

Exploratory Study of Participants

Farm to Table:

A Pathway to Fresh Fruits and Vegetables

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Abstract

The lack of fresh local food production impacts our diet and health. The obesity epidemic indicates that our national food system may not adequately address human health needs. Empowering youth with the knowledge of home food production and consumption is one step to enable them to develop good decision making skills that could help improve health outcomes overtime.

This project report illustrates the creation and implementation of a Farm to Table 4-H youth development program. The overall goal of this program was to introduce youth participants to the way food can be produced and consumed from farm to table using local resources and services. By doing so youth learn how the Virginia agriculture system works and how they can produce and consume fresh, nutritious food safely. The activities within this program have been developed specifically to allow youth hands-on learning experiences while supporting in-class work. Teachers participating in this program have been empowered to change their approach to classroom lessons and instill positive change in youth.

The Virginia Cooperative Extension (VCE) Master Gardeners are adult volunteers specializing in all aspects of horticulture and they volunteer their time to serve the local community, offering communication, education and fellowship. The Master Gardeners can be valuable program partners in the Farm to Table Program. The Farm to Table program, a program designed to emphasize the importance of growing and eating fresh, local foods is designed to be replicated in any school division from rural or urban areas. Given the opportunity, this program can become an integrated part of the spring school year.

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Chapter 1: Introduction

The Farm to Table movement is gaining traction around the country, and it has far reaching effects on the lives of our youth (USDA, 2012). The Farm to Table philosophy embraces a sustainable approach to agriculture and consumption. At its heart, the concept is simple: there is value in eating locally. Rather than purchasing produce at a supermarket, a family that participates in the farm to table lifestyle is likely to have visited the land where the produce has been grown.

The 4-H Farm to Table program draws from this movement and educational theories to support its implementation in many ways. First, developed to utilize an “experiential” approach, participants have the opportunity to gain experience gardening and preparing fresh, locally produced foods. Educators such as Jean Piaget and John Dewey advocated for experiential learning. Piaget believed that hands-on learning and direct student involvement is directly tied to intellectual development (Haury & Rillero, 1994). Using an experiential learning approach in the 4-H Farm to Table program created an opportunity for youth to become involved in Virginia agriculture and learn more about the value of eating locally grown food.

Lynchburg Grows, a private non-profit organization, welcomed the opportunity to work collaboratively with Virginia Cooperative Extension during the program. Lynchburg Grows is an urban farm that takes an experiential approach to teaching others how sustainable food production promotes a healthy lifestyle and a healthy planet. The program consisted of a guided tour of active greenhouse production and outdoor garden sites and provided teaching space for participants to practice experiential learning. The tour focused on showing how fruits and vegetables are produced. Showing participants how food is produced and harvested is crucial to the educational value of this program and to create a positive perception around the use of fresh

foods. With the understanding that “today’s youth will soon make up the main market for food consumption and knowledge of their own eating peculiarities within 5-10 years” (Lalji, 2010, p.2), it is vital that they take an active role in food identification and increasing their knowledge in food and food systems. This allows the opportunity for educated and healthier decision making once they reach adulthood.

It is imperative that youth not only take a more active role in food production, but also healthy food selection. Virginia Cooperative Extension has several educational tools in place that addresses healthy foods. The 4-H Farm to Table program, however, aims to complement and reinforce those programs that address the most pressing needs of our youth.

Statement of the Problem

Statistics from the Centers for Disease Control (CDC) revealed that in 2009 only 9.5% of youth consumed the daily-recommended allowance of fruits and vegetables (CDC, 2009). Consuming an adequate intake of fruits and vegetables has been proposed as one way to reduce morbidity and mortality from heart disease and cancer (American Cancer Society, 1996; Deckelbaum et al., 1999; Ness, 1997). Fruits and vegetables contain several essential nutrients, such as vitamin C and folate, and other dietary factors, such as fiber and flavonoids, which have been linked to the prevention of various cancers and other chronic illnesses. In addition, obesity levels are lowest among those who have high intakes of fruits and vegetables (Produce for Better Health Foundation, 2001). According to the Center for Disease Control (CDC), and a National Health and Nutrition Examination Survey (NHANES), the rates of childhood obesity for children ages 6 to 11 has nearly tripled from 6.5% to 17% since 1980, and for children ages 12 to 19, it has more than tripled from 5% to 17.6% (see Figure 1). Childhood obesity carries both physical and psychosocial risks, including the early onset of adult diseases such as type II diabetes and

cardiovascular disease, asthma, sleep disturbance, joint and bone disorders, social rejection, and low self-esteem (Dehghan, Akhtar-Danesh, & Merchant, 2005). Additionally, overweight children are at considerably higher risk of becoming overweight or obese adults (Serdula, Ivery-, Coates-, Freedman-, Williamson, & Byers, 1993) leading them to potentially become part of the 5.7% of adult Virginians who spent more than \$1.6 billion on obesity-related medical expenses from 1998-2000 (CDC, 2010).

Figure 1: Overweight children and adolescents ages 6-19 years, for selected years 1971-2004

<i>Age (years)</i>	<i>NHANES 1971-74</i>	<i>NHANES 1976-80</i>	<i>NHANES 1988-94</i>	<i>NHANES 1999-2000</i>	<i>NHANES 2001-02</i>	<i>NHANES 2003-04</i>
12-19	6.1%	5%	10.5%	14.8%	16.7%	17.4%

NHANES data on the Prevalence of Overweight among Children and Adolescents

It has been suggested that if “the 4-H program wants to be a force in the future, it needs to be progressive and adaptive to new trends and ideas, reaching youth from all cultures, races, ethnic groups and income levels.” (Van Horn, Flanagan, & Thomson, 1999, p.1). New programs such as the VCE Farm to Table program can assist communities throughout the state by drawing upon the experience of local Extension agents. The VCE Farm to Table program embodies the Virginia Cooperative Extension mission (VCE, 2012) of improving people’s lives at a community level through an educational process that uses scientific knowledge focused on issues and needs such as youth obesity.

Program Limitations

Being a pilot program, there were several limitations. None of them were major and with a little further planning could have been overcome with ease. First, funding the program would be made easier by seeking in-kind donations of facility usage and produce from local producers.

The facilities at Lynchburg Grows provided an excellent environment for the event, as would a farmers market, a commercial orchard, or a packing facility. It is very easy to attempt to accomplish too much during a single day event. Time management is a vital aspect of any program such as this and you do not want to overwhelm participants for the sake of getting information in.

The development of the evaluation is a process that will take time as gathering of the right information is sought more than the gathering of mass information. By conducting more oral interviews with the participants, substantial information can be collected as youth tend to rush through written evaluation processes. By doing the same with teachers/instructors, input gathered from their evaluations will allow for a new evaluation format to be developed that seeks more specific questions and input.

Additional limitations of this program were the available time and acceptance by the local school system. School field trips often take months of planning to gain approval from local administration as well as coordinating the transportation. Costs associated with this program are also a limiting factor for some schools. To address this, the 4-H Farm to Table program was designed to be at a minimal cost to the school. In addition, the proposal for the trip was handled by the teachers and presented to school administration with examples of what students would be learning and a cost breakdown analysis of what it would cost. Once administration approved the program, it was implemented.

