

Experiential Learning in School Gardens and Other Outdoor Environments: A Survey of Needs for
Supplemental Programs

by

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(ABSTRACT)

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The purpose of this study was to determine how the Hahn Horticulture Garden at Virginia Tech can best focus their outreach efforts to benefit the local public school community. The study assessed the needs of local science teachers and how their needs can be met through educational outreach programs. A self-administered online survey was used to inquire about the use of experiential teaching methods using school gardens and other outdoor environments. The survey was also intended to determine interest in incorporating supplemental programs into the K-5 Montgomery County Public School curriculum to enhance the Virginia Standards of Learning related to plants and environmental science. The survey was sent to 273 K-5 teachers in the Montgomery County Public School System in Virginia. Because of the small number of responses, the results from the survey were not representative of the population, but were satisfactory to gain practical information for this study.

Data analysis indicated existing programs, the need for programs, and how programs can best be implemented. Existing programs consisted of hands-on activities in the classroom including growing plants from seeds and dissecting and observing plant parts. Experiential learning opportunities outside of the classroom included school gardening, observations on the school grounds, and outdoor field trips. Survey respondents indicated a need for supplemental programs related to plants and environmental science. Teachers reported interest in a school gardening program, having a guest speaker in the classroom, receiving curriculum support, and taking their class on a field trip to the Hahn Horticulture Garden at Virginia Tech. Most teachers also showed interest in receiving in-service training to strengthen their knowledge of plants and environmental science.

Based on the results of the study, there is a need for supplemental programs related to plants and environmental science. Engaging lessons should be developed to assist teachers with school gardening programs. Experiential learning opportunities such as meaningful field trips should also be developed. Other methods to supplement school curriculum include providing teachers with curriculum materials and lesson kits. All programs developed should correlate to the state-mandated standards.

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Chapter 1

Introduction

Background of the Study

I hear and I forget

I see and I remember

I do and I understand

This proverb explains the importance of experiential learning. Children and adults alike truly learn best by doing. Not only is it important to encourage inquiry, but in today's technological world, it is also important to give children the opportunity to get outdoors and experience nature. This idea of experiential learning is not a new concept. Several of the best educators in history, including John Dewey and Jean Piaget, advocated a hands-on approach to learning. Piaget believed that involvement is the key to intellectual development (Haury & Rillero, 1994). Getting students actively involved in learning about plants and environmental science not only helps them to understand, but gives them an appreciation for the natural world, something that is slipping away in today's society.

School gardens are ideal settings for experiential learning. Gardens have been utilized in schools in the United States since the 1890s (Smith & Motsenbocker, 2005). The first school garden in this country was developed in 1891 by Henry Lincoln Clapp, who was sent by the Massachusetts Horticultural Society to study school gardens in Europe. School gardening soon became a national movement.

Horticulture is a useful tool not only in science, but also other curriculum areas (Dobbs, Relf, & McDaniel, 1998). Gardening themes can be integrated into standards-based activities across the curriculum (Martin, 2006). In an article in a National Science Teacher's Association publication, Debra Shapiro stated that not only do school gardens motivate students to study science, but recent studies show that school gardening programs boost students' scores on science achievement tests (Shapiro, 2006). Gardening is a great activity to bring together many areas of concern regarding youth today.

Gardening activities can give youth a way to connect with nature, learn about where their food comes from, and have a greater appreciation for healthier foods.

Need and Significance of the Study

In the technological world we live in today, it is important for people to stay connected to nature. A connection with nature not only influences people personally, but environmental awareness and knowledge about our natural world has a global influence. The future of our environment lies in the hands of today's youth. Children growing up today know very little about their natural world. It is our responsibility as adults, parents, teachers, and mentors to give today's children an opportunity to embrace nature. A great place to start is in the classroom, or better yet, taking the students outdoors to learn in a school garden or other outdoor environment. Nature gives children an opportunity to explore and discover the living world around them. Children are not naturally intrigued by plants, but when they are growing plants and observing them, they become fascinated. Plants are a great way to get children involved. Children often do not realize the importance of plants and how dependent we are on them. It is important that they learn about plants and the rest of the natural world around them.

In recent studies, teachers reported that they feel less prepared to teach science than any other subject matter (Seefeldt, 2007). Science outreach programs have the potential to offer teachers a way to enhance their science lessons via guest speakers, supplemental science curricula, volunteer involvement in the outdoor classroom, and interdisciplinary lessons that can link virtually every subject area. A previous study on school gardens recommended that further research be done to compare the use of school gardens at different elementary grade levels (DeMarco, 1997). Demarco also recommended identifying and implementing ways in which the horticulture community can assist elementary school teachers with incorporating a gardening program into their curriculum.

The benefits of school gardening and outdoor education are discussed in recent articles in educational and horticultural journals. An article in the American Society for Horticultural Science's

journal, *HortTechnology*, studied the impact of hands-on science through school gardening in Louisiana public elementary schools. The study focused on the science achievement of fifth grade students in three inner-city elementary schools (Smith & Motsenbrocker, 2005). The study concluded that students' science test scores were significantly higher when a gardening program was incorporated into the curriculum (Smith & Motsenbrocker). Another study found that the science achievement of students who participated in a hands-on school gardening program was higher than that of students who did not participate in gardening activities as part of their science curriculum (Klemmer, Waliczek, & Zajicek, 2005). Not only do gardening programs increase science achievement scores, they encourage students to expand their appreciation of the living world around them (DeMarco, Relf, & McDaniel, 1998), they teach youth how to nurture and care for something (Welsh, Whittlesey, Seagraves, Hall, & Harlow, 1999), they foster authentic relationships with the larger community (Martin, 2006), they encourage teamwork and cooperating toward a common goal (Robinson, 2006), and they allow opportunity for countless other life skills.

As part of a land grant university, staff at the Hahn Horticulture Garden at Virginia Tech would like to increase its outreach efforts to the local public and private schools. The Hahn Horticulture Garden is a 6.4 acre teaching garden on the campus of Virginia Tech in Blacksburg, Virginia. This study allowed us to assess the needs of K-5 science teachers and how their needs can be met through educational programs offered by the Hahn Horticulture Garden.

The results from this study will make a significant contribution to programs developed by the staff at the Hahn Horticulture Garden at Virginia Tech. It will provide the framework for what programs will best fit the needs of elementary science teachers in the Montgomery County Public School system.

Purpose of the Study

The purpose of this study was to determine how personnel at the Hahn Horticulture Garden at Virginia Tech can best focus their outreach efforts to benefit the local public school community. The Hahn Horticulture Garden is a 6.4 acre teaching garden on the campus of Virginia Tech in rural southwestern Virginia. The garden is also open to the public and offers a beautiful setting for weddings and other events. The garden's mission includes educating students as well as the community. Garden staff would like to increase their educational offerings to include public and private schools. This study assessed the needs of public school teachers in rural southwestern Virginia and how their needs can be met through educational outreach programs. The objectives for the study included:

1. Identify the stakeholders.
2. Construct a survey to determine existing programs and perceived needs.
3. Evaluate the information gathered from the survey.
4. Create a plan for developing and implementing supplemental programs in plant and environmental science.

