still keeping the cost within a modest range.

The USDA requires schools that participate in the NSLP to meet the USDA Dietary Guidelines for the following categories: one-third of a student’s caloric needs should be restricted to 30% fat, with less than ten percent being saturated fat. Regulations are also set in place met the Recommended Dietary Allowance for protein, vitamin A, vitamin C, iron and calcium (118).

Any child can participate in the NSLP regardless of income. At the school, meals are served to children who qualify for free or reduced meals (121). The prices for these
meals are set in place on a national level, and children whose families’ income fall at or below 130% of the poverty line are eligible for free meals. Students whose families fall between 185 to 130% of the poverty line qualify for reduced meals (121).

The SNDA-III reports that more than 85% of schools who participate in the NSLP offer reimbursable lunches that met the School Meals Initiative for Health Children (SMI) standards for each of the key nutrients set in place by the USDA: protein, vitamin A, vitamin C, calcium, and iron. Assessing what students actually selected, more than 70% of schools met the USDA standards for these target nutrients (122). The USDA nutrition regulations for the NSLP and SBP meals are being reviewed and updated but are currently based on the 1995 Dietary Guidelines.

A key finding from SNDA-III was that NSLP participants consumed more nutrients at lunch than matched nonparticipants, even after adjusting for differences in observable characteristics (123), results were consistent with a recent analysis using the National Health and Nutrition Examination Survey (1999-2004), which also examined nutrient intake and dietary quality of children who participated and did not participate in NSLP (79).

School-based studies

Many interventions are conducted in a school-based setting because the school environment is an essential catalyst for children’s overall development. To best understand kids’ habits and their learning behaviors, school-based interventions allow researchers the resources needed to get the most accurate and informative data pertaining to kids and their environment.
A study conducted by Mcfarlane and Pliner (124), found children’s willingness to try new foods did not increase when they were given additional information on the foods and its benefits (124). These findings are consistent with another study which investigated food-choice motivations in adolescents. Contento and colleagues (125), found younger people were more influenced by social and environmental factors than personal motivational factors, such as nutritional value or taste (124, 125).

School-based interventions

With strong evidence showing the correlation between more increase amounts of vegetables in children’s diets and the reduced risk of childhood diet-related diseases, elementary schools are instituting more interventions and programs to try to combat the problem at a younger age. School-based interventions have provided evidence that such programs are effective at increasing student’s awareness of vegetables and intake of vegetables (126). Evidence points out a combination of different school based interventions, or a multi-component intervention, are most effective. Researchers have found that classroom curriculum, accompanied by a parent/home component, and a school food service component is the most effective intervention.

One study determined that children eat the most vegetables at lunches they eat at school compared to lunches they eat on weekends or not at school (74). This data clearly supports the need and the role for both the national and the state school lunch program as a considerable contributor to the dietary quality of elementary students. They still need improvement (74). Although weekday lunches provide the highest rates of students’ vegetable consumption, an additional serving of vegetables at school lunch could help
improve the students’ overall health (74). Schools have been working with the NSLP to help incorporate more vegetables into the lunchroom meal while still meeting the dietary guidelines set in place. Schools have set methods to help children increase their vegetable servings per day (113, 127). Schools have put fruit and vegetable bars in the cafeteria to allow for children to pick and choose from the vegetables and fruit available. Salad bars have also been placed in schools to help the children consume more increase vegetables (127). Schools across the country have put some effort into increasing school-aged children’s fruit and vegetable consumption.

The most promising effort in schools has been done in the classroom, where curriculum encourages students to intake increased amounts of fruits and vegetables (127, 128). However, school-lunch interventions combined with classroom curricula have shown greater promise for changing behaviors. The lunchroom remains an influential setting for children to associate between what is being taught in the classroom about the importance of consuming vegetables, and the vegetables being served in the lunchroom (127). Many schools throughout the United States have implemented a salad/vegetable bar as an optional lunchroom food choice. Although this strategy to increase vegetable consumption has not been documented to a full extent, the USDA along with the NSLP and School Breakfast Program (SBP) has conducted studies to determine the improvements in school lunch. San Diego State University conducted a study with four elementary schools to determine if salad bars in elementary schools are beneficial in increasing the amount of vegetables students consume and if the should become a permanent fixture in the lunchroom setting (127). Two of the schools had self-serve salad
bars, while the other two schools had pre-portioned vegetables. Students who were randomly assigned to participate in the study selected salad from the bar first before they continued on to the entrée. The researchers weighed the food to determine the amount each student took. They took an additional weighed measurement taken after the student was done eating. Results showed no statistically significant differences (127) between the two groups of students. Although results show salad bars in schools do not significantly increase the vegetable consumption among students, the study did find that when a greater variety in vegetables is offered, children will consume more vegetables if there are salad/vegetable bars at their school.

The NSLP, along with the Department of Nutrition-and Food administer a national Fresh Fruit and Vegetable Program (FFVP) to schools. The purpose of the program is to provide funding for schools so they can increase the amount of fresh fruits and vegetables in the lunchroom (129). The NSLP believes that this program can be an important catalyst for change in our efforts to combat childhood obesity by helping children learn more healthful eating habits (129). The FFVP began as a pilot project under the Farm Security and Rural Investment Act of 2002. The Act provided six million dollars for the purchase of fresh and dried fruits and fresh vegetables. The purpose of this pilot was to determine the best practice for increasing fresh fruit and vegetable consumption in schools. In 2004 the program expanded to help provide fresh vegetables and fruits into schools across the country. In September 2006, the Centers for Disease Control and Prevention (CDC) released results on an evaluation of a Mississippi fresh fruit and vegetable program funded by the CDC (130). While study conclusions were
limited by the evaluation design, the data suggest the program might have had positive impact on student’s attitudes, preferences, and eating behaviors. The FFVP believes that key factors to program success remain the commitment and support of school and district administration, as well as student and parent involvement and the schools ability to purchase fresh fruits and vegetables. The FFVP has been successful in introducing school children to a variety of produce that they otherwise might not have the opportunity to sample. Along with providing healthier meals in school lunch, the FFVP is consistent with the support and recommendation of the recent report by the Institute of Medicine to provide healthier snack choices in schools, including fruits and vegetables (129, 130).

Multi-component intervention studies

Multi-component interventions are more effective in increasing children’s vegetable consumption and knowledge than single component interventions (91). Reynolds, Franklin, Binkley found positive results with a multiple-intervention strategy titled the “High 5 Project,” which the researcher conducted on a diverse population of nine to 11 year olds. After one year of intervention, the project showed an increase in vegetable consumption of + 0.35 servings/day (25, 70). The intervention included a nutrition curriculum, parental-led home based activities and outside-of-the-home-based activities. There was low participation in the outside-of-the-home-based activities. The lunchroom also altered meals to increase preparation and promotion of vegetables.

California and Minnesota both conducted the 5-a-day Power Play program (25, 70, 80, 131), in which they added additional vegetables to the lunch menu during the week for children to have more exposure. The programs also included cafeteria
marketing. They implemented point of sale nutrition education, as well as advertising vegetables on posters throughout the lunchroom (25, 70, 80, 131). The 5-a-day Power Play programs found success when cafeteria and school marketing were involved. Vegetable consumption increased 0.2 servings/day for the school intervention only, with a 0.4 servings/day increase on vegetable consumption with school and community marketing of vegetables. The program used parent involvement as well as educational television advertising to help promote vegetable consumption (70).

Evidence from other programs with multiple-component interventions also showed positive results (25, 70). In the review Blanchette and Brug conducted, (70) seven interventions were multi-component, with various combinations of curriculum to expose the children to vegetables in a variety of settings. Of all of the seven settings, results from the multi-component interventions were all positive. The combination of various components of teaching nutrition in the classroom, parent involvement in some aspect, and a school foodservice component appears to be the most effective. In a multi-component intervention, children are exposed in various ways to the importance of vegetables as well as the taste of vegetables. The foodservice staff’s knowledge and awareness of providing a variety of vegetables will allow for accessibility and availability of the vegetable, producing a positive correlation of children’s preference and an increase in their consumption of vegetables overall (73).

Several multi-component programs aimed at increasing vegetable consumption among six to 12 year-olds were combined to determine the impact of the interventions. The results showed an increase in daily servings of vegetables the participating children
consumed. The summary of the different programs showed that children ages six to 12 consumed more vegetables varying serving sizes. Some studies showed the results of vegetable consumption varied in increase from zero to 2.54 servings daily on average. Of the various programs with vegetable intake interventions, 14 of the 15 resulted in increased consumption of vegetables. Each of the various programs used a different intervention strategy. All of the programs focused heavily on vegetable intake through various means of education and exposure for the students (70).

The High 5 Project conducted by Reynolds and colleagues used a multi-component curriculum for a three year cycle, along with parental activities, which were reported to have high participation, and school meal modification to provide more vegetables to students. The results of the project after a year showed that students consumed more 1.68 more servings of vegetables per day after two years of the multi-component intervention an additional one serving/day increase. The study found positive outcome expectations were influenced by intervention and influenced vegetable intake. Self-efficacy, knowledge, parental consumption were influenced by intervention as well (70).

Two school-based interventions have specifically studied the effect of nutrition education and vegetable exposure. One school had a daily free vegetable distribution, while the other school had a multi-component program set in place at the school. The interventions included classroom curriculum, parental involvement, and an environmental component consisting of posters displayed around the school to remind the students to eat more vegetables. The multi-component program did not have a lunchroom vegetable
distribution (126). The results from both studies showed nutrition interventions in schools were effective and significantly increased children’s vegetable intake. During the distribution program children’s intake increased from 2.6 times per day at baseline to 3.1 times per day after intervention. The multi-component program saw an increase in vegetable intake from 2.5 times per day to 3.0 times per day (126).

In the multi-component study, educators had to develop their own lesson plans. At the end of the intervention period, they evaluated the programs and their components favorably. Educators who used the lesson plans in their classroom expressed their intention to use the program again the following year. The educators’ attitude towards the programs was positive and allowed greater exposure of vegetables to the children in the classroom. The educators’ involvement can increase children’s intake of vegetables as seen from the educators’ evaluations and the end data of children vegetable intake (126). Educator involvement was an important factor and predictor of change (126). The lack of time for the educators to implement vegetable education lesson plans throughout the day was a barrier in the multi-component study. As the school year progressed the educators completed, fewer interventions (132). The overall outcome of the comparisons of the two studies showed positive correlations with both the single intervention and multi-component intervention and the increase of vegetable intake among the students. The single vegetable distribution study indicated a slightly more effective increase in vegetable intake than the multi-component program. Reasons for this outcome could include children’s actual tasting of the vegetables in a school setting, whereas the multi-component only had visual stimuli. Combining the two studies together could prove to
have a more effective impact on children’s intake of vegetables. By providing visual stimulation and vegetable tasting, children’s consumption could increase. When educators teach about vegetables in the classroom and follow up with the implementation of vegetables in the lunchroom, this provides the greatest exposure to the vegetable. Then the children are more likely to try the vegetable and understand its importance to the diet.

**Summary of effectiveness of interventions**

The Nutrition Division of the Food Standards Agency (FSA) is an independent department set up by the parliament in London to protect the health of the general population relating to food (133). In 2001, a seminar was held to discuss results from six research projects/presentations designed to increase fruit and vegetable intake among children within schools. Participants in the seminar were researchers with the common interest and concern on the topic related to school-based nutrition, mainly encouraging vegetable consumption in schools, and debating what works and what does not. Participants in the seminar were divided into four groups. Each represented a range of perspectives for discussions on the issue of nutrition in schools. The school-based interventions were examined and set up to determine what methods would be most beneficial in increasing student vegetable intake and to helping to combat the rise in diet-related diseases. Throughout the seminar, various researchers presented research on the interventions from different school-based studies. The review provided evidence of likely moderate success of nutrition education programs in schools. Several interventions that provide multiple tasting and other tactile experiences show positive impact on the amount of vegetables children consume. Multiple tasting can be done in a variety of ways; first,
provide the children with hands-on experience which allows them to have a better understanding of the importance of vegetables (134) and second, interventions are more effective when educators and administration serving in the capacity of role models among young children have a positive attitude and are willing to be a positive role model towards the students.

Conclusion

Nutrition education and exposure to vegetables to young children may lead to increased health for children in the U.S. who suffer from diet-related chronic diseases. Nutrition interventions aimed at increasing preference, exposure and knowledge of vegetables during early childhood may result in the increase consumption of vegetables among children. Multi-component interventions may be an effective way to increase children’s preference and knowledge resulting in increased consumption of vegetable intake over their lifespan.