Significance

The 4-H Farm to Table program was designed to provide youth with hands-on experiences and to be a part of food production and consumption with a specific emphasis on container gardening and nutrition education. Allowing youth to become an active learner outside

the classroom, students conducted agricultural and nutrition-based activities as part of their learning. Experiential learning allows students to be part of the learning process and in this process they become active participants instead of passive learners. Because they are actively involved, their work becomes personally meaningful (Haury & Rillero, 1994). It allows the learner to engage in in-depth investigations with objects, materials, phenomena, and ideas and draw meaning and understanding from those experiences (Haury & Rillero, 1994). American teacher and philosopher John Dewey believed that education worked best when it started within a child's own experience (Raffan, 2000).

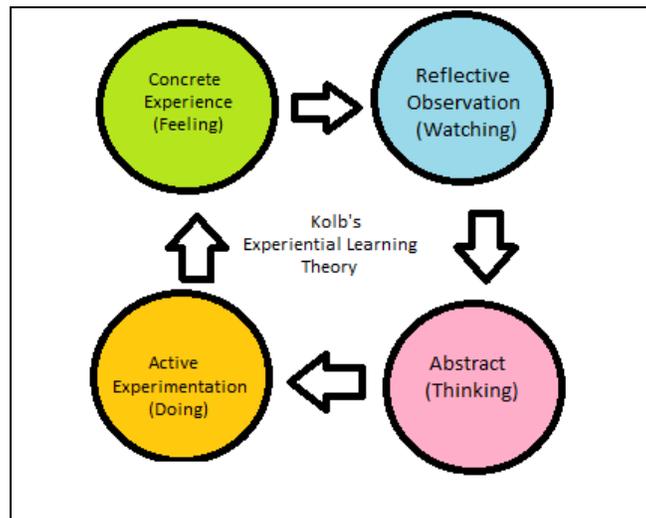
This program was significant in that it provided youth with an opportunity to first-hand experience agricultural processes from farm to table. Virginia Cooperative Extension developed educational programs such as *Healthy Weights for Healthy Kids* as a tool for Extension agents to deliver nutrition awareness to communities they serve (Serrano, 2009). The 4-H Farm to Table program draws upon these and other resources to introduce the youth to the connections between food eating decisions and agriculture, and specifically Virginia agriculture. Youth that learn the nutritional benefits of healthy eating may also influence maintaining healthy lifestyles through adulthood.

Second, the Farm to Table programming efforts helped reveal important connections with Virginia agriculture. For example, the youth took note that they were a very valuable part of food production. Empowering the youth to make healthier decisions through gaining knowledge of how food is produced is not easy in the classroom as time and available instruction tools are not always available. The 4-H Farm to Table program, however, guided participants through several stages of food production ending with consumption. The on-site visit to a food production area specifically helped reinforce what had been learned in the classroom. These

participants now have better opportunities to help make well-informed suggestions for family food buying and eating decisions.

Third, program such as the 4-H Farm to Table has a unique opportunity to merge classroom exercises and instruction with practical experiences. American educational theorist David A. Kolb believes “learning is the process whereby knowledge is created through the transformation of experience” (1984, p.38). Kolb’s experiential learning cycle consist of four stages and can begin at any of them (see Figure 2). This process helps participants to complete Kolb’s learning cycle. Participants will “DO” by participating in the event, “REFLECT” on the activities preformed, “THINK” about their experiences, and “PLAN” how they can implement them in their daily lives.

Figure 2: Kolb’s Experiential Learning Cycle



Project Objectives

The purpose of this project was to develop an experiential learning program with the specific aim of providing youth the opportunity to have a hands-on experience, including reflection and application, in food production while also learning aspects of food nutrition

education. Specifically, 4-H Farm to Table program enabled participants to experience many facets of agriculture production and nutrition education, emphasizing the importance of fresh fruits and vegetables, local foods, soil composition, container gardening, and related lifestyle change. Based on this overall goal, the following questions provided the groundwork to frame learning objectives and curriculum activities:

- Increase the number of youth learning about the food production process.
- Improve students' perceptions about agriculture.
- Increase the knowledge gained by participants in the areas of soil composition, seed germination, building compost, and nutrition.
- Enhance local educator's ability to integrate farm-to-table concepts and activities into science curriculum.

Chapter 2: Methodology

Participants and Target Population

The 4-H Farm to Table program was designed to be implemented with students aged 9-18. This program has been developed for use in the classroom, in local 4-H programs, home-school groups, and other groups who want to learn more about the production of food and how it gets from farm fields to their dinner table. The pilot 4-H Farm to Table program was conducted using 85 youth participants ranging from 12-14 years of age who attended a central Virginia middle school. Being an active member and resident of the community, I learned there was a need for programming that would introduce students to gardening and locally produced foods. During the research stage of this program, I found a study conducted by researchers at Virginia Tech that revealed 87% of teachers in Virginia have an interest in school gardening (Klemmer, Waliczek, & Zajicek, 2005). Taking the opportunity, I contacted the school, provided my credentials as an educator and inquired if the need was substantiated. I then worked with the school administration to determine which grade would work best for a program such as this. It was determined by the administration that the eighth grade students would benefit the most from this program. Determining a program design for a participant pool for 85 students required a schedule similar to what is used in many schools similar to a school period schedule. By developing short workshops the program was better able to meet the learning needs of increasingly diverse clientele and allowed the participants flexible scheduling. The period schedule provided a familiar sense of order for both teachers and students and required little change of routine for classroom implementation and was well accepted by school administration.

Following this approval, a date was set for the spring program. The group of eighth grade students provided a representation of the surrounding community. Although these students

represented only a small portion of the 9 – 19 age group in Virginia 4-H, this program can be tailored to fit any age bracket. This program was also designed to be customized to fit any schedule, even multi-day events. This program also follows the typical 4-H program approach where “all reasonable efforts” are made to ensure that everyone who would like to be part of this program has the opportunity to participate. Figure 3 shows the actual schedule program elements.

Figure 3: Schedule of Program Elements

Time	Workshop	Description
9:00 a.m.	Students Arrive	
9:15 a.m.-9:30 a.m.	Opening Tours	Lynchburg Grows
9:40 a.m-10:10 a.m.	What is Soil Made of	Basic components of soil
10:20 a.m-10:50 a.m.	Compost Basics	Amending soils
11:00 a.m-11:30 a.m.	Seeds of the Season	When to plant seeds
11:40 a.m-12:10 p.m.	Food Nutrition	Safe food preparation and nutrition
12:10 p.m.- 1:00 p.m.	Lunch	Nutrition education
1:00 p.m.-1:45 p.m.	Container Gardening	Growing food at home
2:00 p.m.	Load Buses	

Data Collection

By exploring research design, evaluation limitations, and data collection for the project, I was able to lay the project's philosophical groundwork that began with gathering relevant information from participants which is critical for any program. In order for a program to be sustainable, an adequate evaluation tool must be used to be able to show measurable impact. To evaluate the 4-H Farm to Table program a summative evaluation was conducted. A summative evaluation is "any combination of measurements obtained and judgments that permit conclusions to be drawn about impact, outcome, or benefits of a program or method" (Green, 1986, p.362).