The study specifically focused on the need for K-5 school programs in the areas of plant and environmental sciences. This needs assessment allowed me to look at existing programs as well as perceived needs for such programs. Data was collected through a needs assessment survey sent to K-5 public school teachers in Montgomery County, Virginia. Data analysis indicated existing programs related to plants and environmental science, the need for programs, and how programs can best be implemented.

Research Questions

1. Do the public elementary schools in Montgomery County, Virginia have school gardens? To what extent do K-5 teachers use those gardens?

2. What type of support is desired by K-5 teachers to enhance the Standards of Learning related to plants?
3. What is the best way to offer such programs to the local schools?
4. Are K-5 teachers interested in in-service education to enhance their knowledge of plants and environmental science?
5. What experiential learning opportunities related to plants and environmental science are given to K-5 students?

Assumptions

The following assumptions were made for the purpose of this study:

1. The teachers who responded to the survey teach science lessons.
2. Teachers have access to email and the Internet, which enabled them to receive the request to complete the survey.

Definition of Terms

Experiential learning: the process of constructing knowledge, skill, and value from direct experience.

Garden-based curriculum: an interdisciplinary curriculum in which a variety of subjects are taught by way of growing plants and learning in a garden. Gardening can be the basis for problem solving, mathematics, designing experiments in science, studying the growth of civilization in history, developing interpersonal skills in social studies, understanding good nutrition in health, discovering the beauty of nature in art, and providing the theme for reading, writing, and spelling mastery (DeMarco, 1997).

Hands-on learning: learning by doing.

Horticulture: the science and art of growing fruits, vegetables, flowers, or ornamental plants (Bachert, 1979).

Inquiry-based learning: educational approach that is driven more by a learner's questions than by a teacher's lessons.

Interdisciplinary curriculum: a curriculum that involves or joins two or more branches of learning. Based on the concept that knowledge is interconnected, and subject matter is presented to demonstrate this interrelationship. Activities and teaching strategies integrate fields of knowledge resulting in an understanding of the material that is both meaningful and relevant (DeMarco, 1997).

Interdisciplinary lessons: lessons that integrate content and skills from a variety of subject areas.

Science process skills: detailed in the Virginia Standards of Learning for elementary science: observing, classifying, measuring, collecting data, manipulating variables, conducting investigations, and noticing how the environment is affected by weather, seasons, and other organisms.

School garden: outdoor laboratory for direct instruction. It is part of the school equipment as books, blackboards, charts and apparatus are (Bachert, 1979).

School gardening: the use of growing plants and horticulture as an educational strategy and learning tool in an educational setting. The gardening activities can involve growing plants indoors or outdoors in a variety of ways that differ with every learner's circumstances. Plants are grown in such places as windowsills, under grow-lights, in containers, around flag poles, in terrariums, or in ordinary, plowed garden plots (DeMarco, 1997).

Chapter Summary

This chapter provided a background for the study including information on the history of school gardens, reasons for using hands-on, inquiry-based, and experiential teaching strategies, and incorporating a gardening program into the curriculum. A statement of the problem that led to the focus of the study was also included. The purpose of the study was explained. Research and supporting

material were incorporated to state the need and significance of the study. Finally, a definition of terms used throughout the study was included.

Chapter 2

Literature Review

Introduction

This chapter presents a review of literature concerning interrelationships of experiential learning, school gardens, outdoor education, and interdisciplinary lessons. The first section examines the history of school gardens and early educators who were instrumental in experiential teaching methods. The next section focuses on the importance of experiential and inquiry-based learning and benefits of these methods. The benefits and impacts of school gardens, outdoor classrooms, and field trips are addressed in the following sections. Quality programs and curricula available to supplement lessons in horticulture and environmental education are described. How these programs can be used across the curriculum is also addressed. The next section describes specific studies that have been done to address school gardens, outdoor classrooms, programs that have been successfully implemented in the classroom, and needs for similar programs. Specific impacts on academic achievement, life skills, environmental awareness, and health and nutrition are discussed. The final section of the chapter focuses on the importance of reconnecting with nature.

History of School Gardens

Many educators have been advocates of school gardens and outdoor education. As far back as the early 1600s, Europeans such as John Amos Comenius thought of school gardens as an opportunity for children to admire and appreciate trees, flowers, and herbs. In the 1700s, Jean-Jacques Rousseau declared that nature was the child's greatest teacher and believed that knowledge of the natural world serves as a foundation for later learning (Subramaniam, 2002). Johann Heinrich Pestalozzi followed Rousseau's views but also spoke of the importance of observation and activity in learning rather than learning mere words (Subramaniam). In the late 1700s to early 1800s, Friedrich Froebel was one of the most effective advocates of school gardens; he saw the importance of learning by observing, exploring,

and doing. Following in the same thought, Maria Montessori, founder of the Montessori method of education, supported an education for the senses first, then the education of the intellect (Subramaniam). Montessori felt that gardens had a profound effect on children. She stated, “When he (the student) knows that the life of the plants that have been sown depend upon his care in watering them...without which the little plant dries up...the child becomes vigilant, as one who is beginning to feel a mission in life” (quoted in Subramaniam, p. 2). Throughout history there have been many famous educators who were advocates of hands-on, experiential, inquiry-based teaching. John Dewey, the great American teacher and philosopher, was an advocate of experiential learning. He believed that education worked best when it started within a child’s own experience (Raffan, 2000). All of these early educators recognized the benefits of school gardens, outdoor education, and learning by doing.

Gardens have been utilized in schools in the United States since the late 1890s and early 1900s (Smith & Molsenbocker, 2005). The first school garden in this country was developed in 1891 by Henry Lincoln Clapp, who was sent by the Massachusetts Horticultural Society to study school gardens in Europe. Soon after his trip, the first school garden was established in the United States in Roxbury, Massachusetts at the George Putnam School. School gardening soon became a national movement. In 1993, the American Horticultural Society held its first youth gardening symposium to bring together youth educators to brainstorm ways in which children’s gardens could support educational curricula. This led to the development of numerous curricular materials that will be discussed later in this chapter.

Experiential Learning

With traditional teaching methods, students must rely on memory and abstract thought to learn science concepts. Hands-on learning allows students to be part of the learning process and not just spectators; they become active participants instead of passive learners. Because they are actively involved, their work becomes personally meaningful. 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). Haury and Rillero best described the importance of experiential learning in science by stating that science must be experienced to be understood. “By actually doing and experiencing science, students develop their critical thinking skills as well as discover scientific concepts” (Haury & Rillero, p. 1). According to the National Academy of Sciences, from the earliest grades, students should experience science in an engaging form that fosters understanding (Haury & Rillero). In a case study that explored early elementary hands-on learning activities, Miller (2007, p. 14) stated, “Experience is a powerful learning tool, and children remember hands-on learning.” An experiential approach to teaching in a natural setting provides a way for teachers to help children physically, intellectually, emotionally, and spiritually connect with nature and internalize their learning (Miller).