References


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Table 2.1: Disorders related to childhood obesity and their impact on the bodies systems

<table>
<thead>
<tr>
<th>System and disorder</th>
<th>Explanation</th>
<th>Estimated prevalence in pediatric populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperension</td>
<td>High blood pressure</td>
<td>2-4%</td>
</tr>
<tr>
<td>Left ventricular hypertrophy</td>
<td>Increased thickness of the heart's main pumping chamber</td>
<td>Unknown</td>
</tr>
<tr>
<td>Atherosclerosis</td>
<td>Hardening of the arteries</td>
<td>50% (fatty streaks) 8% (fibrous plaques) 4% (&gt;40 in those with atherosclerotic plaque)</td>
</tr>
<tr>
<td>Metabolic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin resistance</td>
<td>The process in which the action of insulin is retarded</td>
<td>Unknown</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>Abnormal changes in cholesterol and triglycerides in the blood</td>
<td>5-10%</td>
</tr>
<tr>
<td>Metabolic syndrome</td>
<td>Correlation of risk factors including increased waist circumference, elevated blood pressure, increased triglyceride and decreased HDL cholesterol concentrations, and raised plasma glucose</td>
<td>4% overall, 30% in obese</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>A condition in which the body either makes too little insulin or cannot properly use the insulin it makes, leading to elevated blood glucose</td>
<td>1-15 persons per 100,000 overall, almost all in obese</td>
</tr>
<tr>
<td>Pulmonary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>A chronic inflammatory pulmonary disorder characterized by reversible obstruction of the airways</td>
<td>7-9%</td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
<td>A breathing disorder characterized by interruptions of breathing during sleep</td>
<td>1-5% overall, approx. 25% in obese</td>
</tr>
<tr>
<td>Gastoretentinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonalcoholic fatty liver disease</td>
<td>Fatty inflammation of the liver not caused by excessive alcohol use</td>
<td>3-6% overall, 50% in obese</td>
</tr>
<tr>
<td>Gastroesophageal reflux</td>
<td>Backward flow of stomach contents into the esophagus</td>
<td>2-20%</td>
</tr>
<tr>
<td>Sicklecell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tibia vara (Sickle cell disease)</td>
<td>Growing of children's legs caused by a growth disturbance in the proximal tibial epiphysis</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Slipped capital-femoral epiphysis</td>
<td>A disorder of the hip's growth plate</td>
<td>1-8 persons per 100,000</td>
</tr>
<tr>
<td>Psychiatric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>A mood disorder characterized by sadness and loss of interest in usually satisfying activities</td>
<td>1-2% in children, 3-5% in adolescents</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polycystic ovary syndrome</td>
<td>A constellation of abnormalities including abnormal menses, clinical manifestations of such anomalies excess as acne and excessive growth of hair, elevated levels of circulatory androgens, and polycystic ovaries on ultrasound evaluation</td>
<td>Unknown in adolescents, 5-10% in adult women</td>
</tr>
<tr>
<td>Pseudotumor cerebri</td>
<td>Raised intracranial pressure</td>
<td>Rare</td>
</tr>
</tbody>
</table>

Source: Author's estimates based on various sources.

Adapted from Daniels, S.R. *The Consequences of Childhood Overweight and Obesity.*
CHAPTER 3

A MULTI-COMPONENT SCHOOL-BASED INTERVENTION AIMED AT INCREASING VEGETABLE PREFERENCE AND INTAKE AMONG ELEMENTARY-AGED CHILDREN

Abstract

Background Nutritional interventions in schools are important in the fight against children becoming overweight and/or obese. Studies have shown children in the United States fall well below the USDA’s recommended dietary intake for vegetables. Poor dietary choices among children are contributing factor in the cause of an alarming number of overweight and obese children. Along with consuming more calories, children are also choosing foods with minimal nutrient density.

Objectives The objective of this study was to determine if a multi-component school-based vegetable intervention in an elementary school setting, increased the intake of self-selected vegetable consumption among second and fourth grade students’ who attended the target school and participated in the National School Lunch Program.

Methods Children ages seven to 11 (n=450) were involved in a multi-component intervention that included, cafeteria marketing of target vegetables, introduction of target vegetables into the NSLP in the cafeteria, classroom education, after school education, parent cooking classes, and newsletters that provide information on the importance of vegetables that is family friendly. All interventions were conducted from September 2008 through May 2009, and had a common vegetable-of-the-month theme. Second and fourth
graders (n= 136) participated in a plate waste assessment. Students’ vegetable intake was assessed by digital observations of the foods consumed during lunch periods. Knowledge and attitudes regarding usual vegetable intake behavior was assessed using a pre- and post-intervention survey.

**Statistical analyses performed** Differences in the mean vegetable intake and knowledge and behavior pre- and post-intervention were examined using paired t-tests, Mean post-intervention vegetable intake was not different from mean pre-intervention vegetable intake (p=0.483) second and (p=0.467) fourth. Knowledge of vegetables and self-reported preference for vegetables increased. A paired t-test showed a slight increase in students’ knowledge and preference of vegetables as well as the willingness to try new vegetables among students at Canyon Elementary.

**Conclusion** Despite the lack of positive data shown in this study, money and time constraints in the schools, interventions which promote healthy eating habits including increased vegetable intake should be continued in a school setting. Continuation of education of healthy eating habits will empower children with the option of choosing healthier foods as they are more familiar with healthy food alternatives and the importance of a balanced diet, which results in better overall health.

**Introduction**

Children across the United States continue to fall below the national recommended dietary guidelines for vegetable consumption (1-4). In the Report Card on the Diet Quality of Children Ages two to nine conducted by the USDA Center for
Nutrition Policy and Promotion, it is estimated that only 19% of children ages four through six, and 22% of children ages 7 through 9, three servings per day (5). One factor associated with low consumption of vegetables among children is greater consumption of snack foods high in fat and added sugar (5).

The current Dietary Guidelines for Americans include recommendations for all Americans to increase vegetable intake. The Dietary Guidelines regarding diet and physical activity are based on scientific evidence and recommendations support health and lower the risk for chronic disease. Research has consistently shown that ample consumption of vegetables is associated with decreased incidence of and mortality from various chronic related diseases, including cardiovascular disease, diabetes and cancer (3, 6-8). These risks are not exclusive to adults in the U.S. population. Common societal trends of reduced physical activity and poor diet contribute to an improper balance of energy intake to expenditure and increase risk for obesity and chronic disease.

**Dietary trends among Americans**

The current Dietary Guidelines recommendations for the amount of vegetables needed to support health and prevent disease is higher than recommendations have been in the past (3). Previous dietary guidelines called for intakes of two to three and a half cup servings of vegetables or one and a half cups of vegetables per day for those consuming 2000 calories. The 2005 Dietary Guidelines recommend two and a half cups of vegetables per day for this calorie level and recommend consuming leafy green and orange vegetables as to the types of vegetable to select. Many Americans consume less than adequate amounts of vitamins A, E, and C, fiber, calcium, and folic acid. These
nutrients are plentiful in vegetables (3). In addition, vegetables are high in fiber and promote satiety and may encourage Americans to move towards a healthier and optimal weight (5, 9, 10).

NHANES data

The National Health and Nutrition Education Survey (NHANES) is an ongoing population–based survey and provides information about dietary trends in the general U.S. population. The NHANES data reinforce other observations that Americans do not eat the recommended amount of vegetables and that they are consuming fewer now than they did ten-15 years ago. Thirty-five percent of Americans met dietary recommendations for vegetable intake in 1988-1994 and only 32% met recommendations in 2001-2002. Results from a previous findings showed 35% of Americans were meeting the dietary recommendations for vegetable guidelines in 1988-1994 (3). According to the NHANES data, women need to consume an average 0.9 cups more vegetables per day to meet current recommendations (3). Shockingly, 25% of Americans reported consuming no vegetables on an average day on the survey days. Among those surveyed, 50% reported consuming at least one serving of garden vegetables and 20% reported consuming at least one serving of fried potatoes per week. When fried potatoes were excluded, the percent of people meeting recommendations for vegetable consumption decreased significantly (27-2%) (3).
Preference

Children across cultures have a general dislike towards vegetables. Vegetables are consistently ranked at the bottom of the food preference list (11). A survey of school-aged children showed vegetables were ranked the lowest on the preference scale and high sugar, high fat foods were ranked the highest (12). This data shows children do not prefer foods of high nutritional value and they are more inclined to choose foods high in sugar and fat rather than vegetables, which are nutrient dense and help to combat chronic disease.

Barriers to vegetable consumption among children

Vegetables are the least favored food group among children and many children report a fear, or neophobia, of trying new foods, including vegetables. The concept of food neophobia was first introduced by Rozin in 1976 (10, 13). Humans show interest but avoid and are reluctant to try new foods (13, 14). Food neophobia is present even in young children. Often children will decide whether or not to try a new food by using their senses (10, 13). In short, how a food looks or how a food smells may influence whether or not a child is willing to try a particular food. Sensory references may decrease neophobia and encourage children to try new foods.

Food neophobia

As children learn to associate new foods with familiar food choices, they are able to correlate the taste they know from familiar foods with the new food the child is sampling (15). Repeated exposure to new foods makes a food more familiar and
decreases the degree of neophobia a child feels towards that food. Research has shown that children need to be exposed to a new food between six to ten times before they can accurately decide whether or not they have a preference for that food (14, 16-18). Through continuous exposure, the child can learn to be more accepting of new foods and the phobia of new foods in general decreases (16). Repeated exposure to a target food has been shown to decrease the degree of neophobia to other foods in that food group, in general (14). Children who were repeatedly exposed to unfamiliar foods were more likely to prefer and consume the unfamiliar foods and they along with their parents, reported a lesser degree of neophobia to other vegetables as well (16).

School-based interventions

Research conducted on various interventions in schools provides strong evidence supporting the idea that school-based multi-component interventions are more successful at changing behavior related to vegetable intake than are single-component interventions or interventions targeting children at places other than school(19-21). Multi-component interventions often include combinations of classroom based education /cafeteria interventions, parent outreach interventions, and community interventions combined (21). Reynolds found positive results with a multiple-intervention strategy titled the “High 5 Project,” conducted among of nine to 11 year olds of diverse ethnic heritage. After one year of intervention, the project showed an increase in vegetable consumption of +0.35 servings/day (21, 22). The intervention included a nutrition curriculum, parental-led home based activities and outside-of-the-home-based activities. The lunchroom also altered meals to allow for coordination between what children were learning in the
classroom and what was being served in the meals. This effort caused an increase in preparation and promotion of vegetables.

Other factors that have been identified as barriers to vegetable consumption among children include the availability and accessibility of vegetables at school and at home. Blanchette and Brug’s recently reviewed (22) the evidence examining potential determinants of vegetable intake and effective intervention strategies to increase consumption among children. They report strong inverse correlations between accessibility and availability and the amount of vegetables children consume. Not surprisingly, preference for vegetables was a strong predictor of vegetable consumption.

Jago, Baranowski, Baranowski’s review (23) of studies examining the association between availability of vegetables and consumption of vegetables among children found that the accessibility of vegetables was associated with preference of vegetables and concluded that children are more likely to prefer vegetables that they have access to. This evidence supports the notion that availability and accessibility of vegetables to children likely impacts preference and intake.

Other strategies described in the literature aimed at increasing vegetable intake among children include education, social norm marketing, and reward systems. Some researchers have found positive associations between traditional nutrition education and vegetable intake (24). Kalina and Arnold (25) studied the impact of cafeteria marketing focused on food choices over a three week period on food choices and intake. Cafeteria marketing of vegetables that included visually appealing posters placed in strategic locations frequently viewed by children increased the consumption of vegetables by 37%.
The placement of posters promoting more general nutrition education resulted in no significant changes in the vegetable consumption. These findings suggest that targeted cafeteria marketing may be an effective way to promote positive change in vegetable consumption among students (25).

This project follows along with other research based interventions as a multi-component intervention to increase consumption, knowledge and preference of vegetables among elementary-aged children. The project consists of diverse interventions aimed at increasing knowledge, preference and consumption of vegetables towards the target population. The project focused on sensory-based nutrition education, rather than nutrient intake. The project collected data on actual consumption and knowledge rather than the nutrient intake among children. This project was done to determine the target population’s willingness to consume vegetables.

**Subjects and Methods**

**Study participants**

The Utah State University Institutional Review Board reviewed the protocols and procedures for this study to ensure protection of participants. A letter of information was sent home with each student in which parents were asked to return the form indicating approval or disapproval of their child’s participation. Children whose parent’s indicated that they did not want their students to participate were invited to participate in the study-based activities, but did not provide data for analysis. Canyon Elementary was selected
through consensus by administrators at Cache County School District and Utah State University Nutrition, Dietetics and Food Sciences Department.

All fourth and second graders attending Canyon Elementary during 2008-2009 were invited to participate in outcome measures designed to assess the effectiveness of the intervention regarding changes in vegetable intake. Although outcome assessments were only collected among second and fourth grades, the program was implemented school-wide (See Table 3.1).

Ninety eight percent of parents provided consent for their child to participate. Nine parents out of 519 declined allow his/her child to participate in the survey assessments, one parent declined to allow their child to participate in assessment of lunch-time consumption of vegetable intake.