The data collection methods to evaluate the program included: 1) participant interviews during the program, 2) surveys of the 85 youth participants, and 3) interviews with the teachers who took part in the spring 2012 program. Both participants and teachers were therefore given the opportunity to provide feedback during and at the conclusion of the program. As the facilitator of the program, I first asked questions to teacher and student participants before, during, and after the program. These participants were randomly selected out of the 85 participants who attended. It also was important to conduct the survey at the conclusion of the program so that participants could complete the evaluation while the experience was fresh in their memory. The majority of the written survey was qualitative and was based on a Likert scale while the remainder of the evaluation asked open-ended questions that allowed participants to express their personal views of the experience. To collect data in regards to the participant's personal views and values, a comment section that asked open-ended questions was created so that participants were able to share openly about the program (see Appendix A).

The qualitative format was chosen so that all information gathered could be represented. By being able to create percentages for the answers provided, the evaluation can show

measurable impacts and can provide additional information from participants. After collecting the written surveys, the participants separated into youth and teacher/instructor categories. The data collected were recorded for each question on a master sheet and assigned a percentage for the responses for each question. A comment section was available for those wanting to provide additional thoughts on the program.

Conducting evaluations with both participants and instructors/teachers provides different points of views of what impacts took place. While it is a common practice that participants are evaluated at the conclusion of programming for program effectiveness, it's essential to evaluate the teacher/instructor as well. This can identify opportunities to improve the learning of the participant. There's also another purpose of instructor/teacher evaluation: to encourage professional development. When both evaluations are looked at together from improvement, credibility in an evaluation system is increased and deemed essential. Ultimately, the evaluation process proved to be an integral process of the entire program as it provided information that later was used to create a program guide.

Chapter 3: Analysis & Outcomes

The 4-H Farm to Table program was designed to be simple, while at the same time offering educational results. Current educators are bombarded with new curricula annually and it is challenging to invest time and resources in new programs. Keeping this in mind, the program was intended to be accessible and straightforward which allows the educator to follow the manual steps until complete and high impact by making the SOL correlations by teaching science principles in a experiential learning program.

Participant Evaluation

The pilot program provided many new ideas while at the same time allowed for reflection on original ideas. Of the 85 students that participated in the pilot program none lived on a farm or actively participated in gardening in the home setting. This program, therefore, introduced youth to agriculture for the first time. Accordingly, specific details of this program were not given to the students prior to arrival at the program site to minimize preconceived attitudes and expectations about agriculture. Instead, students were allowed to create images about agriculture and farming as they experienced it through the program, allowing for a positive interpretation (Lalji, 2010).

When introduced to the program the participants were initially hesitant to become involved, but with basic introduction they began to actively take part in the program and soon were fully engaged. A rotational format of the schedule worked well as they were shown all class locations during the opening tour of the facilities. The participants seemed eager and enthusiastic throughout the day, as I observed. Students took an active role in processing, debriefing, question and answer sections, and volunteered readily for demonstrations during events.

Information gathered from the evaluation process revealed that the most highly rated aspect of the program was the unit on soils. Once participants had the opportunity to examine

soil samples, and understand the makeup of soil, they held a higher regard for it. The second highest rated unit was composting. This unit illustrated how to amend soil through composting organic waste that usually finds its way to the garbage. During that unit, the participants witnessed firsthand the food chain, which demonstrated that each living thing in an ecosystem is part of multiple food chains. Figure 4 shows knowledge gain by percentages evaluated.

Figure 4: Knowledge Gained Per Unit

N=85

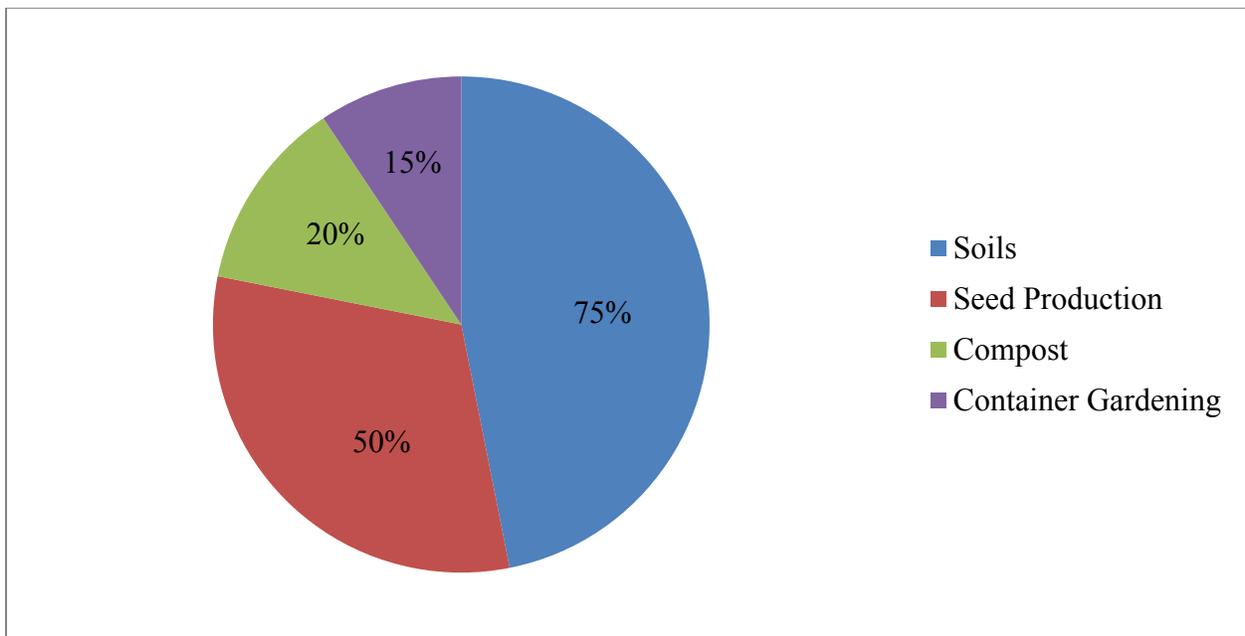
Unit Area	Great Gain	Moderate Gain	Little to No Gain
Compost/Soils	90%	8%	2%
Seeds/Container Gardening	88%	0%	12%
Nutrition/Safety	99%	1%	0%

Educator Evaluation

Teachers attending the 4-H Farm to Table program intended to introduce new programming in the classroom (Figure 5). The teachers enjoyed having the opportunity to conduct a learning experience outside of the classroom. Based on the evaluations, the programs were run well and contained useful information that will be used in the classroom. However, for future programs it was advised that the workshops although good, could more fully utilize the Virginia Standards of Learning. One noticeable absence in Figure 5 is the Food Nutrition and Safety session of the 4-H Farm to Table program. One teacher advised “not to remove the program aspect of nutrition and safety but that it wouldn’t be heavily introduced to classroom instruction as it didn’t tie in well with classroom curriculum”.

By utilizing both positive and negative feedback, it was demonstrated to administrators that the program not only contributed to the education of the students but the program, through its hands-on activities, increased knowledge of the students by allowing them to see, feel, touch, and sometimes taste the message that was being presented. A study conducted by the Bethel Learning Institute focused on student retention rates based on teaching methods. The study was broken down by percentages to show student retention rates by delivery mode. It found that 11% of students retained more information from lectures, 75% by learning by doing, and 90% when students teach other students (Subramanian, 2002). Input from the evaluations provided accountability to stakeholders to increase support for the program. Amherst County School System will not only take part in the program in 2013 but will be also expanding it to its other middle school.