When teaching science outdoors, the scientific method can be used as a conceptual and hands-on learning process that stresses critical thinking, reasoning, and problem solving skills. A study conducted by Bethel Learning Institute focused on student retention rates based on teaching methods. The study found an 11% retention for lectures, 75% for learning by doing, and 90% when students teach other students (Subramaniam, 2002). Hands-on, experiential learning serves as the main idea behind most school garden programs (Klemmer, Waliczek, & Zajicek, 2005).

Inquiry-based Learning

Inquiry-based learning is defined as an educational approach that is driven more by a learner’s questions than by a teacher’s lessons. In a traditional classroom, learning is centered on a more structured, curriculum-centered framework. Teachers act as the source of knowledge and, along with administrators, school boards, and bureaucracy, determine what children should know and master (YouthLearn Initiative, 2001). Inquiry-based learning projects allow students to choose the questions and develop a sense of ownership—learning projects are driven by the students (YouthLearn Initiative). These projects are still structured, just structured differently. According to YouthLearn at the Education

Development Center, the inquiry-based approach is at its best when students are working on interdisciplinary projects that reinforce multiple skills or knowledge areas in different facets of the same project. Inquiry forces student thinking by requiring interpretation of the observed events, rather than memorization of correct responses (Haury & Rillero, 1994). It allows students to become independent learners and to construct their knowledge by doing science. It is so much easier for students to understand the concept of pollination if they actually see a bee pollinating a flower. Actually tracking the movement of the sun and observing the effects is not even comparable to reading about it in a textbook. What better way to understand a square foot than to utilize that space for planting in a garden, or to actually see or walk an acre to understand this land area. And how can we expect students to understand the life cycle of a plant or insect without observing it first hand, and ideally in its natural habitat. There really is no better way to learn than in the “real world” or by actually doing. “Inquiry strategies tap children’s natural gift of curiosity, especially when they’re exploring their everyday world” (Boss, 2001, p. 15).

Many “hands-on” and “minds-on” methods are based on a social constructivist approach that recognizes the importance of peers and teachers in mediating learning (Lewis, n.d.).

“It is important not only that children actively relate what they are doing to their prior knowledge, but also that they become participants in larger groups, where novices can benefit from more experienced members and where children take on roles appropriate to their level of understanding” (Lewis, n.d., p. 2).

When a hands-on method is used, students will remember the material better, feel a sense of accomplishment when the task is completed, and be able to transfer that experience easier to other learning situations. Other benefits of inquiry-based, or hands-on, learning include increased motivation to learn, increased enjoyment in learning, increased skill proficiency, increased independent thinking and decision making, and increased perception and creativity (Haury & Rillero, 1994).

Current Interest in School Gardens

Current educational philosophies including utilization of hands-on and experiential learning, as well as the importance of environmental science and nutrition education, are generating renewed interest in school gardening programs (Dirks & Orvis, 2005). “The purpose of school gardens is not to have an elaborate landscape, but to create a ‘living laboratory’ for student observation of science concepts in the real world and experimentation in an unpredictable environment” (Smith & Motsenbocker, 2005, p. 1). School gardens give students an opportunity to learn outside of the traditional classroom setting. Gardens provide a link between concepts learned in the classroom and real life applications (Smith & Motsenbocker). They provide laboratories where scientific concepts literally come to life (Mohrmann, 1999). Gardens are not only useful for teaching plant science, but can be used to teach across the curriculum. Concepts and skills from virtually every subject area can be learned through a garden (Smith & Motsenbocker). Math is easily incorporated using fractions, measurement, and multiplication to figure out the proper number of plants per square foot or the amount of fertilizer to apply. Literature arts can easily be represented in drawings, stories, and garden journals. Studying the origin of plants, how they were used in history, and how they are used today are applicable to social studies. There are many possibilities for incorporating science into gardening, including studying the soil, plant parts, photosynthesis, insects, and environmental factors. Science is also incorporated by observing and experimenting with plant growth, fertilizer, and light.

Elementary school teachers may use school gardening to improve student academic and social achievement, to provide a hands-on learning experience that reaches across the curriculum, and to encourage students to expand their appreciation of the living world around them (DeMarco, Relf, & McDaniel, 1998). Gardens also benefit youth by introducing them to patience and delayed gratification, independence, cooperation, self-esteem, enthusiasm and anticipation, nurturing living things, and exposure to role models from different walks of life (Raffan, 2000). Ideally, teachers will incorporate

school gardens into their daily plans, but gardens are also useful as an out-of-school program to enhance, support, and expand on the core curriculum. School garden programs should focus on issues that are currently important to school administration, such as compliance with state mandated educational standards, time and cost efficient stimulation of academic achievement, and improving the health and nutrition of students (Phibbs & Relf, 2005).

Alice Walters was a prominent figure in school gardens and founder of “The Edible Schoolyard,” a program that involves students in all aspects of farming a one-acre garden (Subramaniam, 2002). She believed that having a garden for food production at schools would teach compassion, patience, and self-discipline. “The Edible Schoolyard” acts as a model in the education of social responsibility, community participation, and sustainable agriculture (Subramaniam). In the school garden, children learn firsthand the seed-to-seed cycle, the rhythm and traditions of the harvest, and the taste, touch, and smell of fruit, vegetables, and flowers. This is not something they are going to experience in the traditional classroom. A school garden can provide a rich and stimulating resource and setting for learning and teaching. It provides a way to create understanding of the relationships between human food needs, organic food waste, the land and the complexity of organisms, and to learn about cycles of life, death, decay, and regeneration (Raffan, 2000). “A school garden is an ideal way to create ongoing science projects in the outdoor classroom” (Studer, 2007, p. 6). A survey conducted by researchers at Virginia Tech revealed that 87% of teachers in Virginia have an interest in school gardening (Klemmer, Waliczek, & Zajicek, 2005).

Subramaniam (2002, p. 5) collaborated with research colleagues to develop the following points to summarize why teachers should use school gardens:

Purposes of School Gardens:

1. To support core academic training, particularly in science and math

2. To add a sense of excitement, adventure, emotional impact, and aesthetic appreciation to learning
3. To teach basic skills and vocational competencies
4. To teach about food and fiber production
5. To teach ecological literacy and/or environmental education
6. To teach sustainable development
7. To produce food and other commodities for subsistence consumption and trade
8. To improve nutrition, diet, and health

Outdoor Classrooms

“Using the real world is the way learning has happened for 99.9 percent of human existence. Only in the last 100 years have we put it in a little box called a classroom” (Gerald Lieberman, as quoted in Raffan, 2000 p. 15). In the outdoor classroom, students are challenged to move beyond memorization. Students are engaged in constructing knowledge rather than accumulating information (Subramaniam, 2002). The outdoor classroom gives students an opportunity to learn with more freedom while reinforcing and imparting basic skills. Children are by nature observers and explorers and have an innate curiosity about the natural world. Outdoor classrooms allow for direct experiences with natural phenomena that will provoke curiosity and thinking (Haury & Rillero, 1994). The outdoor classroom can offer rich learning experiences not found indoors (Studer, 2007). Nature is full of wonderful things for children to experiment with, discover, and explore. It allows children to use all of their senses. The natural outdoor environment not only is important as a “classroom” for learning, it is important for natural play. It encourages creativity and imagination. Children are more inclined to pretend when playing in a natural environment, as opposed to the tarmac of a school playground. Outdoor classrooms introduce children to the world they live in and help them to understand their role in caring for the environment (Miller, 2007). The outdoor classroom gives teachers an opportunity to interact with their

students in a relaxed, informal environment. What better place to learn the difference between living and nonliving things or to learn about life cycles and habitats (Seefeldt, 2007)? Suzie Boss (2001, p. 13) offered her opinion of children's experiences in the outdoors, "Their outdoor investigations will give them opportunities to raise questions and test hypothesis. If they happen to have fun, get a little dirty, and polish their teamwork skills in the process, all the better."