Although the elementary school selected was among the most ethnically diverse school in the district, 82% of the study participants were non-Hispanic whites (see Table 3.1). Socioeconomic status was assigned according to the USDA guidelines on the Income Eligibility for free and reduced lunch status for National School Lunch Program participants (26). Any child can participate in the NSLP regardless of income. At the school, meals are served to children who qualify for free or reduced meals (26). The prices for NSLP are determined by the USDA. Children whose families’ have incomes that fall at or below 130% of the poverty line are eligible for free meals. Students whose families fall between 130% and 185% of the poverty line qualify for reduced price meals (26).
Forty-nine percent of the student population at the target elementary school qualified for free or reduced lunch in 2008-2009 and of those, 80% received free lunch through the NSLP (27). Canyon elementary is a Title I school, meaning at least 40% of students come from families of low-income and are eligible to receive federal Title 1 funds (28). The proportion of low-income families is most frequently measured by the percent of students receiving free and reduced-priced lunch (29).

Components of the Interventions

The components of the intervention included integrated classroom nutrition education, lunchroom exposure to target vegetables, nutrition education during after school programs, monthly vegetable-themed newsletters send home with children, and a vegetable fair. All interventions were implemented during the 2008-2009 school during the months of September through April.

Classroom curriculum

A curriculum of monthly vegetable themed nutrition education was presented to teachers at the beginning of the school year. Lessons were designed to integrate information about vegetables into the core curriculum. The curriculum included one lesson covering each of the nine target vegetables. A target vegetable was identified for each month and the other components of the intervention were also focused on the target vegetable of the month. Teachers were asked to teach at least one nutrition lesson on the vegetable of the month each month, a nutrition lesson at least to use at their own discretion. The lesson plans included additional teaching resources for classroom
teachers. Teachers were encouraged to incorporate the activities into their core curriculum, e.g., teachers could use the vegetable as a theme for a poem, the base of a math problem, or as the topic for a research report. The additional teaching materials also provided teachers with websites for further teaching ideas. This allowed the teachers the freedom to teach the students according to their discretion. Table 3.2 and 3.3 are a summary of the lesson plans that were taught to the student’s during the intervention. The method for each curriculum was different for the two components. Teachers were asked to complete a survey about their perceptions of the quality, effectiveness and usability of the curriculum.

The after school curriculum was developed by USU dietetic students and included three lessons for each of the nine target vegetables previously identified as the vegetable of the month. The objective of the lessons (see Appendix) was to teach the children about the importance of consuming vegetables, where and how the vegetable grows, and options for preparation of the vegetable and other food pairings so that they might more fully enjoy eating the vegetable. Each lesson was taught to children participating in the after school program and included tactile and sensory experiences enforcing the concepts being taught and at least one tasting opportunity of each target vegetable. The after school curriculum was taught by USU Dietetic Students.
Cafeteria tasting experience

The vegetable was highlighted in the lunchroom on a variety of menus which would be appealing to the students and encouraged children to try new vegetables. The first week of the month the vegetable was done emphasized daily during the lunchroom intervention. (Local grocers in Hyrum donated or discounted a variety of the vegetables each month).

Newsletters

Monthly newsletter was sent home for the parents highlighting recipes relating to the vegetable of the month and fun nutritional facts. The newsletter was double-sided to target both parents and children. The front of the newsletters was filled with information for parents that focused on the vegetable of the month. Recipes and nutritional information was provided to teach parents the importance of providing a variety of vegetables to children. The back of the newsletter provided information that was geared towards children. There were activities that they would do that referred to the vegetable of the month, e.g., jokes, word searches, coloring a drawing of the vegetable, and how to make a dish that includes the vegetable. All of the information provided was done to provide information for the whole family. Distribution of the newsletter was done by the school at the beginning of each month.
Data Assessment

Lunch-time vegetable intake was assessed by digital observation of the amount of vegetables selected and consumed on three days prior to the intervention, and three days after the intervention. Though the most accurate method of observing food intake at a specific occasion is weighing the foods before and after eating (30-32), this method is time consuming, disruptive and costly (32). Digital photography has recently been introduced as an alternative to the weighing method and others report high correlations between visual versus weighed estimates of food consumed (r values between 0.89 and 0.97, p=0.712) (32). At least one other study confirms the use of digital photography as a highly accurate means of estimating cafeteria consumption among certain populations, that include school-aged children or others who often eat in cafeteria style eating establishments (32).

Children’s attitudes and behaviors regarding vegetables were assessed by a self-completed survey. The survey consisted of 12 questions about the behavior and preference for vegetables in addition to an evaluation of the awareness of vegetable designated as target vegetables for the intervention. Pre-intervention surveys were completed by children in grades first through fifth during class-time in August, and were facilitated by teachers who helped students with questions and completing the survey. Post-intervention surveys were completed by children in May. The surveys were administered by classroom teachers and were collected within a five-day period (Table 3.2) (See Appendix).
The children ranked their liking and knowledge on a hedonic scale. The hedonic scale is made up of five faces ranging in smiles to neutral to frowning. The scale is used to accommodate participants of all ages (see Appendix for rating and ranking sheets). It is also a good marker for young children who may have a difficult time reading the questions and the ranking scale. The ranking form measured preference on a scale of one to five with one being “strongly dislike,” three “neutral,” and five being “strongly liked.” The forms, however, do not have the numbers written prior to testing in order to avoid confusion to young participants. Children are asked to read the questions and fill out the appropriate face according to their agreement with the question.

The amount of vegetables selected and consumed by the second and fourth graders was photographed and estimated using the methods of digital photography (32). Information was collected for three consecutive days during the pre-interventions period and again over three consecutive days during the post-intervention period. The food choices were determined by district food service manager and the same menu options were used for the pre and post-intervention data collections. The foods offered as part of the main food service line were pre-portioned by the food service personnel. The school also offers a fruit and vegetable bar that provides an opportunity for children to self-select vegetables in addition to those provided at part of the main NSLP menu. A fruit and vegetable bar was provided for children all six days of vegetable selection although the vegetable included on the bar differed across days.

On the days of observations, a sticker label of each student’s study ID was placed on the tray of the student when they entered the lunch line. Students were instructed to
proceed to the photographing station after they had selected their foods and before sitting down to eat. A digital photographing of the tray was taken by a trained research assistant from a designated distance. Students were then instructed to proceed to a second photographing station after they were finished eating but before dumping the contents of their meal and returning their tray to the dishwashing area. A second digital photograph was taken. On days when the students were allowed to return to the food line for second helpings, students were instructed to visit the first photograph station again. At the post-intervention data collection, students who brought their lunch from home were also photographed.

Only the students who provided data for at least two of the three days of observation at both the pre-and post-intervention data collection periods were included in the assessment of differences in intake. Seventy six students (45% of all second- and fourth-graders) provided at least two days of observational data at the pre-intervention period. Eighty one provided at least two days of observational data at the post-intervention period.

A digital plate waste study was conducted to assess the food choices and consumption of the second-and fourth-grade students. Two separate data collections were conducted during the school year, which corresponded with various interventions aimed at increasing children’s intake of vegetables in school lunch. Students were assigned a study ID number. As the students were finished taking food from the serving line and vegetable bar, they moved to an assigned area where a digital photograph was taken of the tray which included the student’s identification number and the student’s
food selection. The student was not included in the photograph to preserve confidentiality. After students finished eating, they were ushered to another table where trained researchers took photographs of what was left on the student’s plate before the student disposed of his or her tray. At the end of each data collection students were given a small incentive such as an eraser, plastic toys, rulers, pencils as a thank-you for their participation.

Trained observers assessed the three-day plate waste by viewing the photographs, and using a plate waste guide as an education tool to accurately measure the consumption. Students were permitted to take an unlimited quantity of vegetables from the vegetable bar. Vegetables provided on the serving line were pre-portioned into cups serving sizes. Observers counted the number of vegetables taken from the vegetable bar and assigned a percentage based on serving size determined from the USDA website, which accurately calculated vegetable portions. Three observers were used to maintain consistency and to differentiate between any discrepancies in the assessments. The mode observation was used if two of the three observations were the same. The mean was used on the corresponding rating scale, if all three observers assessed different percentages. For 90% of the assessments 100% agreement between the observers was met. When data was excluded this included students who took no vegetables, the exact number dropped to 86%. The agreement between the observers for the post-assessment data had similar accuracy. The high percentage of accuracy could be correlated with the observers close working relationship and opportunity to collaborate.
To compare the consumption of the second-and-fourth grade students to national recommendations, the number of total vegetable servings consumed was calculated. Serving size parameters were reflective of the recommended by the USDA’s publication of My Pyramid for eight to ten year olds who are active for at least 30 to 60 minutes on most days of the week.

**Interventions**

A parental survey was distributed to parents in May. The parent survey included 12 questions that were similar to questions asked to students on both the pre- and post-intervention surveys. Parents were asked about their vegetable eating habits, preference and knowledge as well as their children’s eating habits and preference (See Appendix). No pre-intervention parental survey was conducted. The surveys were provided to the student to take home to the parents to fill out. The survey was collected one week after they were sent home to parent with the children (see appendix).

The educators at Canyon Elementary were asked to fill out a survey with questions about their vegetable intake, along with data concerning the time spent on teaching the vegetable of the month program in their classrooms. The educators’ survey was distributed at the conclusion in May (See Appendix).
Statistical Analysis

The SPSS (SPSS, Chicago, IL, USA) software package was used for data analysis. Analysis of variance and chi-squared distributions were done to provide means, standard deviations and proportions of the participants by factors of interest. Paired student t-tests were calculated to assess differences in the amount of vegetables selected and consumed pre- and post- intervention. Paired t-test analysis included participants who provided data for the pre and post-assessments (n=99). Chi-squared distributions were used to assess the differences in the distribution of responses to pre- and post-intervention surveys regarding student’s knowledge and preference for vegetables. One-way ANOVA was used to compare the pre- and post- intervention surveys when the categories were treated as an ordinal variable. For example, the surveys asked students to rank their preference of a list of ten vegetables. Students selected if they had ever heard of the vegetable and the ranking questions were ordered with yes being two, no being one and I don’t know zero. Assessment questions asked children’s consumption of vegetables and their frequency of consumption. The ranking questions were assessed on a one through five scale. A score of one indicated strong disagreement with the statement and five indicated strong agreement with the statement.

Spearman rank correlation coefficients were used to compare the correlation between parent’s and children’s responses to the knowledge and behavior survey.
Spearman rank correlation was used to assess correlations between level of agreement reported by parents and children on the post-intervention survey. For example, analysis of the parent survey was conducted on three separate survey questions correlated with the student survey questions: lots of vegetables provided in my home, vegetables are important to eat daily, and willing to try new vegetables.

**Results**

Demographics for participants in this study were collected by researchers to provide adequate information pertaining to students. Four hundred and fifty students participated in the assessment portion of the study. 54% of the population was male (242) and 46% was female (208). The distribution of students was broken down into class sizes. 20% (90) of the students-participants were in first grade, 16% (72) were in second, 18% (81) were in third, 15% (67) were in fourth and 15% (68) were in fifth grade. Students participating in the plate waste study made up 19% of the entire study population. This included second graders (ten percent of total study population) and fourth graders (nine percent of total study population). Of the students who participated in the school lunch program 71% receive reduced price lunch and 73% receive free lunch from the NSLP.

Table 3.4 shows the demographics of the participants. The table describes the amount of students in the school and the number of students who received free and reduced lunch from the NSLP. Table 3.5 represents the description of the responses for the children’s pre-assessment survey. Table 3.1 shows the meal selection over the three day plate-waste intervention including the main entrée and the available vegetables.
The students were asked to rank their preference in agreement on a hedonic scale. The ranking was weighed on a five point scale, with five being strongly agreed and one strongly disagreed. To determine the statistical significance of the student’s rankings pre/post assessment, paired t-tests were used to determine the mean and standard deviation of the preference towards vegetables throughout the intervention. The pre-assessment survey revealed that 92% of children think it is important to eat vegetables everyday (Table 3.5). Forty-nine percent of students agreed with eating vegetables as a snack, and 26% disagreed with vegetable consumption as a snack. All of the percentages in the pre-assessment survey favored the agreement category. This shows that most of the student’s had a pre existing knowledge of vegetables and their consumption.

Table 3.6 displays results from the parent survey. Parents reported a higher degree of agreement with all statements as compared to mean degree of agreeance reported by the children. Ninety five percent of parents agreed with the statement that “I like to eat vegetables” and “vegetables are important to eat everyday” (95%). Only 43% of parents agreed with the statement that “I consume vegetables at lunch time.”

Table 3.7 describes the difference in the mean ordered scores of students’ pre-and post-assessment survey questions. There was no difference in the responses at the pre-compared to the post-intervention survey when the responses were ordered (1-5). The majorities of the questions had a negative mean, meaning level of agreeance with the statements increased from the pre-intervention to the post-intervention survey, and were not significant. The question in the survey asked “willing to try new vegetables” had a mean of -0.381 with a significance of 0.
Pre-post-intervention assessment of lunchtime vegetable intake

The mean difference in the amount of vegetables selected and consumed is displayed in table 3.8. The average amount of vegetables consumed at the pre-intervention assessment was 0.16 (0.25) SD and 0.15 (0.30) SD cups for second- and fourth-graders respectively. Fourth-graders selected less and ate more vegetable than did second--graders at both the pre-and post-intervention assessments. The difference between the amount of vegetable consumed by second and fourth graders, or boys and girls within or across grades, was not significant (p-value > 0.05 for all stratified comparisons). The amount of vegetables selected and consumed did not change from the pre-intervention to the post-intervention assessment (p= values >0.05).