Figure 5: Introduction of Program in the Classroom



Conclusions

Whereas this program started as a final project and report for the OMALS program at Virginia Tech, it developed into something much more. I have found that in order to help Virginia Cooperative Extension Agents and teachers gain skills and knowledge in Virginia agriculture, general plant biology, and food nutrition and safety, the programs have to be well planned and relevant. The program must contain measurable changes that can be reported clearly and have direct impacts on the participants. With the information gathered and additional work, this 4-H Farm to Table program can be a quality tool for youth development.

Based on follow up conversations with teachers who participated in the 4-H Farm to Table program, they heavily support the program for continuance in the 2012-13 school year. Even more important, many of the teachers are willing to take what they learned from the 4-H Farm to Table event and implement aspects of it into their classrooms. This is an opportunity for the local 4-H agent in Amherst County to work with a new group of clients in the county and build new relationships.

Drawing on conclusions obtained through the evaluations, not only did the students gain knowledge about Virginia agriculture, but the teachers did as well. Therefore, this program accomplished what it set out to do: to introduce participants to concepts of food safety and nutrition and its connection to childhood obesity and Virginia agriculture. I hope teachers will add the 4-H Farm to Table program into their curriculum as well as to more fully contribute to understanding the connections between making healthy food choices and supporting local agriculture in Virginia. Given the opportunity to provide more feedback, both participant and teacher comments can assist in program developments leading to better workshops, presentations, and evaluation data.

A program such as this requires multiple, engaging activities to fully engage the interest of participants. This program shows the participants that through efforts of their own they can produce fruits and vegetables. Producing one's own food is not an easy task if not prepared. Through multi-day activities the education of food production can be broken down into its most basic steps. Trying to achieve everything in one day forced the program to be concentrated into shorter module times and brief introductions. Once the limitations are addressed and corrected, the overall program will undoubtedly be enhanced, despite the limitations that did occur; this program was well run and received by all parties involved.

Suggestions for Future Implementation

Future implementation of the 4-H Farm to Table program should include working with teachers and the school administration to tailor the field experience around what they are teaching in the classroom. Aside from classroom activities, a record book has been developed as part of the curriculum that will allow participants to obtain 4-H recognition. Other factors such as the availability of instructors, training opportunities for teachers, transportation, and funds are also factors that need to be addressed before planning of the field experience. I would advocate for program planning in early fall for a mid-spring program. Although this program has been developed for the classroom, a field trip to a food production facility deepens the participant experience.

To enhance the experience for the participants I would also recommend soliciting donations such fresh fruit such as apples, peaches, and berries from local producers to provide free samples to the participants and market local businesses. In addition, local media should be invited to promote the event. Finally, I would suggest printing copies of the 4-H Farm to Table record book to present to participants to encourage them to become involved with 4-H. By

joining 4-H, completing a record book and turning it into the 4-H Agent for comment creates a viable bridge between in-school and out-of-school time learning.

Experiential learning can be a fun new way for teachers to excite their students. Being actively involved in the learning process has been proven to have beneficial outcomes on learning and students tend to retain the knowledge of the activity longer. Not all students are verbal linguistic learners and this is where experiential learning can help bridge the gap. A program that combines physical activity with intellectual learning provides opportunity for teachers to create an energized atmosphere for student involvement. Experiential learning expands the capacity to explore new ways of both teaching and learning.

References

- 4-H Targeting Life Skills*. Retrieved July 17, 2012, from MU Extension website, <http://4h.missouri.edu/getinvolved/volunteer/volunteerorientation/building/uilding6.html>
- American Cancer Society Advisory Committee on Diet, Nutrition, and Cancer Prevention. (1996). Guidelines on diet, nutrition, and cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. The American Cancer Society 1996 Advisory Committee on Diet, Nutrition, and Cancer Prevention. *Cancer Journal for Clinicians*, 46(6), 325-41.
- AYP Results for 2010-11*. Retrieved August 3, 2012, from Center on Education Policy website, www.cep-dc.org/cfcontent_file.cfm?Attachment=Usher_Report
- Compost Cycle*. Retrieved July 18, 2012, from Getgreenliving.com website, <http://www.getgreenliving.com/ten-tips-to-building-rich-compost/>
- Deckelbaum, R. J., Fisher, E. A., Wintson, M., Kumanyika, S., Lauer, R. M., Pi-Sunyer, F. X., St. Jeor, S., Schaefer, E. J., & Weinstein, I. B. (1999). Summary of a scientific conference on preventive nutrition: *Pediatrics to geriatrics*, 100(4), 450-6.
- Dehghan, M. Akhtar-Danesh, N., & Merchant, A. T. (2005). Childhood obesity, prevalence and prevention. *Nutrition Journal*, 4, 24-32.
- Garden-based learning in basic education: *A historical review*. Retrieved July 20, 2012, from University of California at: <http://www.communitygroundworks.org/sites/default/files/Overview%20of%20Research%20supporting%20Garden-Based%20Learning.doc>
- Hunter, T. (2011, August 17). Parts of a Seed. Retrieved from <http://taylorhunter.blog.com/2011/08/17/lobsters-seeds-and-pain-2/>
- Johnson, D., Wardlow, G., & Franklin, T. (1997). Hands-On Activities Versus Worksheets IN reinforcing physical science principles: Effects on student achievement and attitude. *Journal of Agricultural Education*, 38(3), 10.
- Klemmer, C.D., Waliczek, T.M., & Zajicek, J.M. (2005). Growing minds: The effect of a school gardening program on the science achievement of elementary students. *HortTechnology*, 15(3).
- Life Cycle of a Plant*. (Ulmer, R.H.) Retrieved July 17, 2012 from Studybuddy at: <http://studybuddygroup.com/ep-printable-writing-dot-point-planner.htm>
- Mission and Vision*. Retrieved August 20, 2012, from Virginia Cooperative Extension at: <http://www.ext.vt.edu/about/mission.html>

- MyPyramid*. Retrieved August 1, 2012 from the USDA at:
<http://www.fns.usda.gov/eatsmartplayhardhealthy lifestyle/tools/mypyramidtracker.htm>
- Ness A. R., & Powles, J. W. (1997). Fruit and vegetables, and cardiovascular disease.
International Journal of Epidemiology, 26(1):1-13.
- Peoples Garden School Pilot Program*. Retrieved September, 7, 2012, from the USDA at:
<http://www.fns.usda.gov/outreach/grants/garden.htm>
- Perspectives: Hands-on learning engages teachers and students*. Retrieved from California School Board Association:
http://www.csba.org/NewsAndMedia/Publications/CASchoolsMagazine/2010/Spring/Departments/Perspectives_Simon.aspx
- Perspectives of hands-on science teaching*. (Haury,D.L., & Rillero,P.) Retrieved September 7, 2012, from website,
<http://www.ncrel.org/sdrs/areas/issues/content/cntareas/science/eric/eric-toc.htm>
- Petri Dish Germination*. Retrieved July 18, 2012, from Education.com website,
<http://www.education.com/reference/article/seed-germination-test/>
- Planting a Tree from Seed*. Retrieved July 18, 2012, from the VCE website,
<http://pubs.ext.vt.edu/420/420-025/420-025.html>
- Raffan, J. (2000). *Nature nurtures: Investigating the potential of school grounds*. Toronto, Ontario.
- Serdula Mk, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T. (1993) Do obese children become obese adults? A review of the literature. *US National Library of Medicine National Institutes of Health*, 11(2):167-77.
- Stafne, E., & Kelsey, K.D. (2011). *Perceptions of Land-grant University Specialists Regarding Competition and Collaboration with Community College Programs in Viticulture and Enology*. *HortTechnology*. 21(6):789-796
- Soils*. Retrieved July 17, 2012, from the Thinkquest Team at:
<http://library.thinkquest.org/J003195F/default.htm>
- Van Horn, B. E., Flanagan, C. A., & Thomson, J. S. (1999). Changes and challenges in 4-H.
Journal of Extension, 37(1).
- Why is Urban Agriculture Important?* Retrieved July 20, 2012, from the RUAF Foundation
<http://www.ruaf.org/node/513>