Field Trips

For schools that have limited resources on site or to supplement outdoor education, field trips to natural areas or botanical gardens can be an effective learning experience for students. To reduce anxiety often associated with exposing students and teachers to new surroundings, a pre-visit lesson can help make the most of the field trip experience (Haynes, Pieper, & Trexler, 2005). Staff at a facility could supply teachers with lessons of what will be covered during the visit. These lessons can provide focus of what the students are expected to learn on their adventure. Post-visit lessons and evaluations should also be incorporated so the students can share what they learned. Active learning during the field trip will keep students engaged and enrich their outdoor learning experience. Teachers are challenged by using off-campus outdoor sites for science instruction due to lack of administrative and financial support, fear of student management problems, lack of planning time, lack of skills and knowledge regarding teaching in the outdoors, and liability and safety concerns (Cronin-Jones, 2000). These concerns are addressed later in this chapter.

Many studies have documented positive shifts in students' environmental attitudes when exposed to long-term experiences in natural settings, such as summer camps. The attitudinal benefits of short one-day field trips to natural settings are minimal, indicating that frequent, repeated experiences in natural settings are needed to significantly influence environmental attitudes (Cronin-Jones, 2000). Another less than positive finding regarding field trips indicates that students learn less from field trips to natural settings off school grounds than they do in more familiar natural settings (Cronin-Jones,

2000). This factor may be due to the anxiety that results from off-campus field trips opposed to the familiarity of the schoolyard.

Although outdoor experiences are most beneficial in the long-term, field trips to public gardens and other natural settings offer an alternative for schools that do not have natural settings directly outside of their school. Field trips also offer a unique learning experience that gives students the opportunity to explore other natural settings.

The Hahn Horticulture Garden at Virginia Tech is a wonderful resource not only for the university community but also for the local public schools. The garden is rich in flora from around the world, with thousands of woody and herbaceous plant specimens. The garden also provides an opportunity for observing wildlife with the many bird species that visit as well as aquatic life that reside in the ponds and stream. A field trip to the garden can offer a unique learning experience for students by getting them out of the classroom and into a different context that provides the prospect of new discovery.

Integrating the Curriculum

Science, math, social studies, art, language, and other subjects can be taught using nature as the learning laboratory, making these concepts more meaningful (Subramaniam, 2002). There are many curricula available that are rich in disciplinary content and can supplement existing classroom lesson plans in science. Wonderful resources are available that provide fun, hands-on, cross-disciplinary lessons. Such curricula can be found through the professional horticulture community, Cooperative Extension and 4-H, Master Gardeners, private education companies, botanical gardens and arboreta, and horticultural associations and societies. Many of the lessons are aligned with the state-mandated educational standards. The most common goals of these programs are inquiry and problem solving, understanding specific science concepts, stewardship, life skills, encouraging high-level thinking, understanding of native habitats, health concepts, and environmental awareness (Lewis, n.d.). Lessons

aimed at school gardens or the outdoor classroom must maximize the extent to which such work is integrated with other work in the curriculum (Dillon, Morris, O'Donnell, Reid, Rickinson, & Scott, 2000). "Teachers and other outdoor educators should consistently aid students to understand how what they experience in the outdoor classroom connects to, extends, and reinforces their in-school work" (Dillon et al., p. 4). To integrate any program into the schools, teachers must be provided with specific activities geared to address state-mandated educational standards.

The Standards of Learning for Virginia's Public Schools identify essential academic content of the science curriculum at different grade levels. Standards are identified for kindergarten through grade five, for middle school, and for a core set of high school courses. Academic content is divided into strands that progress in complexity at each grade level. Teachers are not expected to strictly follow the standards, but are encouraged to go beyond the standards and to select teaching strategies and assessment methods appropriate for their students. A goal listed in the Science Standards of Learning states that students should "experience the richness and excitement of scientific discovery of the natural world through the collaborative quest for knowledge and understanding" (Standards of Learning for Virginia Public Schools, 2003). This specified goal relates directly to experiential learning in a school garden or other outdoor environment. Refer to Appendix F for Virginia K-5 Science SOL Strand Sequence.

The Down-to Earth program is a resource designed to introduce youth to sustainable agriculture and environmental education using the scientific method as a conceptual and hands-on learning process that stresses critical thinking, reasoning, and problem solving (Williamson & Smoak, 1999). The Down-to Earth educational package includes specific concept objectives, lesson plans, learner competencies, student guidebook, and suggestions for delivery methods. The program supports the idea that hands-on experiences are the best way for students to develop an understanding of the complex world and their place in it (Subramaniam, 2002). Down-to-Earth has reported impacts of their program as increased

knowledge of the scientific method, plants, fertilizer, and pests as well as positive attitudinal and behavioral changes, increased awareness, and facilitation of higher order thinking processes (Subramaniam). The program focuses on engaging youth in hands-on and fun experiential learning that allows for active and challenging development of new knowledge (Williamson & Smoak). The program allows youth educators to incorporate a mixture of multi-disciplinary and inter-disciplinary topics including agriculture, natural resources, environmental management, health and human safety, and horticulture.

Junior Master Gardeners (JMG) is a nationally recognized organization. The JMG curriculum offers an enjoyable and hands-on approach to learning horticulture and environmental education while also cultivating community service, leadership, and life skills (Klemmer, et al., 2005). The JMG curriculum covers science, horticulture, and the environment and correlates to national science education standards and to the mandated standards in many states. The curriculum covers topics such as plant growth and development, photosynthesis, soils and water, ecology and environmental horticulture, insects and diseases, landscape horticulture, and the interdependent relationships among living things (Shapiro, 2006). The hands-on activities integrate math, science, language arts, and social studies. The program also offers “independent and group learning experiences, life skills and career exploration, and service learning opportunities for youth” (Shapiro, 2006 p. 2). The Junior Master Gardener Program is built in three tiers: Level 1 is targeted at Grades 3-5, Level 2 is targeted at Grades 6-8, and Level 3 is targeted at Grades 9-12 (Welsh, Whittlesey, Seagraves, Hall, & Harlow, 1999). The curriculum was developed by the Texas Agricultural Extension Service and the Texas 4-H Youth Development Foundation with the goal of involving youth in organized gardening activities that will build leadership and self-confidence and foster a positive academic learning environment (Welsh, et al.). The JMG program is flexible and can be used in public schools, home schools, after-school programs, or youth clubs. An evaluation of the Junior Master Gardener program in third grade classrooms resulted in

qualitative data that indicated students enjoyed the program, shared what they learned with others, and wanted to participate in more JMG and gardening-type activities (Dirks & Orvis, 2005). In the same study, teachers indicated that they were satisfied with the program in their classrooms and planned to reuse their JMG materials for future classes. The JMG program has the capacity to increase service learning and impact students to connect with their communities (Dirks & Orvis).