Teacher participation survey

Nineteen (100%) teachers and four food service staff provided responses to an end-of-school-year survey evaluation the 2008-2009 Canyon Colts Love Veggies program, under the Viva Vegetables program. Teachers were asked to report how much time they spent incorporating Canyon Colts Love Veggies curriculum into their class each month. Fourteen (74%) incorporated some aspect of the Canyon Colts Love Veggies Curriculum into their core curriculum during the year. Among this 14, the average amount of time spent was once per month. There were no specific questions relating to what type of teaching plan was used. No data was collected pertaining to the type of information provided for students, but the number of times it was taught was determined. Of the 18 who filled out the teaching sections seven taught once a month, seven taught
once the entire year, and four answered they never taught any vegetable curriculum in their classroom.

There was a positive correlation between the survey responses of the second and fourth-grade students whose teachers taught nutrition education in the classroom and an increase in vegetable consumption. A chi-squared distribution was conducted between teachers and the students to determine the percent of students who participated in the plate waste and their vegetable consumption. Data collected from student surveys showed responses of student’s whose teachers taught vegetable curriculum had greater vegetable intake at the post-intervention assessment as compared to the pre-intervention assessment an increase in vegetable consumption at the end assessment. For example, one teacher had 90% of students who ate more vegetables at the end assessment, which correlated with the teacher’s survey of teaching vegetable curriculum in the classroom at least once a month.

Correlation between parent survey responses and children’s survey responses

The parental post survey was collected to determine the relationship between parent’s and children’s attitudes and behaviors related to vegetables (table 3.7). Parents with multiple children filled out one survey and the information was matched to the individual children. Parents with multiple children filled out one survey and the information was matched to individual children. The distributions of responses to the parent survey are displayed in table 3.9, which displays the average means of answers among parents in the post survey. Parents were not given a pre-intervention survey, so adequate data on the change in behavior/attitude and consumption habits among parents’
is not determined in the study. Ninety-five percent of parents reported they agreed with the question “I like to eat vegetables,” four percent reported that they disagreed with the question (see table 3.6) There was a weak correlation between parent and child post assessment survey question stating “I think vegetables taste good” (r= 0.166 p=0.014) Overall the data shows that parents agree with the statements, with the lowest agreement from survey “willing to try new vegetables” mean 3.9 standard deviation (1.3). The data in table 3.10 shows a correlation between the parental influence and what the child exhibited in their survey.

Comparison to national recommendations

The mean vegetable consumption levels did not meet recommended MyPyramid levels. For an nine-year old, which is the mean age of the study participates in the plate waste assessment, who is active 30 to 60 minutes most days of the week, MyPyramid recommends consuming two and a half cups of vegetables per day. The National School Lunch Program (NSLP) requires schools who participate in their program for school lunches to provide at least one-third of the calories and other select nutrients of a child’s diet (33). School lunches should also be requiring at least one-third of the recommendations for vegetables to the children, which is two-thirds cups. The average amount of vegetable consumed by children at Canyon elementary during lunch was 0.27 cups per day.
Discussion

The objective of this study was to implement a multi-component school-based intervention aimed at increasing vegetable consumption among students attending one public elementary school in Northern Utah. The components of the intervention included: classroom curriculum, newsletters distributed to parents, lunchroom exposure, and after school curriculum. These components provide additional research in the important area of child nutrition. Research in this area continues to innovate and evaluate effective interventions used to increase vegetable consumption along with children’s knowledge of the importance of consuming vegetables. Implementation of a multi-component school-based vegetable intervention was conducted to determine behavior and attitude towards vegetable consumptions. Their ability to incorporate knowledge into their lives will allow them resources to make healthier food choices into a habit.

Vegetable consumption among second-and fourth—graders was far less than recommended. A multi-component intervention that included classroom curriculum, newsletters home, lunchroom vegetable exposure, after school curriculum did not result in changes to preferences, intake, knowledge or attitudes regarding vegetables. Parent’s behaviors and attitudes regarding vegetable consumption were positively associated with children’s attitudes regarding vegetables consumption and no positive influence was associated with the offering of vegetables in the lunchroom. The concluding results from the plate waste assessment are consistent with research from other studies conducted
among school-aged children that found vegetable intake was below recommended dietary intake (34-36). Low vegetable intake among children continues to be a cause for concern. Schools provide food to children and should deliver consistent messages about the importance of consuming vegetables and should strive to consistently offer children vegetables as part of the national school lunch program. In addition, a key component of interventions aimed at increasing vegetable intake among children should include factors that influence the availability of vegetables to children at home.

This multi-component did not produce the same results as other multi-component studies done in school. Although various interventions were conducted to educate, expose and make vegetables available to the children, the lack of statistical significance in the children’s preference and knowledge according to plate waste assessment and preference survey shows that children did not increase their vegetable intake over the course of the intervention. One possible explanation for the null results could be selection of vegetables available to students on the days we observed their vegetable intake. The menu days of the pre-and post-interventions observations were standardized and included the same selection of vegetables. However, the vegetables provided were not particularly favorable vegetables and were not related to the Canyons Colts Love Veggies Curriculum. The vegetables offered to students on the days of observation included: celery, cucumbers, green beans, iceberg lettuce. The days of observation were selected for convenience. We might have observed very different results if the menu days had included the vegetables targeted in the Canyon Colts Love Veggies program. Thus, the intervention did not result in increasing to vegetables that children were familiar with and
exposed to on a regular basis, but may have been successful in increase intake of less familiar vegetables that were included in the interventions.

Others have demonstrated positive associations between exposure, availability and accessibility of vegetables and knowledge and preference for vegetables (11, 22, 23, 37-41). Children, when served a variety of vegetables, may have an increased consumption because of the child’s familiarity with the variety of vegetables being offered (42).

This multi-component intervention included classroom curriculum, newsletters home, lunchroom vegetable exposure, after school curriculum. Students received consistent and positive messages about the importance of eating vegetables in take home newsletters, classroom, the cafeteria, and in after school programs. In addition, these messages about targeted vegetables were coordinated with multiple opportunities to taste the vegetable in the cafeteria during the selected month the specific vegetable was highlighted. This is one of only a few interventions that provided this level of targeted vegetable exposures in a school environment. This idea was well-received by students and teachers. From observation and information provided by teachers and food service staff, children were excited about the new vegetables that were provided during the meal. With encouragement from staff, students were able to try a variety of vegetables, and ended up liking the vegetables that they previously had not tried or that staff thought they would like. Participants in this study benefited from the multi-component intervention, which allowed them various strategies to learn about vegetables. Children were educated in the classroom, after school programs, newsletters, experience of a variety of fresh
vegetables served in the lunchroom. The Canyon Colts Love Veggies curriculum included information about where vegetables grow and how they get from the farm to the cafeteria or dinner table. Education emphasized the fact that vegetables come in different varieties and can be prepared in different ways to meet the individual preferences of this eating them.

Additional school-based multi-component interventions in schools would be beneficial for children should be conducted. A large and more effective home component should be addressed. This data supports the research suggesting parents have a strong influence on what their child eats and that, food neophobia might be established in children before they reach school-age.

Research should use assessments that capture change in the desired outcomes. Continuous education during the years at school will expose children to vegetables, and provide repetitiveness, which helps the children become familiar with the variety of vegetables available. Influence and encouragement from teachers has shown to help students participate in programs during school and teaches them to try new things (43). Although there are several barriers to children’s consumption of vegetables this project strengthen previous research with the data outcome suggesting multi-component interventions and repeated exposure can allow for positive adjustments to help children meet the recommended dietary allowances.

Various programs have already been implemented on a national level to help educate the general population and encourage schools to promote and provide vegetables in their schools. Team Nutrition is an example of a national program which encourages
children to eat healthier food options (19, 44). Team Nutrition has implemented nutrition curriculum and different strategies for schools to use to enhance the menu options for school lunch (44). This project was conducted to help the children at Canyon Elementary increase their vegetable intake while participating in the NSLP and increase their knowledge of the benefits of vegetables on the body.

**Conclusion**

Children who participated in the Canyon Colts Love Vegetable Project did not change their intake of familiar vegetables during pre- and post- intervention lunchtime observations of vegetable intake. Confounding factors uncontrolled in these analyses may have skewed results towards the null. A positive effect may be seen with the consumption of vegetables with more exposure, stronger classroom curriculum and parent participation.

**References**


24. Reinaerts E, de Nooijer J, Candel M, de Vries N. Explaining school children's fruit and vegetable consumption: the contributions of availability, accessibility,
exposure, parental consumption and habit in addition to psychosocial factors.


Table 3.1 Meal selection for three day plat waste assessment.

<table>
<thead>
<tr>
<th>Entrée</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrée 1</td>
<td>Cubed Turkey</td>
<td>Cheese Pizza</td>
<td>Salad Bar w/ ham, cheese, croutons</td>
</tr>
<tr>
<td>Entrée 2</td>
<td>Chicken Fried Steak</td>
<td>Pepperoni Pizza</td>
<td>Corn Dogs</td>
</tr>
</tbody>
</table>
### Table 3.2: Classroom curriculum

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Objectives</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to Teach about… Corn</td>
<td>Students will understand why corn, like all vegetables is healthy for them to eat. Students will discover different ways to eat and prepare corn.</td>
<td>Guessing game. Clues will be read out loud to children, when they figure out what they are guessing they will raise their hand. Corn word Scramble. Students will try and unscramble the words that they learned in the lesson about corn.</td>
</tr>
</tbody>
</table>
Table 3.3: After school program curriculum

**Vegetable: Cauliflower**

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Objectives</th>
<th>Activities</th>
</tr>
</thead>
</table>
| **A Tasty Little Vegetable**               | Children will use positive adjectives to describe the taste of cauliflower.  
Children will understand how to incorporate cauliflower into mealtimes.  
Children will make and eat a simple, nutritious snack using cauliflower. | Taste test to determine the taste characteristics of a cauliflower.  
A food demonstration and meal discussion on cauliflower popcorn and receive a copy and awareness for trying the cauliflower. |
| **Exploring Vegetables with the Senses**   | Children will understand how cauliflower relates to four of their five senses  
How does cauliflower feel?  
How does cauliflower sound?  
How does cauliflower smell?  
What does cauliflower look like?  
Children will connect sensory experiences to what they already know.  
Children will understand that eating cauliflower is an experience that can involve all of the senses. | Mystery Bucket. The kids will have to solve a mystery and find out what vegetable is in the bucket using their senses.  
Writing Sensory words.  
Children will use their senses and write out sensory words to describe those senses.  
Children will split into groups and make up a song using their sensory words. |
| **How it Grows**                           | Children will understand one reason cauliflower is healthy for them to eat.  
Children will understand what part of the plant the cauliflower is (root, stem, leaf, flower, fruit or seed)  
Children will understand the story of cauliflower for the garden to their plate (including stages of growth of cauliflower). | Clue Game. Clues will be read aloud, once the child knows that the clues are describing they will guess what the object is.  
Have a poster of a plant, so children can identify what part of the plant cauliflower is.  
Children will react the story of the harvesting of the cauliflower from garden to the store. |
Table 3.4: Characteristics of Canyon elementary students; 2008-2009.

<table>
<thead>
<tr>
<th></th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>N= 242 (54%)</td>
</tr>
<tr>
<td>Female</td>
<td>N= 208 (46%)</td>
</tr>
<tr>
<td><strong>Grade Level</strong></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>N= 72 (16%)</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>N= 90 (20%)</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>N= 72 (16%)</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>N= 81 (18%)</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>N= 67 (15%)</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>N= 68 (15%)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>N= 369 (82%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>N= 81 (18%)</td>
</tr>
<tr>
<td><strong>Eligibility</strong></td>
<td></td>
</tr>
<tr>
<td>Free</td>
<td>73%</td>
</tr>
<tr>
<td>Reduced</td>
<td>71%</td>
</tr>
</tbody>
</table>
Table 3.5 Distribution of responses to pre-intervention survey (n=450).