Lalji, V. (2010). *Youth in Agriculture: Challenges and Opportunities*. pp. 2 Retrieved from Caribbean Community Secretariat website,
http://www.caricom.org/jsp/communications/Youth_in_Agriculture_Concept_Note%20Final.pdf

Farm to Table: Pathway to Fruits & Vegetables



4-H Club and Classroom

Activity Guide



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Why Farm To Table In 4-H Youth Development

Welcome to the 4-H Farm to Table project. Virginia Cooperative Extension (VCE) through its multiple program areas strives to provide educational opportunities for healthy living curriculum. By doing so we have created this program where you will learn about:

- Soils
- Seeds
- Compost
- Foods & Nutrition

You will have a variety of activities to complete that will give you “hands-on” experiences while working with plants, soils, and living organisms. By completing the activities in this program, you will enable your participants to discover if they have any interest in farming while having fun doing so. These activities can potentially lead to a new hobby for your participants as well as a potential life long career. With the increasing cost of food and rate of childhood obesity a Farm to Table program could change youths’ attitudes about health and agriculture. During the course of this project, youth ought to gain an understanding of the process in how food makes its way from the location it is grown to their tables.

If allowed, this program will enable youth to participate in field study activities to gain new information of how the food system works. It also aims to introduce youth participants to agriculture, specifically Virginia agriculture. This program aims to educate the youth with hands on experiential learning about

Virginia agriculture and other subjects such as plant biology and nutrition which fulfill several requirements of the Virginia Standards of Learning (SOL) testing. By allowing teachers the opportunity to be involved with this program, they will be provided a unique learning opportunity to duplicate the program in future years.

The United States has transformed over the decades from an agrarian society to more of a service society. Gone are the days of 4-H Canning Clubs, hello to Lego Robotics. One thing that remains the same with youth is that they must eat. We live in a world today where convenience takes precedence over quality. This program is the beginning step in correcting this cultural change.

To empower youth with the knowledge that will allow them the opportunity to make life changes is what 4-H is all about. This program will show the youth the importance of being able to make wise decisions when it comes to choosing what foods they consume.

The Farm to Table movement is gaining traction around the country and it has far reaching effects on the lives of our youth. The health aspect of this program through education of diet and nutrition should be more than enough to sway any skeptical thinker but it also has the opportunity to have the youth become involved in Virginia agriculture and community events.

How to Use this Guide

This curriculum is the beginning stage to help you understand just how the food we eat makes it from the farm to our dinner table. Designed for youth ages 9-19, the activities contained in this project can be implemented in the 4-H club or in a classroom setting. For you more ambitious learners you can even do it at home. Each activity has been put together to encourage participants to “learn by doing”. After the activities are completed the participants will be able to reflect on what was accomplished and how it is related to everyday living. As you progress through the program, participants should build knowledge and skills that will enable them to produce their own fresh fruits and vegetables.

Activities cover the following areas:

- Soils
- Plants from Seeds
- Building Compost
- Benefits of Fresh Food

Advice for the Educator:

- Select an activity from each core area
- Complete the activity you selected
- Implement activities in small and large groups
- Leave room for discussion. Share what you have learned
- Keep all your records together in one place to be turned in to the 4-H agent for project book recognition at the end of the program



4-H Targeting Life Skills MU Extension

Farm to Table: Soils

What is soil and how is it formed? The earth is covered by land and water. In fact water covers nearly 75% of the surface. The rest is covered by minerals, living organisms, air, water, and very small rocks. This mixture is called soil. As with building of anything you must have something to start with. The base material for soil is your general rock. Now you may ask how a rock is the base for soil. Rocks are always breaking down into smaller particles and they do this by many avenues. The heat and cold help break rocks up by **expanding** and **contracting** in hot days and cool nights. Most rocks are **porous** which allows water to get inside the rock. If the water freezes inside the rock it will expand the **fracture** the rock into smaller pieces. Water also can **dissolve** different minerals that make up the rock into smaller particles that will eventually become part of the soil.

Living organisms such as plants and animals play a major role in the creation of soil. As living matter die they begin to decay. **Fungus**, **bacteria**, and **protozoa** all live in the soil and they help break the dead plant and animal matter down into small particles that become soil. Worms, beetles, and other insects also help this process in the never ending food chain cycle.

When we hear the word soil we typically think of potting soil, the dark fluffy stuff we buy at the store but in actuality soil come in a lot of different forms.

Soil has **texture**. It can range from fine, to medium to course. An example of each would be; clay would be a fine textured example of soil where its particles are so small you would need a microscope to see the individual particles. A medium textured example would be silt and a course textured example of soil would be sand. Activity 1 will demonstrate how this all works.

Plants depend on soil in order to live. A plants root system will work its way along the topsoil then eventually setting its roots into the subsoil. It acts as a sponge for moisture, capturing water, holding it and then distributing it to plant roots. Soil also protects roots and microbes in the soil that plants depend on from direct sunlight, which can harm or kill them.

Activity 1: The Importance of Soil

Life skills: Reflect on previously gained knowledge

Group Size: 8 to 16 participants

Location: indoors

Time Needed: 20 minutes

Objective: to allow participants to reflect back and use the knowledge gained during the soils section.

Directions for the Educator:

Participants should be able to list three things that help make soil and three things that plants use soil for.

Soil is formed by:

1. _____
2. _____
3. _____

Soil is important for plant because it:

1. _____
2. _____
3. _____

Activity 2: Soil Textures

Life skills: Observations made after hands on experiment

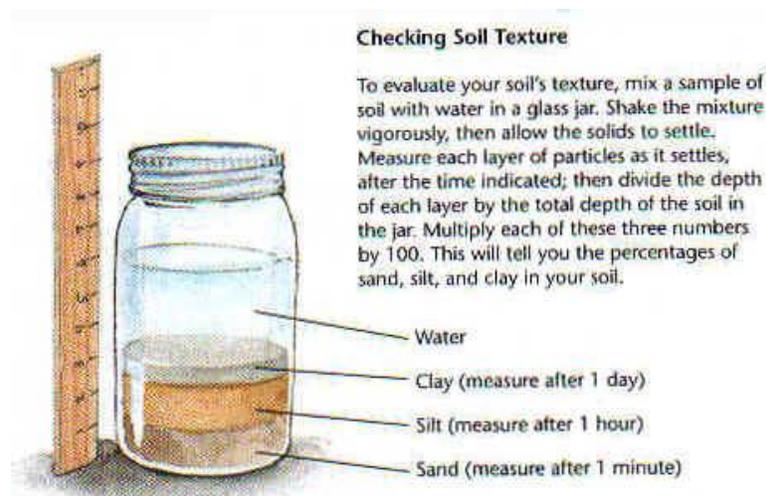
Group Size: 8 to 16 participants

Location: indoors

Time Needed: 20 minutes for introduction and 1 day for activity

Materials: 1 pint canning jar per class, ½ cup of potting soil, dish detergent, and water

Objective: to allow students to see the textures of soil first hand. Following the steps below, students will have the opportunity to transform everyday soil into its most basic building blocks. Once separation begins to occur, it will allow them to understand the parts of soil and its textures.