State 4-H programs within the Cooperative Extension System, National 4-H Headquarters at USDA, and National 4-H Council partner to create quality curriculum in many subject areas. The curriculum is linked to the National Science Education Standards and also many state-mandated standards (4-H History, 2006). Curriculum material is available in subject areas ranging from agriculture and entomology to gardening and forestry. Curriculum professionals develop the material which is reviewed to maintain high standards. The curriculum is designed to be adaptable for multiple modes of delivery and distributed in multiple formats (4-H History).

Project Learning Tree is an award-winning, multi-disciplinary environmental education program for educators and students in grades K-12. Project Learning Tree is a program of the American Forest Foundation and is one of the most widely used environmental education programs in the United States and abroad (Project Learning Tree, 2004). Project Learning Tree meets state and national education standards. Through Project Learning Tree, students learn environmental content that integrates science, social studies, language arts, math, and other subjects and strengthens students' critical thinking, team building, and problem solving skills.

The LifeLab and GrowLab Science Programs offer garden-based projects for learning science and connecting it to all areas of learning. Its award-winning curricula and programs help schools develop gardens where children can create "living laboratories" for the study of the natural world. Since developing the first LifeLab school garden in Santa Cruz, CA in 1978, LifeLab has worked with over 1,400 schools across the United States (Cohen & Pranis, 2002). LifeLab's mission is to encourage respect for

life and the environment, appreciation and understanding of ecological systems, and environmental stewardship with the goal of a sustainable future.

Previous Studies

Many studies have revealed the benefits of school gardens and outdoor education. School gardens and outdoor classrooms have been found to not only improve academic scores, but also improve environmental awareness and attitudes, team work, community service, and numerous other life skills. Previous studies related to school gardens and outdoor education have covered various topics that include successfully integrating a school garden into the curriculum and methods of using horticulture in the classroom. A study of teachers who received a Youth Gardening Grant from the National Gardening Association focused on the factors that determine the successful use of school gardening in the elementary school curriculum (DeMarco, et al., 1998). The study results revealed that teachers were utilizing a variety of resources for their school gardening and volunteer needs. Master Gardeners were used by almost half of the teachers for their expertise as well as for volunteers. Most teachers felt they needed more training to effectively incorporate school gardening into the curriculum (DeMarco, et al.). Maintaining school gardens during the summer months was a concern for teachers using school gardening in the curriculum.

Linda Cronin-Jones (2000) conducted a study that compared the impacts of traditional classroom and outdoor schoolyard instruction on the environmental science content knowledge and attitudes of 285 third and fourth grade students. The results indicated that elementary students learned significantly more about selected environmental science topics through outdoor schoolyard experiences than through traditional indoor classroom experiences.

In spring 1995, a survey was conducted on the use of horticulture or gardening in K-6 classrooms throughout Virginia (Dobbs, Relf, & McDaniel, 1998). That study examined schools across the state of Virginia, while the study reported in this thesis specifically focused on the local county school system. In

the study by Dobbs, et al., 88% of K-6 teachers in the state of Virginia were interested in using horticulture in the classroom. Of those respondents, 85% already used plant material in their classroom to some extent. Availability of resources was stated as one obstacle teachers encountered when implementing such lessons. The study also revealed that only 2% of the teachers who used horticulture in their classroom had utilized prepared horticulture-based curricula such as GrowLab. The study found that teachers were willing to incorporate horticulture into their curriculum with the help of horticulture-based lesson plans, activities, posters, and a monthly newsletter for teachers to provide children's gardening activity ideas (Dobbs, et al.). Availability of materials to implement lesson plans was rated next most important to teachers. The findings from the study indicated that efforts to encourage horticulture curriculum in the K-6 classroom should focus on providing teachers with prepared horticulture-based materials and continuous updates (Dobbs, et al.). The research survey also revealed that 87% of respondents said they were interested in taking part in additional training in horticulture or gardening. This indicates that teacher in-service training would be a useful service to offer the teachers. A one day in-service training session was most desired by the teachers. The study concluded that to facilitate incorporating horticulture into the curriculum for the greatest number of teachers, teaching packets containing horticulture-based lesson plans, activity ideas, posters, and audiovisual materials should be prepared (Dobbs, et al.). The researchers suggested presenting the materials to interested teachers at a local in-service training session.

A needs assessment survey involving 4-H agents, Agricultural and Natural Resource agents, and Master Gardener Coordinators was conducted regarding horticulture programs, areas for new programming, and available resources and resource needs (Phibbs & Relf, 2005). The study also involved interviews with staff of public gardens in Virginia indicating potential for programming partnerships. The results of the survey showed a need for new publications or programs for school enrichment. A list of available support materials, curricula, and contacts was highly requested as a resource needed. 4-H

Camp directors' reported needs included funding to hire additional staff members to teach new curriculum, horticulture training for staff, and more coordination with Master Gardeners. The interviews with education staff members from three gardens in Virginia indicated they have never worked with 4-H but were interested in ways to collaborate. The study concluded that there is a need for a facilitator to generate more collaboration, produce new curriculum, and disseminate information regarding horticulture programs in Virginia (Phibbs & Relf).

Impacts on Academic Achievement

Several recent studies indicate that school gardening programs not only increase students' interest in science, but also boost students' scores on science achievement tests (Shapiro, 2006). A study of the impact of integrating a Junior Master Gardener curriculum into a Louisiana fifth-grade classroom revealed that students' science test scores were significantly higher than for those in classes that did not incorporate the curriculum (Smith & Motsenbocker, 2005). Another study measuring the effect of a school gardening program was done in Temple, Texas using a sample of third, fourth, and fifth grade students from seven elementary schools. In addition to using traditional teaching methods, students in the experimental group participated in school gardening activities as part of their science curriculum (Klemmer, et al., 2005). Traditional classroom-based methods only were used to teach those students in the control group. The school gardening activities proved to be a success when students in the experimental group scored significantly higher on science achievement tests than students in the control group (Klemmer, et al.).

In a highly cited study on experiential education, *Closing the Achievement Gap: Using the Environment as an Integrative Context for Learning*, the documented impacts included (Lieberman & Hoody, 1998):

1. Better performance on standardized achievement tests of reading, writing, math, social studies, and science,

2. Reduced classroom management and discipline problems,
3. Increased attention and enthusiasm for learning, and
4. Greater pride and ownership of accomplishments.

A study carried out by the State Education and Environment Roundtable focused on the environment as an integrated context (EIC) for learning. The study involved 40 elementary and middle schools that included the natural environment as a curriculum element. The study results revealed that in both comprehensive and subject-specific standardized assessments, EIC students outperformed non-EIC students in reading, writing, mathematics, science, and social studies (Raffan, 2000).