<table>
<thead>
<tr>
<th></th>
<th>Agree (%)</th>
<th>Neutral (%)</th>
<th>Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td>74%</td>
<td>17%</td>
<td>9%</td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td>78%</td>
<td>14%</td>
<td>8%</td>
</tr>
<tr>
<td>There are lots of vegetables</td>
<td>63%</td>
<td>20%</td>
<td>13%</td>
</tr>
<tr>
<td>to eat at my home.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat vegetables with my lunch.</td>
<td>58%</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>I eat vegetables with my dinner.</td>
<td>66%</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>I eat vegetables as snacks.</td>
<td>49%</td>
<td>17%</td>
<td>33%</td>
</tr>
<tr>
<td>Vegetables taste good plain,</td>
<td>55%</td>
<td>18%</td>
<td>27%</td>
</tr>
<tr>
<td>without anything added to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>them.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My favorite way to eat</td>
<td>49%</td>
<td>16%</td>
<td>39%</td>
</tr>
<tr>
<td>vegetables is when they are</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>raw.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My favorite way to eat</td>
<td>60%</td>
<td>14%</td>
<td>26%</td>
</tr>
<tr>
<td>vegetables is when they are</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cooked.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willing to try new vegetables.</td>
<td>58%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td>I think vegetables are</td>
<td>82%</td>
<td>11%</td>
<td>7%</td>
</tr>
<tr>
<td>important to eat daily.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think I need to eat</td>
<td>92%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>vegetables to be healthy.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.6 Distribution of responses to parent post-intervention survey (n=215).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agree (%)</th>
<th>Neutral (%)</th>
<th>Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td>95%</td>
<td>.09%</td>
<td>4%</td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td>94%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Vegetables are readily available in my home.</td>
<td>91%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>I eat more vegetable with my lunch.</td>
<td>43%</td>
<td>35%</td>
<td>22%</td>
</tr>
<tr>
<td>I eat more vegetables with my dinner.</td>
<td>79%</td>
<td>15%</td>
<td>6%</td>
</tr>
<tr>
<td>I eat vegetables as snacks.</td>
<td>60%</td>
<td>21%</td>
<td>20%</td>
</tr>
<tr>
<td>Vegetables taste good plain, without anything added to them.</td>
<td>73%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>I like to try new vegetables</td>
<td>72%</td>
<td>16%</td>
<td>12%</td>
</tr>
<tr>
<td>My child eat vegetables</td>
<td>89%</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>My child likes to eat vegetables.</td>
<td>80%</td>
<td>11%</td>
<td>4%</td>
</tr>
<tr>
<td>My child eats more vegetables now compared to last year.</td>
<td>55%</td>
<td>35%</td>
<td>10%</td>
</tr>
<tr>
<td>I think vegetables are important to eat everyday.</td>
<td>95%</td>
<td>1%</td>
<td>3%</td>
</tr>
</tbody>
</table>
Table 3.7: Mean (SD) difference in children's survey results from pre- post- intervention when categories are ranked as an ordinal variable with a score of 1 assigned to those who strongly disagree and 5 to those who strongly agree; n=450

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean difference between pre versus post (n=450)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td>-.079 (SD)</td>
<td>.222</td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td>.078</td>
<td>.271</td>
</tr>
<tr>
<td>There are lots of vegetables to eat at my home.</td>
<td>-.226</td>
<td>.010</td>
</tr>
<tr>
<td>I eat vegetable with my lunch.</td>
<td>0.164</td>
<td>0.085</td>
</tr>
<tr>
<td>I eat vegetables with my dinner.</td>
<td>-0.012</td>
<td>0.884</td>
</tr>
<tr>
<td>I eat vegetables as snacks.</td>
<td>-0.160</td>
<td>0.111</td>
</tr>
<tr>
<td>Vegetables taste good plain, without anything added to them.</td>
<td>-0.019</td>
<td>0.862</td>
</tr>
<tr>
<td>My favorite way to eat vegetables is when they are raw.</td>
<td>0.059</td>
<td>0.602</td>
</tr>
<tr>
<td>My favorite way to eat vegetables is when they are cooked.</td>
<td>0.019</td>
<td>0.850</td>
</tr>
<tr>
<td>Willing to try new vegetables.</td>
<td>-0.381</td>
<td>0.000</td>
</tr>
<tr>
<td>I think vegetables are important to eat daily.</td>
<td>-0.190</td>
<td>0.008</td>
</tr>
<tr>
<td>I think I need to eat vegetables to be healthy.</td>
<td>-0.098</td>
<td>0.054</td>
</tr>
</tbody>
</table>
Table 3.8: Average (standard deviation) amount of vegetables selected & consumed in cups at the pre- post- intervention data collection periods by grade level.

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of vegetables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>selected 2nd (n=46)</td>
<td>0.45 (0.11)</td>
<td>0.39 (0.18)</td>
<td>0.483</td>
</tr>
<tr>
<td>4th (n=43)</td>
<td>0.43 (0.12)</td>
<td>0.36 (0.18)</td>
<td>0.467</td>
</tr>
<tr>
<td>Amount of vegetables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consumed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre 2nd (n=46)</td>
<td>0.25 (0.16)</td>
<td>0.25 (0.13)</td>
<td>0.71</td>
</tr>
<tr>
<td>4th (n=53)</td>
<td>0.30 (0.15)</td>
<td>0.29 (0.21)</td>
<td>0.34</td>
</tr>
</tbody>
</table>
Table 3.9: Average ranking (range 1-5; 1= strongly disagree, 5= strongly agree) for parental vegetable survey.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>Number of respondents</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I like to eat vegetables.</td>
<td>237</td>
<td>4.57 (0.754)</td>
</tr>
<tr>
<td>2</td>
<td>I think vegetables taste good.</td>
<td>237</td>
<td>4.52 (0.768)</td>
</tr>
<tr>
<td>3</td>
<td>Vegetables are readily available in my home.</td>
<td>237</td>
<td>4.42 (0.768)</td>
</tr>
<tr>
<td>4</td>
<td>I eat vegetable with my lunch.</td>
<td>236</td>
<td>3.34 (1.01)</td>
</tr>
<tr>
<td>5</td>
<td>I eat vegetables with my dinner.</td>
<td>237</td>
<td>4.16 (0.916)</td>
</tr>
<tr>
<td>6</td>
<td>I eat vegetables as snacks.</td>
<td>236</td>
<td>3.56 (1.052)</td>
</tr>
<tr>
<td>7</td>
<td>Vegetables taste good plain, without anything added to them.</td>
<td>238</td>
<td>3.87 (1.070)</td>
</tr>
<tr>
<td>8</td>
<td>I like to try new vegetables.</td>
<td>238</td>
<td>3.92 (1.030)</td>
</tr>
<tr>
<td>9</td>
<td>My child eats vegetables</td>
<td>236</td>
<td>4.16 (0.843)</td>
</tr>
<tr>
<td>10</td>
<td>My child likes to eat vegetables</td>
<td>238</td>
<td>3.95 (1.028)</td>
</tr>
<tr>
<td>11</td>
<td>My child eats more vegetables now compared to last year.</td>
<td>235</td>
<td>3.59 (1.027)</td>
</tr>
<tr>
<td>12</td>
<td>I think vegetables are important to eat daily.</td>
<td>237</td>
<td>4.67 (0.743)</td>
</tr>
</tbody>
</table>
Table 3.10: Correlation between student pre-assessment survey and parent survey.

<table>
<thead>
<tr>
<th>Question</th>
<th>R</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td>0.134</td>
<td>0.048</td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td>0.166</td>
<td>0.014</td>
</tr>
<tr>
<td>There are lots of vegetables to eat at my home.</td>
<td>0.145</td>
<td>0.033</td>
</tr>
<tr>
<td>I eat vegetable with my lunch.</td>
<td>0.144</td>
<td>0.034</td>
</tr>
<tr>
<td>I eat vegetables with my dinner.</td>
<td>0.174</td>
<td>0.011</td>
</tr>
<tr>
<td>I eat vegetables as snacks.</td>
<td>0.249</td>
<td>0.000</td>
</tr>
<tr>
<td>Vegetables taste good plain, without anything added to them.</td>
<td>-0.022</td>
<td>0.746</td>
</tr>
<tr>
<td>Willing to try new vegetables.</td>
<td>0.072</td>
<td>0.293</td>
</tr>
<tr>
<td>I think vegetables are important to eat daily.</td>
<td>0.079</td>
<td>0.250</td>
</tr>
</tbody>
</table>
CHAPTER 4

SUMMARY AND CONCLUSION

Summary

The intention of this thesis project was to design, implement and assess the efficacy of a school-based multi-component intervention aimed at increasing vegetable intake among children attending a target school is Cache County School District. Literature on the trends of vegetable intake among children and parents and the association between the two, along with barriers and benefits of vegetable consumption was reviewed during this project. It is very evident that the majority of the children in the U.S. do not consume enough vegetables, which may be a contributing factor in increasing rates of obesity and chronic disease among children (1-12). Large national campaigns have been largely unsuccessful in efforts to increase vegetable intake among children. After reviewing the literature, common components of strategies that have been successful strategies are those that talk about the importance of vegetables, but do not provide children with opportunities to learn about and explore vegetables as foods. The literature supports positive correlations between programs that regularly expose children to healthy foods and the intake of healthy foods by children. From studies conducted multi-component interventions have shown to have a more positive outcome to increase vegetable intake among school-age children, and interventions aimed at promoting and exposing children, to vegetables and healthy eating (13-19).
We implemented a school-based multi-component intervention aimed at exposing children to a variety of vegetables, as well as increase their vegetable intake and knowledge at Canyon Elementary in Cache County School District. In our intervention we used various education methods and resources to expose the students to vegetables and why they are beneficial to the body, as well as exposing children in the lunchroom to a variety of vegetables. Education from this intervention was food-focused and sensory-based instead of traditional nutrient-based. The intervention designed for this thesis incorporated components found to be successful by others and included a coordinated effort that involved the cafeteria, the home environment, and formal education in classrooms and after school programs.

The multi-component study used various components to educate and expose children to vegetables. Data was collected through pre-assessment and post-assessment to measure the children’s consumption and knowledge towards vegetables after the interventions concluded.

The first assessment was a plate waste study done in the lunchroom over a three-day period. The plate waste study showed that children over the course of the intervention consistently fell below national recommendations for vegetable intake, with no improvement over the course of the project, which included education and continuous exposure to vegetables. The average vegetable intake among second and fourth graders was (p=0.71) for second grade, and (0.34) for fourth grade. The findings from this study were consistent with similar projects that show inadequate vegetable intake among children in America (20-22). There was not a significant finding in children’s vegetable
intake from pre-assessment to post-assessment, but children did report in their surveys that they were more willing to try new vegetables after vegetable education. They also reported that that they better, understood that vegetables were important to consume on a daily basis.

Although the students had an understanding of the health benefits of eating vegetables, this did not necessarily translate into the actual consumption of the vegetables they knew were healthy for them. One reasonable explanation behind the lack of increase in vegetable intake among the children is a possible preexisting dislike of vegetables. Children often have a predetermined notion that vegetables taste bad. Kids have been seen taking vegetables in the lunchroom, but not consuming them because they dislike the taste after they try them. A contributing factor to this phenomenon could also be the improper preparation of vegetables at the cafeteria level and the resultant incorrect and unpleasant flavor of the vegetables. Improper food preparation does not allow students to use accurate information to make judgment on their preference for certain vegetables.

Also, it can be difficult to provide students who participate in Utah’s NSLP a variety of vegetables. Because Utah has such a short growing season, providing students a variety of choices at a reasonable price is difficult. While this study did show the benefits of nutrition education, there are some important barriers to consider. Teachers are often overwhelmed with the curriculum that is mandated to be taught and do not have time for extra curriculum and/or lack the motivation to teach outside curriculum in the allotted amount of time. Additionally, a majority of teachers do not have the knowledge
to adequately teach proper nutrition education. Many have not had nutrition courses and teach only the basics.

The after school program has different barriers that prevent nutrition education from being taught. Students who participate in the after school program are often times those who are deemed to be at a greater economic disadvantage and research shows that they are the ones who consume the least amounts of vegetables. Children who participate in the after school program tend to be less engaged during that time period because they have been sitting in classrooms all day and find it difficult sit quietly and receive even further instruction.

The project provided applicable elements for educators and families to help encourage and teach children healthful eating habits. Nutrition education may be considered in classroom settings, as an approach to teaching children various dietary methods to help them choose a more healthful diet, which can be linked to prevention of many chronic diseases. Families can adopt educational information from newsletters, and apply information into the home environment for positive dietary changes as a whole. Parents can expose children to a variety of vegetables in the home through teaching and consumption. Parents can take the role of educator/mentor by teaching and demonstrating to children about healthy eating habits and the importance of consuming a variety of vegetables daily. The approach to correlate a food item unfamiliar to the child with something familiar may help encourage the trying of new vegetables and decrease food neophobia among children (23).
A parent cooking class was provided for parents to come and learn healthy ways to incorporate the Vegetable of the Month into their diet. After several attempts to encourage parents to attend to become more educated on how to incorporate the Vegetable of the Month into their home meals the cooking class was discontinued. Upon review it was determined the class was not producing any benefit towards the interventions to increase the children’s vegetable intake, and it was seen as a misuse of time on the part of the instructor who could be utilized elsewhere. Researchers asked a parent focus group how participation could be increased. The consensus was that a parent-child cooking class to teach the family how to cook healthy meals together would increase participation. This information was beneficial for additional research.

Dietetic students in the Nutrition, Dietetics and Food Sciences Department at Utah State University provided the Vegetable Fair. The fair was set in place to educate the faculty, families and community about the importance of consuming vegetables in a fun and educational manner. Similar fairs had been conducted at various schools in the valley with success, so the lack of participation from the students and parents at Canyon Elementary was disconcerting. Lack of advertising and motivation was suggested as a possible cause for the low participation rate. This component of the project was chosen as a way to provide additional education to families. Based on participation further review of this component will need to be done to provide success in the future.