Thinkquest Team. "Soils" Thinkquest Team. 2000. Web 17 July 2012.
<http://library.thinkquest.org/J003195F/default.htm>

Directions for the Educator:

1. Get clear 1 pint canning jars
2. Crush ½ cup of soil into the bottle
3. Add a table spoon of non-foamy soap to the bottle
4. Close the top and shake for three minutes
5. Place the jar on a flat surface for two days
See how long it take for separation to happen

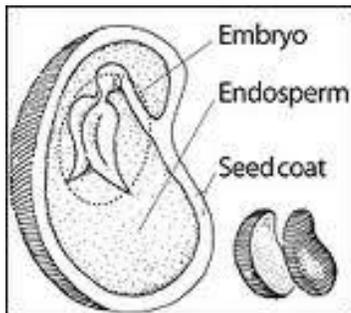
Farm to Table: Seeds

Seed Production

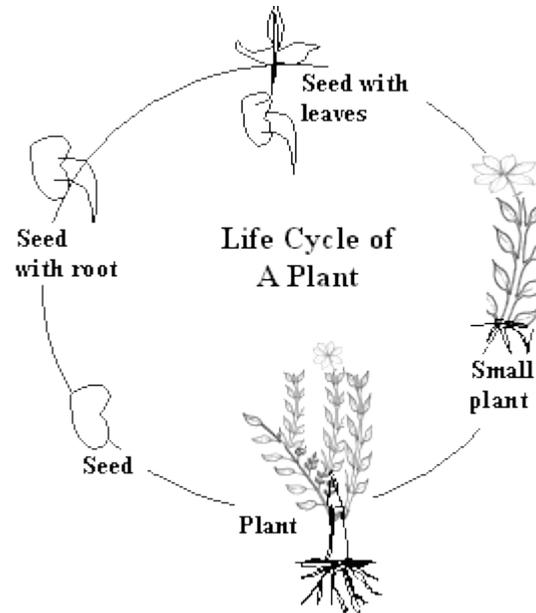
Seeds are the beginning of every plant. For as far as the eye can see almost every plant you encounter will have come from a seed. There are two basic ways plants reproduce and they are called sexual and asexual. Sexual reproduction requires a male and female plant. A male plant releases **pollen** into the air which is carried by wind or an insect such as bees to a female plant where it is then deposited in the flower of the plant.

Once the seed has been produced it contains three basic parts. They are:

1. **Seed Coat**- a protective covering
2. **Embryo**- a small plant inside the seed with stems, roots, and leaves
3. **Endosperm**- A food supply for the embryo



Hunter, T. "Parts of a Seed" The Blog. 2011, Web 18 July 2012.
<http://taylorhunter.blog.com/2011/08/17/lobsters-seeds-and-pain-2/>



Ulmer, R.H. "Life Cycle of a Plant"
Studybuddy.com. 2010. Web 17 July 2012.
<http://studybuddygroup.com/ep-printable-writing-dot-point-planner.htm>

The life cycle of plant determines when it produces seeds. Above is an example of a plants life cycle. Beginning at seed it then grows a small root going on to push a stem and leafs out of the ground developing into a small plant maturing into a full grown plant then the production of new seeds will be begin.

Activity 3: How Seeds are Produced

Life skills: Reflect on previously gained knowledge

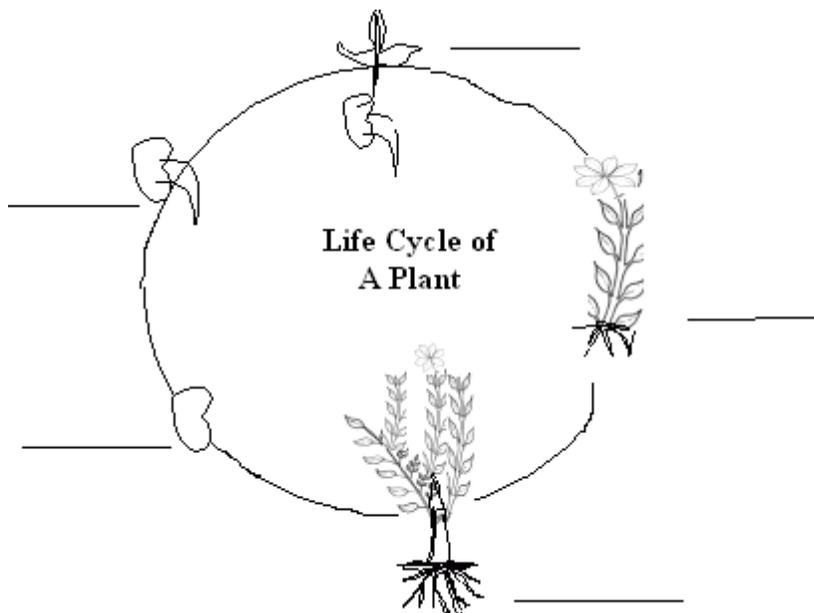
Group Size: 8 to 16 participants

Location: indoors

Time Needed: 30 minutes

Objective: To have the students match the life cycle of the plant and then describe in their own words the process of how seeds are produced.

- A. Seed with Leaves
- B. Mature Plant
- C. Seed with Root
- D. Small Plant
- E. Seed



Ulmer, R.H. "Life Cycle of a Plant" Studybuddy.com. 2010. Web 17 July 2012.
<http://studybuddygroup.com/ep-printable-writing-dot-point-planner.htm>

Activity 4: How Seeds Germinate and Grow

Life skills: Reflect on previously gained knowledge and hands on experience

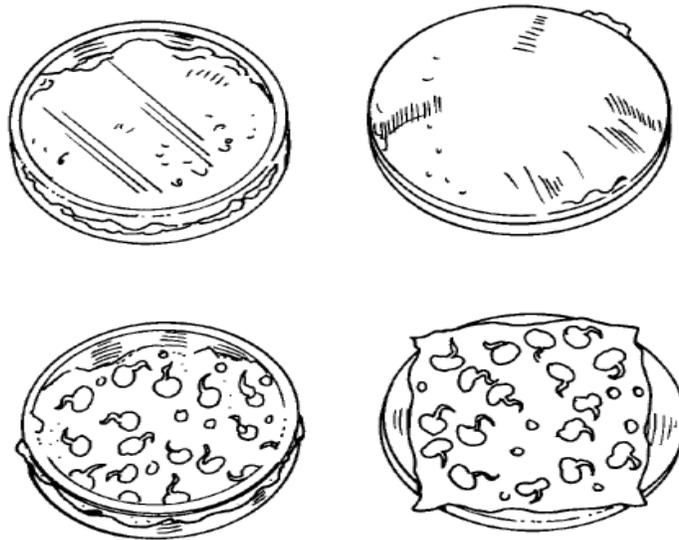
Group Size: 8 to 16 participants

Location: indoors

Time Needed: 1 to 3 days depending on seeds used

Materials: Petri dish, paper towels, seeds, and tape

Objective: To observe seed germination and development of tap root



Mooreman, T. "Petri Dish Germination" Education.com. 2002. Web 18 July 2012.
<http://www.education.com/reference/article/seed-germination-test/>