Impacts on Life Skills and Environmental Awareness

Not only do gardens and environmental education increase test scores, they also have more long-term impacts on children. Gardens and outdoor education build environmental awareness, sense of place, and sense of self in community--all of which extend into adulthood (Raffan, 2000). Outdoor environments lead to general and disciplinary knowledge, thinking and problem-solving skills, and basic life skills such as cooperation and interpersonal communication (Raffan).

Aside from the science skills learned through a school garden, there are social, emotional, aesthetic, and spiritual benefits as well. Gardens make learning teamwork possible. The class goal of a successful garden becomes more important than individual achievement (Subramaniam, 2002). A garden gives students pride in accomplishment, pride in collective action, pride in nurturing living things, and pride in making something for the collective good (Raffan, 2000). Many of the programs available have numerous benefits for youth. The Junior Master Gardener program incorporates elements of volunteerism, positive thinking, leadership, responsibility, and community pride.

Interaction with nature through a school garden or other natural setting is most crucial during middle childhood (Cronin-Jones, 2000). It is a critical time for youth to develop an appreciation for living things. It is also an important time to establish ethical principles, learn to get along with others,

understand delayed gratification, and build language and social skills to negotiate a place in the world (Raffan, 2000). According to Cronin-Jones (2000), scientific and environmental attitudes are usually well established and extremely resistant to change by the age of 12. These findings indicate that elementary school level is the most important time to teach children about the natural world.

At the high school level, experiential learning, especially in a garden or outdoor classroom, results in students being more engaged. They have a greater pride in and ownership of learning, improved academic performance, positive effects of working as equals with new adult role models, and creating a lasting sense of place (Raffan, 2000).

A research project by Our Lady of the Lake University in San Antonio, Texas involving classroom gardening indicated that children are experiential learners and that independent thinking and personal responsibility seem to be developed through gardening activities (Welsh, et al., 1999). In their experience with a school garden, students learned how to care for something, how to work as a team, and how their harvest could provide for others less fortunate.

Impacts on Children's Health and Nutrition

School gardens serve as an ideal context for nutritional programs (Subramaniam, 2002). It is important to find innovative ways to motivate children to develop lifelong healthy eating habits. The Nutrition Education and Training Section of the California Department of Education stated five benefits of garden-based nutrition education (Subramaniam, 2002):

1. Building bridges between school and community,
2. Promoting the transfer of information from one generation to another,
3. Developing environmental awareness in students by caring for a living environment,
4. Providing opportunities for cultural exchange, and
5. Building life skills.

School gardening programs make a huge impact on youth's perception toward healthy foods. Nutrition awareness is incredibly important today with the increasing problems with childhood obesity. A child is much more likely to eat fruits and vegetables that they grow. In a school in Vermont that utilizes a school garden, "children who initially refused to sample a fresh green pepper were clamoring for them after watching their friends eat them in class" (Canaris, 1995, p. 136).

Other Impacts

Inquiry-based learning is often very beneficial to students who do not respond well to lectures and memorization. These students often excel in an inquiry-based setting by showing more confidence, interest, and self-esteem (YouthLearn, 2001). Garden-based learning may become an important approach for working with challenged populations of youth (Subramaniam, 2002). Studies have shown beneficial effects of including a gardening program in the school curriculum for children who are emotionally disturbed, autistic, or mentally challenged. "All children can experience success in a school garden" (Subramaniam, 2002, p. 8).

Research shows that plant-based education produces positive growth for children in a number of important areas, including self-esteem, attitudes toward school and the environment, social development, physical and psychological health, creative thinking and problem solving skills (Lewis, n.d.). The numerous impacts of school gardens and outdoor education make them valuable to the learning experience.

Teacher and School Concerns

According to Raffan (2000), the literature shows that teachers know the outdoors is a potentially productive learning space, but many are concerned about discipline, safety, control, or the perception on the part of colleagues or administrators that outdoor learning is somehow not legitimate. In actuality, research shows that outdoor learning increases student engagement, and enthusiasm for learning goes up, resulting in significantly reduced discipline and classroom management problems.

Other concerns expressed by teachers include pollen and allergies in the outdoors, which can be an issue with some children. However, indoor allergens are just as common. Another concern teachers have regarding a school garden is maintenance, especially during the summer months. This can be remedied by developing a roster of students, parents, community members, and school summer maintenance staff living nearby to do the watering, weeding, and harvesting. It is a great service-learning opportunity for a scout group, Master Gardeners, Junior Master Gardeners, or other organizations.

Probably the most common concern of teachers is their time. Most have a planned curriculum and lesson plans that they follow. Demands on a teacher's time are critical. This is why many organizations provide outreach and curricula for teachers that make it possible for them to incorporate an experiential learning opportunity for their students. Volunteers can be very beneficial for programs such as school gardens. They can provide an adequate adult-to-student ratio and help teachers facilitate successful school gardening projects (DeMarco, et al., 1998). Volunteers may be parents, senior citizens, garden club members, Master Gardeners, or interested community members. In the state of Virginia, Cooperative Extension, 4-H, and other outreach through Virginia Tech such as VT STEM (Virginia Tech's outreach initiative for science, technology, engineering, and mathematics) and the Hahn Horticulture Garden can provide resources and personnel to assist teachers with garden-based and other environmental education programs. Not only can these groups provide volunteers for programs, they can address another common concern teachers have when teaching in the outdoors, and that is lack of knowledge and experience. These resources are available to help teachers successfully implement the outdoor environment in their lessons. In-service training in the areas of horticulture and environmental science would be beneficial to teachers. In previous studies, some teachers have shown interest in completing the Master Gardener program provided by the Cooperative Extension Service (DeMarco, et al., 1998). DeMarco et al. suggested that Extension develop an alternative program specifically for

teachers such as a School Gardener class that provides teachers with lesson plans and activities and teaches them how to implement and integrate these materials into their curriculum.

Resources and funding are major concerns of teachers and administrators. There are numerous grants available for school gardens and environmental education. The National Gardening Association offers many grants for school gardens (National Gardening Association, 2007). There are also many science-related grants offered through the National Science Foundation. Even the home-improvement chain stores such as Lowes and Home Depot offer grants for school gardens.

Integration of school gardening or any environmental education lesson into the curriculum is essential. All lessons, programs, field trips, etc. must correspond to the mandated standards followed by each particular school. This concern is addressed earlier in this review.

The benefits of hands-on, inquiry-based learning in school gardens, outdoor classrooms, or other natural settings far outweigh the challenges and concerns. The impacts created by school gardens and outdoor classrooms are priceless. This is the learning children will remember because it engages them not only academically, but also mentally, socially, and emotionally.

Reconnecting to Nature

In Richard Louv's book, *Last Child in the Woods*, he described the negative impacts of children's alienation from nature, which he aptly referred to as "nature-deficit disorder" (Louv, 2005). According to Miller (2007), studies have indicated many benefits of children having positive experiences with the natural world. These benefits include an increased sense of wonder, imagination, creativity, observation skills, relationship skills, and motivation for life-long learning (Miller). Children need adults to teach them about nature, as stated by developmental psychologist, Tuan, "nature is an inarticulate teacher" (Subramaniam, 2002, p. 4). Adults must nurture the child's curiosity about the natural world.