The multi-component intervention was an opportunity to explore various outlets on how to educate students and their families about the importance of vegetable consumption. From this project I was made aware of the challenges that come with
working with human participants, especially young children. We wanted to get a large sample size but with the number of researchers that were assigned to the project, it was difficult to promote vegetable consumption at a level that would effectively encourage the students and their families to increase their vegetable intake. When taking on a project like this, researchers need to have the full support of the staff and the faculty of the school, in addition to as much parental involvement as possible. When you have both you will be more likely to succeed in helping kids find creative ways to consume vegetables that they like and to understand the importance of vegetable consumption.

For future projects in this area, the continuation of a multi-component intervention is recommended. More accurate data collection and fewer components would help with the accuracy in determining what exactly helps increase the students’ awareness and consumption of vegetables. The multi-component intervention allows the students to get the information on why vegetables are important, and allows them to apply that knowledge as they eat both in the lunchroom and at home.

**Conclusion**

The number of overweight and obese children in American is growing at an alarming rate. The number of children who are diagnosed with chronic disease has increased and children are currently being diagnosed with disease such as Type 2 diabetes that 20 years ago were only observed among middle-aged adults. A healthy diet has been shown to reduce the risk of chronic diseases and positively affect weight management. American children eat far fewer vegetables than recommended, yet
contributed significantly to a healthy diet. Effective exposure to vegetables through education and offering in various settings is beneficial to achieve consumption of vegetables among children. Further efforts to increase vegetable consumption during school lunch can increase children’s exposure and ability to become educated and to choose healthier food choices that can become lifelong habits, resulting in improvement in health.

References


5. Koushik A, Hunter DJ, Spiegelman D, Beeson WL, van den Brandt PA, Buring JE, Calle EE, Cho E, Fraser GE, Freudenheim JL, Fuch CS, Giovannucci EL,


11. Center for Disease Control. Can eating fruits and vegetables help people to manage their weight? Also Available from:


18. Venn AJ, Thomson RJ, Schmidt MD, Cleland VJ, Curry BA, Gennat HC, Dwyer T. Overweight and obesity from childhood to adulthood: A follow-up of


Table 4.1: Food items piloted during Canyon Colts Love Veggies Project and continued the following year on the district menu.

<table>
<thead>
<tr>
<th>Food Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkin Muffins</td>
</tr>
<tr>
<td>Popcorn Cauliflower</td>
</tr>
<tr>
<td>Corn Salsa</td>
</tr>
</tbody>
</table>
APPENDICES
Appendix A: Consent Forms
College of Agriculture
Department of Nutrition and Food Science
1600 Old Main Hill
Logan, UT 84322-8700
(435) 797-1806

Letter of Information
Plate Waste Study in Cache County, Utah

Introduction/Purpose: Dr. Heidi Wengreen in the Department of Nutrition and Food Sciences at Utah State University is conducting a research study to find out more about how to improve nutrition among elementary students. All second and fourth graders at Canyon Elementary, including your child, are invited to participate.

Procedures: If you agree to let your child participate and he/she also agrees to do so, the following will occur. Researchers will identify your child at the beginning of his/her lunch period and will take a digital photograph of his/her tray after they have made their lunch selections, and again just before they dump their tray after eating. The lunchroom assessments will take place twice during the school year, once during August or September of 2008 and once during March of April of 2009.

New Findings: During the course of this research study, you will be informed of any significant new findings (either good or bad). If new information is obtained that is relevant or useful to you, or if the procedures and/or methods change at any time throughout this study, you will be notified and given the opportunity to withdraw from the study.

Risks: The risks of your child participating in this research are minimal. There is a risk of others gaining access to personal information but this is unlikely because of the measures to protect you and your child’s confidentiality.

Benefits: Children will receive a pencil, stickers, or an eraser as an incentive to participate. There may or may not be any other direct benefit to you or your child from this research at this time. The researchers, however, may learn more about how to better market healthy food choices and nutrition education to children. This may lead to positive changes throughout the Cache County School District that help improve the nutrition status of many children.

Explanation & offer to answer questions: If you have other questions or concerns regarding this research, you may reach Elizabeth Strasser, graduate research assistant, by phone (801-699-2833) or email (elizstra@cc.usu.edu).

Voluntary nature of participation and right to withdraw without consequence: Participation of your child in this research is entirely voluntary. You may refuse to have your child participate in this study at anytime or you may withdraw them from this research without consequence or loss of benefits.

Confidentiality: Research records will be kept confidential, consistent with federal and state regulations. Only authorized School District personnel will have access to identifying data, which will be kept in a locked file cabinet in a locked room. Personal, identifiable information will be kept for no more than three years. After that time, it will be destroyed.
Letter of Information
Plate Waste Study in Cache County, Utah

IRB Approval Statement This research project has been reviewed by the Institutional Review Board for the protection of human participants at Utah State University and the Cache County School District. If you have any questions or concerns about your rights, you may contact the IRB at (435) 797-1821.

Investigator Statement “I certify that the information contained in this form is correct and that we have provided trained staff to explain the nature and purpose, possible risks and benefits associated with taking part in this study and to answer any questions that may arise.”

Heidi Wengreen, Ph.D.
Principle Investigator
(435) 797-1806
1600 Old Main Hill
Logan, UT 84322-8700
hwengreen@cc.usu.edu

Elizabeth Strasser
Student Researcher
(801) 699-2833
elizstra@cc.usu.edu

Signature of Parent/Guardian Your child will automatically be included in this study unless you wish to withdraw him or her. If you do not want your child to participate in this research for any reason, please check the box below, fill in your child’s name, sign where indicated, and return this form to Heidi Wengreen at the address listed above or to your child’s teacher.

☐☐ Please withdraw __________________ (your child’s name) from this research study.

____________________ __________________________
Parent/Guardian Signature Date
Canyon Colts Love Veggies Program
Student Pre-assessment

ID#: _______________________
Are you a boy or a girl? _____
How old are you? _____
What grade are you in? _____

Instructions: Please mark the choice that best describes you using the following scale:
(big smiley face) I strongly agree, (smiley face) agree, (blank face) neither agree nor disagree, (frowning face) disagree, (big frowning face) strongly disagree

<table>
<thead>
<tr>
<th>Statement</th>
<th>😊</th>
<th>😊😊</th>
<th>😊😊😊</th>
<th>😊😊😊😊</th>
<th>😊😊😊😊😊</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are lots of vegetables to eat at my home.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat vegetables with my lunch.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat vegetables with my dinner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat vegetables as snacks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables taste good plain, without anything added to them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My favorite way to eat vegetables is when they are raw.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>My favorite way to eat vegetables is when they are cooked.</td>
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<tr>
<td>I like to try new vegetables.</td>
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</tr>
<tr>
<td>I think vegetables are important to eat everyday.</td>
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<tr>
<td>I think I need to eat vegetables to be healthy.</td>
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</tbody>
</table>

What is your favorite vegetable to eat? ________________________________
The rest of the questions have to do with a specific vegetable. Please mark Yes, No, or I don't know if I've ever eaten them.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever eaten tomatoes?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>2. Have you ever eaten corn?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>3. Have you ever eaten peppers?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>4. Have you ever eaten cauliflower?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>5. Have you ever eaten broccoli?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>6. Have you ever eaten onions?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>7. Have you ever eaten parsnip?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
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<tr>
<td>8. Have you ever eaten cabbage?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>9. Have you ever eaten lettuce?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
<tr>
<td>10. Have you ever eaten rhubarb?</td>
<td>O Yes</td>
<td>O No</td>
<td>O I don't know</td>
</tr>
</tbody>
</table>
Canyon Colts Love Veggies Program
Student Post-assessment

ID#: _______________________

Are you a boy or a girl? _____

How old are you? _____

What grade are you in? _____

Instructions: Please mark the choice that best describes you using the following scale:
(big smiley face) I strongly agree, (smiley face) agree, (blank face) neither agree nor disagree, (frowning face) disagree, (big frowning face) strongly disagree

<table>
<thead>
<tr>
<th></th>
<th>😊</th>
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<tbody>
<tr>
<td>I like to eat vegetables.</td>
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<tr>
<td>I think vegetables taste good.</td>
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<tr>
<td>There are lots of vegetables to eat at my home.</td>
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<tr>
<td>I now eat more vegetables with my lunch.</td>
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<tr>
<td>I now eat more vegetables with my dinner.</td>
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<td></td>
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<tr>
<td>I eat vegetables as snacks.</td>
<td></td>
<td></td>
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<tr>
<td>Vegetables taste good plain, without anything added to them.</td>
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<tr>
<td>My favorite way to eat vegetables is when they are raw.</td>
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<tr>
<td>My favorite way to eat vegetables is when they are cooked.</td>
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<tr>
<td>I am more willing to try new vegetables.</td>
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<tr>
<td>I think vegetables are important to eat everyday.</td>
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<tr>
<td>I understand why it's important to eat vegetables to be healthy.</td>
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</tbody>
</table>

What new vegetable have you tried over the year? __________________________
Please turn the page over to answer more questions about vegetables.

Canyon Colts Love Veggies Program
Student Post-assessment

The rest of the questions have to do with a specific vegetable. Please mark Yes, No, or I don’t know if I’ve ever eaten them.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>I don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever eaten tomatoes?</td>
<td></td>
<td></td>
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<tr>
<td>2. Have you ever eaten corn?</td>
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<tr>
<td>3. Have you ever eaten peppers?</td>
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</tr>
<tr>
<td>4. Have you ever eaten cauliflower?</td>
<td></td>
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<td></td>
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<tr>
<td>5. Have you ever eaten broccoli?</td>
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<td>6. Have you ever eaten onions?</td>
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<td>10. Have you ever eaten rhubarb?</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Canyon Colts Love Veggies Program
Parent Evaluation

Name: _____________________________

Ethnicity: ___________________________

Child(s)
Name: ______________________________

Instructions: Please mark the choice that best describes you using the following value scale: (5) I strongly agree, (4) agree, (3) neither agree nor disagree, (2) disagree, (1) strongly disagree

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree or disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Vegetables are readily available in my home.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I eat more vegetables with my lunch.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I eat more vegetables with my dinner.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I eat vegetables as snacks.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Vegetables taste good plain, without anything added to them.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I like to try new vegetables.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>My child eats vegetables.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>My child likes to eat vegetables.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>My child eats more vegetables now compared to last year.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
I think vegetables are important to eat everyday.

How many cups of vegetables do you eat per week? ___________________________

Canyon Colts Love Veggies
Parent Evaluation

The rest of the questions have to do with a specific vegetable, and if you have had them in your home. Please mark Yes, No, or I don’t know if I’ve ever eaten them.

<table>
<thead>
<tr>
<th>1. Have you ever eaten tomatoes?</th>
<th>2. Have you ever eaten corn?</th>
</tr>
</thead>
<tbody>
<tr>
<td>O Yes</td>
<td>O Yes</td>
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<tr>
<td>O No</td>
<td>O No</td>
</tr>
<tr>
<td>O I don’t know</td>
<td>O I don’t know</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Have you ever eaten peppers?</th>
<th>4. Have you ever eaten cauliflower?</th>
</tr>
</thead>
<tbody>
<tr>
<td>O Yes</td>
<td>O Yes</td>
</tr>
<tr>
<td>O No</td>
<td>O No</td>
</tr>
<tr>
<td>O I don’t know</td>
<td>O I don’t know</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Have you ever eaten broccoli?</th>
<th>6. Have you ever eaten onions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>O Yes</td>
<td>O Yes</td>
</tr>
<tr>
<td>O No</td>
<td>O No</td>
</tr>
<tr>
<td>O I don’t know</td>
<td>O I don’t know</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. Have you ever eaten parsnip?</th>
<th>8. Have you ever eaten cabbage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>O Yes</td>
<td>O Yes</td>
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<tr>
<td>O No</td>
<td>O No</td>
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<tr>
<td>O I don’t know</td>
<td>O I don’t know</td>
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</tbody>
</table>

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<tbody>
<tr>
<td>O Yes</td>
<td>O Yes</td>
</tr>
<tr>
<td>O No</td>
<td>O No</td>
</tr>
<tr>
<td>O I don’t know</td>
<td>O I don’t know</td>
</tr>
</tbody>
</table>
Name: __________________________________________

Instructions: Please mark the choice that best describes you using the following value scale: (5) I strongly agree, (4) agree, (3) neither agree nor disagree, (2) disagree, (1) strongly disagree

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
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<th>Neither agree or disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat vegetables.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I think vegetables taste good.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>There are lots of vegetables to eat at my home.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I eat more vegetables with my lunch.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I taught the children about the vegetable of the month.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I like to try new vegetables.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>The Canyon Colts Love Veggies program has helped me eat more vegetables more often.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I encourage students to eat vegetables at lunch.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>The children enjoyed the vegetable Intervention.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>The Canyon Colts Love Veggies program should continue next year.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I thought the program was beneficial for the children.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Canyon students now seem more willing to try new vegetable.