Directions for the Educator:

1. Line the bottom of a petri dish with a paper towel
2. Add water to wet the towel
3. Place seeds in the middle of the dish
4. Take another wet paper towel and lay it across the top of your seeds and close the lid on the dish
5. Make observations and notes of project each day and record what you see

Activity 5: Planting Seeds

Life skills: Reflect on previously gained knowledge and hands on experience

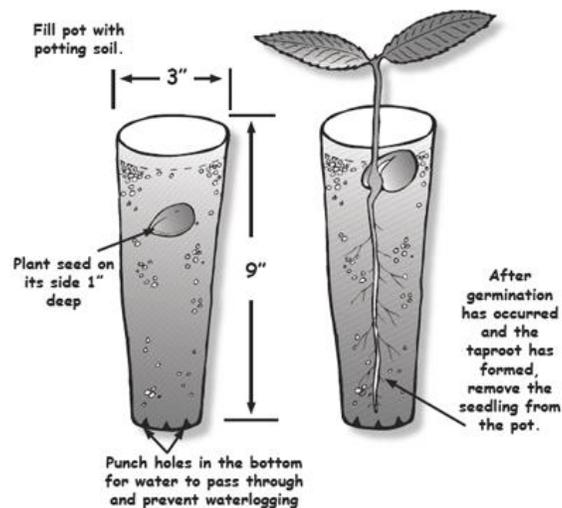
Group Size: 8 to 16 participants

Location: indoors

Time Needed: 1 to 3 days depending on seeds used

Materials: clear plastic cup, pea gravel, potting soil, and seeds

Objective: To plant a seed and understand its growing habits after germination



Kirwin, J. "Planting a Tree from Seed" VCE. Web 18 July 2012.
<http://pubs.ext.vt.edu/420/420-025/420-025.html>

Directions for the Educator:

1. Use a clear disposable cup and punch holes in the bottom
2. Place one inch of gravel in the bottom of the container
3. Fill the container with good topsoil
4. Place your finger in the middle of the bottle and push down until you reach your first knuckle
5. Place a seedling in the hole and lightly cover with dirt

Farm to Table: Compost

Building Compost

In previous sections you learned all about soils and how it's needed to help seeds grow into plants. This section you will learn about composting. Compost has the ability to help regenerate poor soils. The composting process encourages the production of beneficial micro-organisms (mainly bacteria and fungi) which in turn break down organic matter to create humus. Humus is a rich nutrient-filled material that increases the nutrient content in soils and helps soils retain moisture.

Almost any organic material that is usually thrown out of your home can be composted. Leaves and needles, lawn clippings, weeds, garden residue, hedge trimmings, vegetable and fruit garbage, and even shredded paper can be used to create compost. The idea is to recycle these things to be used again in a beneficial way. Worms also are a valuable part of any compost pile they tend to eat the vegetable waste and as it is passed through their body the casting become a nutrient rich part of the compost pile.



Getgreenliving. "Compost Cycle" Building Rich Compost. 2010. Web 18 July 2012
<http://www.getgreenliving.com/ten-tips-to-building-rich-compost/>

Activity 6: Table Top Composter

Life skills: Reflect on previously gained knowledge and hands on experience

Group Size: 8 to 16 participants

Location: indoors/outdoors

Time Needed: 1 to 3 weeks depending on matter used

Materials: clear 2 liter bottle, scissors, organic material, earthworms, and shredded paper

Objective: To create a table top composter will allow the student to observe food scraps and other waste go through natural stages of decay.

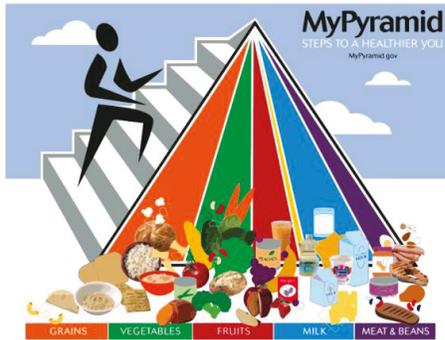
Directions for the Educator:

The following steps will allow you to create a table top composter in your class room or bed room.

1. Gather some organic material to compost. Use fruit and vegetable scraps, which can come from students' lunches or the cafeteria.
2. Cut off the top of a water bottle about two inches below the bottom of the lid. Don't discard the cut-off portion.
3. Place about an inch of loose soil in the bottom of the bottle, followed by the food scraps. Leave room for another inch of soil on top.
4. Poke five holes in the cut-off portion of the bottle with scissors, and reattach it to the bottle with masking tape.
5. Place the mini compost bin in an area of the classroom that gets plenty of sun but doesn't experience temperature extremes.
6. Shake the mini compost bin once a day for about two weeks to "rotate" the soil and help decompose the food scraps.

Farm to Table: Nutrition and Safety

In today's world you are exposed to a large variety of food that your parents at your age never dreamt of! So many in fact that our government had to break them down to in to the following basic food groups.



USDA. "MyPyramid" usda.gov. 2010.
Web 1 August 2010.

It is recommended that you eat at least 3-5 serving of vegetables and 2-4 servings of fruit as part of your daily diet. Although it sounds like a lot it is only like eating ½ cup of broccoli and 1 medium apple a day.

The foods listed on the above pyramid provided your body with the **nutrients** it needs to function on a daily basis. Nutrients are chemical substances that your body gets from the food you eat. Each nutrient has a different job to do and is very important to keep your body going. Nutrients also help your body grow and heal its self when injured. The vitamin C that is found in oranges and broccoli help heal cuts. So it's not just eating food, its eating the right foods. Locally grown food has a higher nutrient content because it is allowed to ripen on the plant and not harvested early to be truck across the country or ocean.

While eating fresh fruits and vegetables is a great way to replenish nutrients in your body you also have to make sure they are safe to eat. Bacteria are microscopic organisms also known as germs. Taking a few extra minutes to make sure all of your food is washed properly will go a long way in making sure you stay healthy. Before you start handling your food you also want to make sure that your hands are clean as well. Running your hands under water is not good enough, **YOU MUST USE SOAP!** Warm water dissolves dirt faster than cold water but if you add soap it will ensure that most if not all the dirt is washed away. Remember to wash our hands for at least 20 seconds or enough time to recite the alphabet.



Here are some tips to make sure that you stay germ free while preparing snacks.

- Don't wipe your hands on your clothes. Wash them instead.
- Use a plastic cutting board because they are less porous.
- Keep food separated until ready to use.
- Use a timer so that you don't forget your food.
- Always use clean utensils.