Many are referring to today's youth as the first generation of "indoor children," and fear their disconnection from nature (St. George, 2007). Michigan school districts are being encouraged to add

curricula and participate in programs that promote outside activities (Hackney, 2007). The statewide plan is part of the national grassroots initiative called Leave No Child Inside. The initiative is a movement brought about by concerns about long-term consequences of children spending too much time indoors. Experts agree it affects emotional well-being, physical health, learning abilities, and environmental consciousness. Leave No Child Inside is an effort to discourage the overuse of video games, television, and indoor activities. In June, 2007, the Virginia-based National Forum on Children and Nature vowed to raise \$20 million in funds to invest in 20 pilot projects that would create opportunities to get children in touch with nature (Hackney). State officials in Maine unveiled a new initiative called "Take it Outside;" the program is aimed at helping children reconnect with the natural world ("State Seeks," 2007). The National Wildlife Federation has created its own movement, "green hour a day" to encourage families to spend at least an hour a day outside (*The Economist*, 2007). A study found that from 1997 to 2003 there was a decline of 50%, in the proportion of children 9 to 12 who spent time in such outside activities as hiking, walking, fishing, beach play, and gardening (St. George). Richard Louv argued that children who spend too much time indoors are more prone to a range of childhood problems, including obesity, depression, and attention disorders (Louv, 2005). Statistics show an increase in these childhood problems and a decrease in time spent outdoors, which provides evidence for Louv's argument. Unfortunately, for many children, the virtual world has become a more familiar setting than the natural one (St. George). A personal connection with nature is good for the soul, and happy souls make good students and exemplary citizens (Raffan, 2000).

Chapter Summary

The benefits of hands-on inquiry learning have been known for centuries. School gardens and other natural areas offer countless opportunities for experiential learning. Many programs that utilize such space provide teachers with creative lessons that integrate the curriculum and correlate with national and state-mandated educational standards. Previous studies have revealed that school gardens

and other outdoor classrooms not only have a positive impact on academics, but also on environmental attitudes and life skills of youth involved in such programs. Teachers are gaining an appreciation for the potential of school ground projects such as gardens that integrate disciplines, produce tangible outcomes, and encourage children to build ties with the communities (Subramaniam, 2002).

School and community gardens and other educational opportunities in the outdoors introduce children to plants, science, and the natural world. With growing concerns about childhood obesity and children spending too much time indoors, it is important to instill in children an interest in gardening and nature so they grow to be health-conscious citizens and good stewards of the land.

Chapter 3

Procedures and Methodology

Introduction

In this chapter the research design, population, research instrument, and data collection procedures are described. The research instrument used in this study was designed to address the research questions of the study. The study research questions were:

1. Do the public elementary schools in Montgomery County, Virginia have school gardens? To what extent do K-5 teachers use those gardens?
2. What type of support is desired by K-5 teachers to enhance the Standards of Learning related to plants?
3. What is the best way to offer such programs to the local schools?
4. Are K-5 teachers interested in courses to enhance their knowledge of plants and environmental science?
5. What experiential learning opportunities related to plants and environmental science are given to K-5 students?

Data were collected using a self-administered online survey. The survey instrument was chosen due to lack of access to participants, reduced time required for survey implementation, ease of analyzing results, lack of costs, and convenience for participants to complete on their own time. According to Dillman (2000), electronic surveys often have a faster response rate and longer answers to open-ended questions than paper surveys. The survey instrument also included characteristics such as the grade level the participant teaches and the size of their class. The survey was written to inquire about the use and/or interest in incorporating a gardening program. The researcher chose to create the

electronic survey instrument because there was not an existing research instrument that fit the specific needs of this study. The layout of the survey was simple and easy to read. Response to questions required a click of the mouse on the bubble that corresponded to the teacher's answer to the question. The survey questions were primarily closed-ended questions for ease of response, analysis, and interpretation. Eight of the questions required only one answer, and four of the questions gave the option of "check all that apply." Two open-ended questions were included to gain specific information that could not be obtained through closed-ended questions. The layout allowed for the participant to type in their short answer to the open-ended questions. The survey was pre-tested by the researcher, the Science Supervisor for the Montgomery County Schools, an elementary school teacher, and one person not associated with the study or the school system. Those who participated in the pre-test of the survey were asked to comment on any problems they might have answering or understanding the questions in the survey. As a result of their comments, one question was eliminated, three questions were reworded, and one question was added. The amended survey was comprised of 15 questions. See Appendix A for the Science Teacher Survey.

Research Instrument Approval for Research Involving Human Subjects

Because this study involved human subjects, protocol requires approval from the Virginia Tech Institutional Review Board and the Montgomery County Public School Administration before proceeding with the study. Information on the study, methods to recruit participants, procedures to ensure confidentiality and anonymity, methodology, and data collection and analysis procedures was sent to the boards for review. The appropriate consent procedures were followed. After several revisions of the Initial Review Application, the Virginia Tech Institutional Review Board approved the survey instrument and research procedures. The approval letter from the Virginia Tech Institutional Review Board (see Appendix B) and supporting documents (including copy of the survey instrument) were then sent to the Montgomery County Public School Administration. That information was submitted in May 2007 and

declined as the administrators were not accepting any additional research projects for that current school year. The forms were resubmitted in August 2007 at which time approval was granted by the Montgomery County Public School Administration to conduct the research involving K-5th grade teachers who worked for their school system. The approval letter from the MCPS administration can be found in Appendix C.

Data Collection Procedures

Once the research approval was granted, an email message was sent to the Science Supervisor to forward to K-5 teachers in the Montgomery County Public Schools. The K-5 population would allow for comparisons and contrasts among the grade levels as well as valuable information for future programs. A link to the Science Teacher Survey was sent by email via the Science Supervisor to 273 K-5 teachers in the Montgomery County Public School System in Virginia. Because it was not possible to send the survey exclusively to science teachers, it was sent to all K-5 teachers in the county. The Science Supervisor estimated that 90% of those teachers teach science. The initial email stated information about the researcher, the purpose of the study, research approval certificates, consent and confidentiality information, notification that the teacher was invited to participate in a voluntary survey, and instructions to access and complete the survey instrument. The researcher's contact information was given to teachers if they needed assistance or had trouble accessing the survey instrument. See Appendix B for the email messages.

The survey was designed to be short, easy to answer, and to take no longer than 10-15 minutes to complete. Unfortunately, problems with the Virginia Tech Survey server resulted in deletion of the URL for the survey. The VT Survey technicians issued a new URL for the survey. As a result of the computer problems, the researcher received several emails and phone calls from teachers who tried to access the survey but were not able to. This problem also may have contributed to the poor response rate. The researcher tested the new URL to assure it was accessible before sending a second email with

the new URL. The email stated the reason for the change and apologized to the participants for the inconvenience.

A reminder email was sent approximately two weeks later to thank those who completed the survey and to remind those who did not complete the survey that they were still able to participate. The reminder email increased the responses from 10 to 18. As suggested by Dillman (2000), the emails sent to the teachers included communications that were constructed to emphasize the survey's usefulness and the importance of a response from each person in the sample. The URL and instructions to access the survey were included in the reminder email.