1. Did you use any of the Viva Vegetables! Resources in your classroom?
   o Yes
   o No

2. If, yes how often did you use the Viva Vegetable! Resources in your classroom?
   o Once per year
   o 1 per month
   o 2-3 times per month
   o 1 per week
   o more than 1 per week
Kitchen Staff Evaluation

1. In what ways do you think the Canyon Colts Love Veggie Program was a success?

2. Do you think Canyon students eat more vegetables now compared to the amount they ate at lunch before the Canyon Colts Love Veggies Program was introduced?

3. In what ways would you improve the program to make it more successful for the school?

4. What are your feelings about the program as a whole, as someone in the kitchen who is in charge of preparing the food for the kids?

5. If any, in what ways did the program helped promote vegetables and increase the student’s vegetable intake over the past school year?
Appendix C: Nutrition Education Lesson outlines
Classroom attendance, attention, and achievement improve when students eat a healthy diet. The *How to teach about vegetables* resource focuses on one locally grown vegetable each month. Use this resource to encourage your students to develop healthy habits that include eating more vegetables, more often.

20-minute lesson on the vegetable of the month (suggested teaching day and time: the first Monday of September, before lunch.) Corn will be featured in the lunch menus each day during the first week of September.

Objectives:
1. Students will understand why corn, like all vegetables is healthy for them to eat.
2. Students will discover different ways to eat and prepare corn.

Materials
- Word Scramble for each child
- Picture of Corn to explain the different parts of corn.

Introduction activity: Guessing Game

Time: 5 minutes

Read the following clues one at a time. Have the children raise their hand once they know what vegetable you are describing. Call on someone to name the vegetable after all the clues have been read.

1. I am the number one field crop grown in America.
2. I am a good source of starch.
3. I have tightly wrapped leaves called husks.
4. I can be used for many different things besides food, such as fuel, and a sweetener.
5. I am also called maize.
6. I am a good source of vitamin C.
7. I have lots of kernels that can be popped into a tasty treat.
8. I am multicolored but most people eat me when I am yellow.
Objective 1: Students will understand why corn, like all vegetables is healthy for them to eat.

Time: 5 minutes

Corn has been an important nutritional resource for people all over the world for thousands of years. Corn is a good source of food energy. Maize or corn is rich in starch, starches are good for you because they have very little fat, saturated fat, or cholesterol. Corn is also packed with vitamins especially B-vitamins, minerals, and fiber.

Objective 2: Students will discover different ways to eat and prepare corn.

Time: 5 minutes

Build a chart that displays the class’s favorite ways to eat corn. Invite children to share ways they have tasted corn. Write the children’s ideas on the chalkboard.

Suggest other ways not mentioned: corn bread, polenta (they eat this lot in Italy and other European countries), corn salsa, etc.

Activity: Corn Word Scramble

Time: 5 minutes

Pass out Corn Word Scramble to students. The Words are different corn parts or products that have corn in them.

Conclusion

While the children are working on their word scramble, explain to them that corn will be the vegetable of the month, and have them look for different ways to eat corn at home, and in the lunchroom.

Additional Resources for Corn

Nutrition Resources:
http://teamnutrition.usda.gov/educators.html
www.eatright.org
www.mypyramid.gov
www.fruitsandveggiesmorematters.org (formerly www.5aday.org)
www.fruitsandveggiesmatter.gov (formerly www.5aday.gov)

Elementary Education:
www.lessonplanet.com/vegetables
www.learningisfun.com
www.educationworld.com
www.theteacherscorner.net
Reading/History:
www.ksgrains.com
www.ncga.com
www.campsilos.org

Curriculum Ideas

Problem solving
Use both the kernels and the cobs in math equations, fractions and to demonstrate multiplication tables.  
For example:  
Easier Problem Solving
There are 20 kernels on each row of corn, a cob of corn has 10 rows. How many kernels of corn on each cob?

More Difficult Problem Solving
According to the United States Department of Agriculture, the average American consumes about 1/2 lbs of corn product each day.

- At this rate, how many pounds of corn will your family eat in one month?
- How many pounds of corn will your entire class eat in one month?
- How many cups are in total number of pounds of corn eaten by the class in one month?

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www.campsilos.org

History
Trace the history of the corn back to its origins in ancient Mesoamerica. Have students research the native populations that cultivated corn and how they used them (e.g., for food, medicine, religion). Assign groups of students with a region in North, Central or South America and have each group do a presentation.

Creative Writing
Use “corn” in a poetry assignment or for a discussion on literary elements such as alliteration, rhyming, onomatopoeia, similes and metaphors.

Science
There are more than two hundred varieties of corn, many are different colors. The peak season for fresh corn is May through September.
Typical corn plants develop 20 to 21 total leaves, silk about 65 days after emergence, and mature around 125 days after emergence. The part of corn that we eat is called kernels, or seeds, and they are found on the ear or cob. It is protected by a husk, or covering, of tightly wrapped leaves. Display a picture and point out different parts including: ear or cob, kernels, husk, roots, silk, stalk, tassel.
http://weedsoft.unl.edu/documents/GrowthStagesModule/Corn/Corn.htm
www.ncga.com
Visit a local corn grower in the area.
Geography
Iowa is the number one corn farming state in the country. About 90 percent of Iowa’s land is dedicated to farming. The state grows corn in great quantities. Much of its economy is based on the production of corn and corn byproducts -- popcorn, corn oil, corn syrup, cornmeal, cornstarch, and animal feed. Have students explore Iowa’s geography to learn why it is able to grow a diverse variety corn. Topics to study may include:

- State and regional climates
- Land features and general topography
- Annual and monthly precipitation
- Types of soil

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Corn Word Scramble

Unscramble the words below to discover more about corn.

ksuhs _ u _ _ - The name for the leaves that are wrapped around the corn

misnagit B _ _ t _ m _ _ - Corn is a good source of these

berdanorc c _ _ _ r _ _ _ - This makes a delicious side dish to a BBQ

ron sekalf _ _ _ n f _ a _ _ _ - You can eat these for breakfast

lrke ne k _ _ _ l - The name of a corn’s seed

golansie g _ _ o _ _ _ - Corn can also be used for fuel in your car
Corn Word Scramble Answer Sheet
Husks
B-vitamins
Cornbread
Corn flakes
Kernel
gasoline
The goal of *A Tasty Little Vegetable* lesson is to give children an opportunity to taste cauliflower. Some may think they don’t like cauliflower because they have never tasted it. By tasting cauliflower, they can broaden their taste experience and think about eating cauliflower in different ways. If children realize that cauliflower can taste different or have special appeal depending on how it is prepared, they may be more inclined to taste it!

**Objectives:**
1. Children will use positive adjectives to describe the taste of cauliflower.
2. Children will understand how to incorporate cauliflower into mealtimes.
3. Children will make and eat a simple, nutritious snack using cauliflower.

**Total Time:** 25 minutes

**Materials**
- 4-oz. cups (1 per child)
- Tape
- Copies of “Cauliflower Popcorn” snack label sheet to tape around the snack cups (1 label per cup) if serving cauliflower popcorn for the snack. There are six copies of the labels per sheet.
- Copies of “Veggie Tasters Award” sheet (1 per child). There are two awards per sheet. You may want to sign the awards before you make copies.
- Enough cauliflower for each activity. Cauliflower will be used three different times: pre-activity, food demo, and snack. One head of cauliflower will likely provide about 24 florets
- Ingredients for the recipe in classroom size-adjusted amounts (recipe attached, “Cauliflower Popcorn” or “Sesame Salt”)
- Props for the main activity: camcorder (can be brought from home and does not need to work) and other props you may have that are applicable to the activity.

**Preparation Required**
- Begin preparing the cauliflower popcorn for the snack one hour before the snack is to be served. Be sure that someone is available to turn the cauliflower throughout the cooking time.
• Cut up 1-3 heads of cauliflower for the pre-activity. Be sure to have enough cauliflower so that each child may have one floret. One head of cauliflower will likely provide 24 florets of cauliflower.
• Cut out “Cauliflower Popcorn” labels and tape on small plastic cups if serving cauliflower popcorn.
• Cut “Veggie Tasters Award” sheet into single awards and sign them if you haven’t already.
• Gather ingredients for food demo and set up for demonstration. Note: **Will not be cooking the cauliflower popcorn prepared during the food demo. This is a simple demonstration to show how the snack is prepared so the children can take this idea home.**
INTRODUCTION: Word challenge
Time: ~2 minutes
- Write the word “cauliflower” on the board.
- Ask the children to make as many words as they can out of the word “cauliflower” in 30 seconds. Have them raise their hands when they want to share a word. Words may include:
  - Flow  
  - Flower  
  - Cow  
  - Life  
  - Low  
  - Role
- Tell the children you will be talking about cauliflower today.

OBJECTIVE 1: Children will use positive adjectives to describe the taste of cauliflower.
Activity: Taste-testing
Time: ~5 minutes
- Gather the children for the pre-activity and food demo and give each child a floret of cauliflower. Let the children eat their cauliflower floret and invite them to discuss how the cauliflower tastes and feels in their mouth.
- Ask the children the following questions:
  - How does it feel in your mouth? Spongy, etc.
  - It is crunchy or soft? Crunchy, etc.
  - What do you think it would feel and taste like in your mouth if it was cooked? Soft, savory, etc.
  - What if it was roasted in the oven? Sweeter, etc.
  - Is it juicy?
  - Does it taste like something you have tasted before? Milky, nutty, etc.

OBJECTIVE 2: Children will make and eat a simple, nutritious snack using cauliflower.
OBJECTIVE 3: Children will understand how to incorporate cauliflower into mealtimes.
Activity: Food demonstration and meal discussion
Time: ~5 minutes
There are two options for this instructional section:
1. Prepare the cauliflower up to step 3 of the recipe. Once the cauliflower is coated you may spread it onto a cookie sheet or, to avoid a mess, just have a cookie sheet to show the children and explain how it is used to roast the cauliflower.
2. Bring all the ingredients of the recipe but don’t actually put it together. Discuss the steps of the recipe with the children.

If it is easier to make the sesame salt for dipping, demonstrate that instead.

After the food demo, ask the children if they have tasted cauliflower and in what ways. Answers may include:
- In soups or salads
- Raw or dipped in a tangy sauce
- Steamed and sprinkled with salt and pepper
- Roasted into “cauliflower popcorn”

Viva Vegetables: A Tasty Little Vegetable
Cauliflower
3 | Page
Activity: Commercial
Time: 15 minutes
- Distribute the snack to the children and explain the activity while they eat.
  - The children will pretend they are chefs of a popular restaurant that serves cauliflower.
  - These chefs will make a short commercial or cooking show about the cauliflower snack they tasted to try to get people to come to their restaurant.
  - They should include descriptive words and other ways to eat cauliflower.
  - All children in the group should have some part in the commercial/show.
- Divide the children into groups with 4-5 children in each group. If a larger group of students are present, you may want to include more children per group. Give each group a prop.
- Give the children approximately 5-8 minutes to prepare their commercial/show. If available, use the camcorder as a prop to pretend-record their commercial. The commercial/show does not need to be longer than 1-2 minutes. Have the children present their commercial/show to the other students.

Conclusion: Summary and Regroup
Time: 2 minutes
- Ask the children what they learned about cauliflower that is new to them.
- What way do they want to try cauliflower at home?
- Thank the children for participating.
- Distribute tasting certificates.
Cauliflower Popcorn

1 head cauliflower or equal amount of pre-cut commercially prepared cauliflower
1 tablespoons olive oil
1 teaspoon salt to taste

1. Preheat oven to 425°.
2. Trim the head of cauliflower, discarding the core and thick stems; cut florets into pieces about the size of ping-pong balls.
3. In a large bowl, combine the olive oil and salt, whisk, then add the cauliflower pieces and toss thoroughly.
4. Line a baking sheet with parchment for easy cleanup (you can skip that if you don’t have any) then spread the cauliflower pieces on the sheet and roast for 15 minutes, turning 3 or 4 times, until most of each piece has turned golden brown. The browner the cauliflower pieces turn, the sweeter they’ll taste. Be careful not to burn it.

Sesame Salt

4 tablespoons sesame seeds
2 teaspoons salt

Toast sesame seeds lightly in a dry skillet or in a toaster oven. Add salt and lightly grind together in a small mill, blender, food processor, or mortar and pestle.

Add to salads, vegetables, soups, or stir fry.
VEGGIE TASTERS AWARD

This certificate is awarded to YOU
For tasting and learning about cauliflower.

______________________________  ___________
Teacher Signature             Date

VEGGIE TASTERS AWARD

This certificate is awarded to YOU
For tasting and learning about cauliflower.

______________________________  ___________
Teacher Signature             Date
Exploring Vegetables with the Senses

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A Utah State University Extension and Nutrition and Food Sciences Department campaign

The goal of the Exploring Vegetables with the Senses lesson is to help children use ALL of their senses to experience cauliflower. If they build a more involved, sensory relationship with cauliflower and associate positive things with cauliflower, then they may acquire a more positive attitude about eating cauliflower!