Activity 7: List What Nutrients are in our Food

Life skills: Reflect on previously gained knowledge and hands on experience

Group Size: 8 to 16 participants

Location: indoors

Time Needed: 30 minutes

Materials: Access to internet

Objective: To gather information about the nutrition content of the food we consume

Directions for the Educator:

In order to help students understand nutritional values have them do a short internet search for what nutrients are contained within the following foods. They will see that most all food contain some of the same nutrients as other but with higher/lower values. (An internet search is required for this activity)

Food	Types of Nutrients	Calories per Serving	Location of Production
			
			
			
			
			

Activity 8: Food Safety Check List

Life skills: Reflect on previously gained knowledge

Group Size: 8 to 16 participants

Location: indoors

Time Needed: 10 minutes to record, 20 minutes for discussion

Objective: To record current hygiene and food safety practices of participants.

Directions for the Educator:

After the check list is completed, give the students the opportunity to explain why it is or why it isn't a good idea to do so.

Yes - No

		Wash hands before touching raw food, especially meats
		Wash hands before going to the restroom
		Do you cough or sneeze in your hand
		Touch hair, face, or other people while handling food
		Use separate utensils for different foods
		Is it ok to double dip with friends

Facilitator Evaluation

1. Please rate each of the following aspects of the Farm to Table experience by circling a number that represents your opinion (on a scale of 1-5, where 1=poor and 5=excellent).					
	1	2	3	4	5
	Poor	Fair	Average	Above Average	Excellent
How would you rate the FTT Event overall?	1	2	3	4	5
Activities	1	2	3	4	5
Program Delivery	1	2	3	4	5
Facilities	1	2	3	4	5
Helpfulness of the Instructors	1	2	3	4	5
Grade Appropriateness	1	2	3	4	5
2. What did you enjoy most about the Farm to Table Event?					
3. What solutions do you have for what you enjoyed least about the Farm to Table Event?					
4. Please tell us about yourself. <i>[Circle the best fit]</i>					
<p><u>Note about these questions:</u> <i>Gender, age, and race are important to demographic variables that help us to ensure that we are serving the needs of diverse audiences and that diverse audiences are satisfied with Virginia's 4-H programming. Thank you for identifying your gender, age, and race. This information is voluntary.</i></p>					
GENDER: MALE FEMALE					
AGE: 19-65 65+					
RACE: AFRICAN AMERICAN / BLACK HISPANIC AMERICAN INDIAN ASIAN WHITE / CAUCASIAN MULTICULTURAL					
5. Please circle what best fit your role in the program?					
Chaperone Instructor Teacher Administration					

Evaluation format based off collaborative works of Barry A. Garst, Ph.D., Assistant Professor and Extension Specialist and 4-H Center Program Directors (May 2006, updated April 2010, Sarah Baughman)

Participant Evaluation

1. Name of the school you are attending											
2. Please rate each of the following on a scale of 1-5 (1= poor and 5= excellent.)											
											
	Poor	Fair	Average	Above Average	Excellent						
How would you rate the FTT Event overall?	1	2	3	4	5						
Activities	1	2	3	4	5						
Program Delivery	1	2	3	4	5						
Facilities	1	2	3	4	5						
Helpfulness of the Instructors	1	2	3	4	5						
3. What did you enjoy most about the Farm to Table event?											
4. What did you enjoy <u>least</u> about the Farm to Table event?											
5. Of the activities listed below, what were your <u>3 favorite</u>?											
<input type="checkbox"/> Soil Textures <input type="checkbox"/> Importance of Soil <input type="checkbox"/> Seed Production <input type="checkbox"/> Seed Germination <input type="checkbox"/> Planting Seeds Table Top Composter <input type="checkbox"/> Nutrients in our Food <input type="checkbox"/> Do you or Don't you, food safety											
6. Please tell us about yourself. [Circle an answer for each]											
* This information is voluntary.											
AGE:	8	9	10	11	12	13	14	15	16	17	18
GENDER:	<input type="checkbox"/> BOY (Male)					<input type="checkbox"/> GIRL (Female)					
RACE:	AFRICAN AMERICAN / BLACK					HISPANIC					
	AMERICAN INDIAN					ASIAN					
	WHITE / CAUCASIAN					MULTICULTURAL					

** Likert scale with face images on page one adapted from Foddy, W. (1993). *Constructing questions for interviews and questionnaires: Theory and Practice in social research.* New York, NY: Cambridge University Press.

Putting it All Together

The lack of fresh, local food production also significantly impacts our diet and health. We tend to eat what is available – highly processed food that can handle long distance travel and has a long shelf life. The obesity epidemic is one of the most visible and obvious indications that our food system with its lack of access to fresh locally grown foods has a significant and negative health impact. Empowering youth with the begging knowledge of home food production will enable them to consume fresh nutritionally rich foods that will directly combat the obesity epidemic.

This program can be replicated in any school division whether it is rural or urban. An adult VCE civic association entitled VCE Master Gardener along with VCE agents can be valuable partners during this program. The Master Gardeners volunteer their time to serve the local community through communication, education and fellowship. Master Gardener volunteers will be able to encourage school-aged youth to improve eating habits by helping them and their teachers understand the value of growing and eating fresh fruits and vegetables. If given the opportunity the program can become an intergraded part of the spring school year as that is when the planting season begins.

In conclusion, youth will gain understanding about the Virginia agriculture system and how they themselves can produce and consume food safely. The activities contained within this program are meant to allow youth hands on learning while supplementing your class work. Teachers participating in this program will be empowered to change their approach to classroom lessons and instill positive change. There is truth to the saying “You are what you eat” and through programs such as this, we will be putting our youth on a better track to a healthier life. If you have any questions please do not hesitate contact your local Virginia Cooperative Extension office. There they will be able to assist you in your needs. I do hope that you have enjoyed your journey during this activity and look forward to future adventures in local agriculture.

Glossary

(Terms found in Webster's New World Dictionary 3rd College Edition)

Bacteria- Microscopic life form: a single-celled, often parasitic microorganism without distinct nuclei or organized cell structures. Various species are responsible for decay, fermentation, nitrogen fixation, and many plant and animal diseases.

Contracting- To decrease in size do to loss of liquid or air.

Dissolve- Become absorbed in liquid: to become absorbed in a liquid solution.

Embryo- A small plant inside the seed with stems, roots, and leaves.

Endosperm- A food supply for the embryo once germination has begun.

Expanding- To increase the size, volume, quantity, or scope.

Fracture- Break or crack: a break, split, or crack in an object or a material.

Fungus- Spore-producing organism: a single-celled or multicellular organism without chlorophyll that reproduces by spores and lives by absorbing nutrients from organic matter. Fungi include mildews, molds, mushrooms, rusts, smuts, and yeasts.

Nutrients- A substance that provides nourishment, e.g. the minerals that a plant takes from the soil or the constituents in food that keep a human body healthy and help it to grow

Pollen- A powdery substance produced by flowering plants that contains male reproductive cells. It is carried by wind and insects to other plants, which it fertilizes.

Porous- Permitting the movement of fluids or gases through it by way of pores or other passages.

Protozoa- Microscopic single-celled animals.

Seed Coat- A protective outer covering of the seed.

Texture- The feel and appearance of a surface, especially how rough or smooth it is.