Objectives:
1. Children will understand how cauliflower relates to four of their five senses (taste is a separate lesson):
   a. How does cauliflower feel?
   b. How does cauliflower sound?
   c. How does cauliflower smell?
   d. What does cauliflower look like?
2. Children will connect sensory experiences to what they already know:
   a. Does the feel of the cauliflower remind them of something?
   b. Does the sound of the cauliflower remind them of something?
   c. Does the smell of the cauliflower remind them of something?
   d. Does the shape or color of the cauliflower remind them of something?
3. Children will understand that eating cauliflower is an experience that can involve all of the senses.

Total Time: 25 minutes

Materials
- “Mystery bucket” (5 gal ice cream bucket w/hole in lid with tube sock attached)
- Raw cauliflower head (1)
- Raw cauliflower cut in pieces, enough for one piece per child
- Cooked cauliflower cut in pieces, enough for one piece per child
- Drawing pad (11 X 14 medium weight—use like flipchart)
- Black marker
- Napkins & wet wipes
- Lyrics to children’s rhymes (attached)
**Preparation Required**

- Create Mystery Bucket by cutting a hole in the lid of a 5 gallon ice cream bucket and attaching a tube sock in the hole so that children can feel inside the bucket without seeing inside of it
- Put a head of cauliflower in bucket prior to class
- Cook enough cauliflower for each child to have 1-2 florets, cook no longer than 5 minutes so it is not too soft or emitting an off-smell
- Make copies of songs, attached, one per group
## LESSON PLAN

### Introduction: “Mystery Bucket”
**Time:** 5 minutes

Tell the kids that they have a mystery to solve. Let them know that they are going to pretend to be detectives to find out what vegetable they will learn about today.

- Ask them what the 5 senses are and write out the 5 senses (sight, touch, smell, hear, taste)
- Reiterate the senses by telling them they need to use their eyes to see, nose to smell, ears to listen and hands to touch.
- Pull out the “mystery bucket” and have them feel in the bucket to find out what the surprise vegetable is.
- Direct the students to keep it a secret to themselves until everyone has had a chance to guess and while they are feeling it, have them describe what they feel.
- After everyone has felt the cauliflower, commend the students for their guesses and then pull out the cauliflower. Ask if anyone thought it was something different and why.

### Objective 1: Children will understand how cauliflower relates to four of their five senses (taste is a separate lesson):

- **a. How does cauliflower feel?**
- **b. How does cauliflower sound?**
- **c. How does cauliflower smell?**
- **d. What does cauliflower look like?**

#### Activity: Writing out sensory words
**Time:** 5-10 minutes

- Display the cauliflower from the bucket and the pieces of raw and cooked cauliflower.
- Give each child a piece of both cooked and raw cauliflower.
- Have the children describe the cauliflower. Write their descriptive words on the board or drawing pad to refer to later. Worksheet is provided for older children to use during this lesson.
  - **FEEL**
    - Have them rub it on the side of their cheek or back of hand
    - Rough, smooth, soft, hard, fuzzy, etc
  - **LOOK**
    - What if it was a different color
    - What if it was really big
    - How is the stem different than the top
    - Color, shape, texture, size
  - **SMELL**
    - Avoid negative words like “stinky”
  - **SOUND**
    - Rub fingers over head of broccoli and hear how it sounds

### Objective 2: Children will connect sensory experiences to what they already know:

- **a. Does the feel of the cauliflower remind them of something?**
- **b. Does the sound of the cauliflower remind them of something?**
- **c. Does the smell of the cauliflower remind them of something?**

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*Viva Vegetables: Exploring Vegetables with the Senses
Cauliflower*
d. *Does the shape or color of the cauliflower remind them of something?*

**Activity:** Verbal comparison  
**Time:** 3 minutes

To help children internalize the concepts of what they learned about cauliflower while using their senses, compare cauliflower to similar items (these are ideas, can use others from previous descriptions)

- White like _______(snow)______.
- Round like _______(rock)______.
- Bumpy like _______(carpet)______.

**Objective 3: Children will understand that eating cauliflower is an experience that can involve all of the senses.**

**Activity:** Cauliflower Sensory Song  
**Time:** 15 minutes

- Split the main group into groups so there are about 4-5 children in each group.
- Have each group make up a song about cauliflower choosing a song from the attached list and changing the words but using the same tune. They should use the words and comparisons from the previous descriptions about the cauliflower. If it is easier, you may want to assign each group a specific song.
- Give each group about 10 minutes to make up their song; have one person in each group write it down on a piece of paper.
- Have each group perform their song for the class.

**Conclusion: Regroup and Summary**  
**Time:** 3 minutes

- Regroup and have each child tell one new word they can use to describe cauliflower.
- End by saying: Next time you see cauliflower in the store, in the lunch line, or at home on the table, remember cauliflower is not an ordinary vegetable, but can be fun to eat.
“Mary Had a Little Lamb”
Mary had a little lamb,
Little lamb, little lamb,
Mary had a little lamb,
Its fleece was white as snow
And everywhere that Mary went,
Mary went, Mary went,
 Everywhere that Mary went
The lamb was sure to go

“Yankee Doodle Dandy”
Yankee Doodle went to town
A-riding on a pony
Stuck a feather in his hat
And called it macaroni.
Yankee Doodle, keep it up
Yankee Doodle dandy
Mind the music and the step
And with the girls be handy.

There was Captain Washington
Upon a slapping stallion
A-giving orders to his men
I guess there was a million.
Yankee Doodle, keep it up
Yankee Doodle dandy
Mind the music and the step
And with the girls be handy.

“Old Macdonald Had a Farm”
Old Macdonald had a farm, E-I-E-I-O
And on his farm he had a cow, E-I-E-I-O
With a "moo-moo" here and a "moo-moo" there
Here a "moo" there a "moo"
Everywhere a "moo-moo"
Old Macdonald had a farm, E-I-E-I-O

Old Macdonald had a farm, E-I-E-I-O
And on his farm he had a pig, E-I-E-I-O
With a (snort) here and a (snort) there
Here a (snort) there a (snort)
Everywhere a (snort-snort)
With a "moo-moo" here and a "moo-moo" there
Here a "moo" there a "moo"
Everywhere a "moo-moo"
Old Macdonald had a farm, E-I-E-I-O

Old Macdonald had a farm, E-I-E-I-O
And on his farm he had a horse, E-I-E-I-O
With a "neigh, neigh" here and a "neigh, neigh" there
Here a "neigh" there a "neigh"
Everywhere a "neigh-neigh"
With a (snort) here and a (snort) there
Here a (snort) there a (snort)
Everywhere a (snort-snort)
With a "moo-moo" here and a "moo-moo" there
Here a "moo" there a "moo"
Everywhere a "moo-moo"
Old Macdonald had a farm, E-I-E-I-O

“On Top of Spaghetti”
On top of Spaghetti, all covered with cheese,
I lost my poor meatball when somebody sneezed.
It rolled off the table, and onto the floor,
And then my poor meatball rolled out of the door.
It rolled down the garden, and under a bush,
And then my poor meatball was nothing but mush!
The mush was as tasty, as tasty could be,
And then the next summer it grew into a tree.
The tree was all covered, all covered with moss,
And on it grew meatballs, all covered with sauce.

So if you have spaghetti, all covered with cheese,
Hold onto your meatball, 'cause someone might sneeze.

"Twinkle, Twinkle, Little Star"
Twinkle, twinkle, little star,
How I wonder what you are.
Up above the world so high,
Like a diamond in the sky.
Twinkle, twinkle, little star,
How I wonder what you are!

When the blazing sun is gone,
When he nothing shines upon,
Then you show your little light,
Twinkle, twinkle, all the night.
Twinkle, twinkle, little star,
How I wonder what you are!

Then the traveler in the dark
Thanks you for your tiny spark;
He could not see which way to go,
If you did not twinkle so.
Twinkle, twinkle, little star,
How I wonder what you are!

In the dark blue sky you keep,
While you thru my window peep,
And you never shut your eye,
Till the sun is in the sky.
Twinkle, twinkle, little star,
How I wonder what you are!

"Three Blind Mice"
Three blind mice,
Three blind mice
See how they run,
See how they run!

They all ran after
The farmer's wife
She cut off their tails
With a carving knife
Did you ever see
Such a sight in your life
As three blind mice
EXPLORING CAULIFLOWER WITH THE SENSES

Use your senses to interact with the raw and cooked cauliflower.

Write descriptive words about both the Row and Cooked cauliflower on the lines below.

_Example:_

Cauliflower is **white** like **snow**.

Cauliflower sounds **snappy** like **a branch breaking**.

---

**RAW**

Cauliflower feels ___________ like ___________.

Cauliflower smells ___________ like ___________.

Cauliflower sounds ___________ like ___________.

Cauliflower looks ___________ like ___________.

---

**COOKED**

Cauliflower feels ___________ like ___________.

Cauliflower smells ___________ like ___________.

Cauliflower sounds ___________ like ___________.

Cauliflower looks ___________ like ___________.

_Do you like cooked or raw cauliflower better?_

_Why do you like it better?_
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The goal of the How it Grows lesson is to help children understand how cauliflower gets from the garden to their plate. If they have an idea of where cauliflower comes from, they may gain an interest in or appreciation of what it takes for it to get to the store or market. This may encourage children to taste cauliflower.

Objectives:
1. Children will understand one reason cauliflower is healthy for them to eat.
2. Children will understand what part of the plant the cauliflower is (root, stem, leaf, flower, fruit, or seed).
3. Children will understand the story of cauliflower from the garden to their plate (including stages of growth of cauliflower).

Total Time: 25 minutes

Materials
- Coloring supplies
- Paper, one piece per child
- Poster of plant parts, attached
- Pictures of cauliflower from seed to flower, attached

Preparation Required
- Make copies of pictures to show children
- Read over lesson to be able to explain how cauliflower grows
- Gather coloring supplies and paper for activity
**LESSON PLAN**

**Introduction: Clue Game**

Time: 5 minutes

Read these clues aloud and have the children guess what vegetable it is. Have the children raise their hands when they think they know it, whether it’s the first clue or the last. Stop when all children have their hands raised.

1. It takes 55-60 days for me to grow from seed to harvest.
2. I am from the Brassica family.
3. I am related to the cabbage.
4. I am white.
5. I have big green leaves.
6. Broccoli is my cousin.
7. Farmers sometimes call me a curd when I am in the field.
8. My name starts with C.

Comment children for their guesses and explain that you are going to be talking about how cauliflower grows.

**Objective 1: Children will understand one reason cauliflower is healthy for them to eat.**

Activity: Nutritional fact discussion

Time: 2-3 minutes

Ask the class why cauliflower is good for them. Commend the students for their guesses. After children have made a few guesses, explain that cauliflower (also) has something called folate:

- Ask class if anyone knows what folate does.
- Explain that there is a secret code called DNA that makes your body work. Folate helps make the secret code so that your body can grow. If you didn’t eat cauliflower, or folate, or other vegetables that have folate your body would stay the same size.
  - Ask the children for a good way to remember that cauliflower has folate.
  - Have a child explain what folate does in their own words.

**Objective 2: Children will understand what part of the plant the cauliflower is (root, stem, leaf, flower, fruit, or seed).**

Activity: Identification of cauliflower on the plant parts poster

Time: 3-4 minutes

Explain that all vegetables are edible parts of a plant

- Show poster of plant parts and have a volunteer child point to the part of the plant of which he/she thinks cauliflower is.
- Have the child explain why they chose that part of the plant.
- The answer would be that cauliflower is the flower part of the plant.

**Objective 3: Children will understand the story of cauliflower from the garden to their plate (including stages of growth of cauliflower).**

Activity: A drawing of the children harvesting cauliflower

Time: 10 minutes
• Show pictures of a cauliflower plant from start to finish (at the end of the lesson plan). Explain that the cauliflower head is covered by very large green leaves. By covering the cauliflower with the leaves, it stays white.
• Ask the children how they think large fields of cauliflower are harvested and taken to stores.
• Explain that cauliflower is harvested by hand, so men and women cut the cauliflower heads off of the plants.
• The workers then put the cauliflower on a machine that is in the field with them. The machine cools the cauliflower and packs it in bins and boxes for transport.
• Have the children draw a picture of themselves helping to harvest cauliflower.

Conclusion: **Regroup and Summary**

**Time: 2 minutes**

Regroup and have each child go around in a circle telling one new thing they learned about how cauliflower grows. Tell them that they can’t repeat something that anyone else has said. When they have gone around the circle once remind them of how cauliflower grows and thank them for participating.
Cauliflower is cut off the plant by hand and then placed on machines in the field that cool the cauliflower and pack it into bins and boxes so it is ready for washing and packing.
These pictures show cauliflower seedlings, or baby cauliflower plants.

These bottom pictures show cauliflower being covered from the sun so it stays white. Some cauliflower plants do it themselves and others require people to tie the leaves together.
PARTS OF A PLANT
PARTES de una PLANTA
(English/Spanish words are provided.)

Blossom/Flor

Fruit/Fruta

Leaf/Hoja

Stem (Stalk)/Tallo

Roots/Raíces