Due to the poor response, a "call for help" email was sent again thanking those who had completed the survey and asking those who had not to consider doing so. The message emphasized that the survey was important to collect data for research and develop educational programs that will benefit the teachers. This fourth email again gave the URL and instructions for accessing the survey as well as an alternative to have a hard copy of the survey sent to the teachers if they were uncomfortable with completing it online. The email resulted in almost doubling the responses up to 31. It was assumed that those who completed the survey teach science, but there is no way to know how many of the non-respondents also teach science or how many of those non-respondents did not respond because they do not teach science. If this study were done again, the researcher recommends including a question on the survey asking if the teacher does teach science. The actual response rate was very low at 13%. The 31 responses cover various grade levels and have varying responses, so the data allow for comparison and contrasts for the study. The small number may not be an accurate assessment of all K-5 teachers in the school system. The participants who completed the survey could possibly be biased toward school gardening programs and this may have motivated them to complete the survey. These variables make it difficult for the researcher to gain a proper assessment of the overall interest in a school gardening program.

Data analysis

The results from the survey were accessible from the VT Survey website. The results for each survey question were given in both frequencies and percentages. Because there was a small number of responses, it was feasible to utilize the percentages given without a need for further statistical analysis. Many of the results were reported by grade levels to allow for comparison of responses from teachers of different grades. Percentages distributed among grade levels were determined by simple calculations.

Chapter Summary

This chapter described the procedures and methodology used to assess the use and/or interest of incorporating a gardening program into the school curriculum to enhance the Standards of Learning related to plants and environmental education. The research design, population, research instrument, data collection procedures, and data analysis were described.

Chapter 4

Results

This chapter includes the results obtained from the Science Teacher Survey. The survey was written to inquire about the use of experiential teaching methods using school gardens and other outdoor environments. The survey was also intended to determine interest in incorporating supplemental programs into the K-5 Montgomery County Public School curriculum to enhance the Virginia Standards of Learning related to plants and environmental science. The survey was sent to 273 K-5 teachers in the Montgomery County Public School System and 31 teachers responded. Of the 31 respondents, 8 (25%) taught 4th grade, 7 (22%) taught 5th grade, 6 (20%) taught 1st grade, 4 (13%) taught 2nd grade, 3 (10%) taught kindergarten, and 3 (10%) of the respondents taught 3rd grade. The average class size was 18 students.

The results of the Science Teacher Survey are presented as percentages obtained from the survey data. Many of the tables that represent the results are distributed among the grade levels taught by teachers that responded to the survey. The research questions are listed with survey results that correspond to the research questions. See Appendix E for survey results.

Research question 1. *Do the elementary schools in Montgomery County Public Schools have school gardens? To what extent do K-5 teachers use those gardens?*

The results from the Science Teacher Survey revealed that of the 31 teachers who responded, 13 (42%) reported that their school does have a garden and 18 (58%) reported that their school does not have a garden. Of the 13 teachers who reported that their school does have a garden, 9 (70%) reported that they use the garden for lessons less than once per month. Three teachers (23%) reported that they use the school garden twice per month. One teacher (8%) reported using their school garden once per week. Table 1 illustrates these results distributed over the grade levels of the respondents.

Table 1

Frequency of Use of School Gardens

Grade Level	n	Less than once per month	A couple of times per month	At least once per week
K	0	0	0	0
1	5 (16%)	4 (13%)	0	1 (3%)
2	2 (6%)	3 (10%)	0	0
3	0	0	0	0
4	3 (10%)	1 (3%)	2 (6%)	0
5	3 (10%)	2 (6%)	1 (3%)	0
Total	13 (42%)	10 (32%)	3 (10%)	1 (3%)

Note. Percentages are of the 31 who responded to this item.

Research question 2. *What type of support is desired by K-5 teachers to enhance the Virginia Standards of Learning related to plants and environmental science?*

Survey participants were asked to check all answers that apply from a list of ways they would be interested in enhancing Standards of Learning (SOL) related to plants and environmental science. Of the 30 teachers who responded to this question, 26 (87%) teachers specified an interest in taking their class on a field trip to the Hahn Horticulture Garden at Virginia Tech. Twenty three (77%) respondents indicated interest in having a guest speaker in the classroom. Twenty (67%) were interested in receiving curriculum support from professionals at Virginia Tech. And 19 (63%) marked that they were interested in incorporating a gardening program into their curriculum. Survey participants were asked if they were

interested in receiving more information on outreach programs offered through Virginia Tech. Of the 31 respondents 29 (94%) indicated that they were interested in receiving more information on outreach programs offered through Virginia Tech. Only 2 (6%) marked that they were not interested in receiving such information.

Research question 3. *What is the best way to offer supplemental programs to the local schools?*

Teachers could mark all items they were interested in from a list of strategies for enhancing plant-related Standards of Learning (SOL). Results from the survey indicated that offering field trips to the Hahn Horticulture Garden was desired by 26 (84%) teachers. Twenty-three (74%) showed interest in having a guest speaker in the classroom to enhance lessons related to plants and environmental science. Twenty (65%) indicated interest in receiving curriculum support from professionals at Virginia Tech. And 19 (61%) showed interest in incorporating a gardening program into their curriculum.

Teachers were asked when they would prefer to be assisted with an SOL-friendly gardening program. They were able to check all of the following answers that applied: during regular school hours, before school program, after school program, summer club such as 4-H or Junior Master Gardener. Twenty-eight of the 31 teachers responded to the question. I assumed that the three that did not respond to this question were not interested in assistance with a school gardening program, and percentages were calculated using 28 as the base. Table 2 represents the responses distributed among grade levels. The most popular time for receiving assistance was during the school day (24, 77%).

Table 2

Timing for Assistance With a Gardening Program

Grade	During school	After school	Summer club	Before school
K	3 (11%)	1 (4%)	0	0
1	5 (18%)	1 (4%)	0	0
2	4 (14%)	0	0	0
3	2 (7%)	0	0	0
4	7 (25%)	5 (18%)	1 (4%)	1 (4%)
5	3 (11%)	3 (11%)	1 (4%)	0
Total	24 (77%)	12 (39%)	2 (6%)	1 (3%)

Note. Percentages are of the 28 who responded to this item.

Survey respondents were asked if they have utilized any of the following outreach education programs: 4-H, Cooperative Extension, VT STEM Outreach Programs, or other (briefly describe). Respondents were able to “check all that apply” and the “other” option allowed for space for a brief description. Nine out of the 31 respondents (29%) reported having utilized some type of outreach education programs. One kindergarten teacher reported having used 4-H outreach programs. One first grade teacher had utilized a program offered by the Home Depot. One third grade teacher had used 4-H programs. One fourth grade teacher had also used 4-H and another fourth grade teacher had utilized the Wood Magic Show offered by the Wood Science Department at Virginia Tech. Three fifth grade

teachers reported having used 4-H programs and one fifth grade teacher had used other Cooperative Extension programs.

Survey participants were also asked if they were interested in receiving more information on outreach programs offered through Virginia Tech. Twenty-nine (94%) responded that they were interested, and only two (6%) marked that they were not interested in receiving information on outreach programs.

Research question 4. *What experiential learning opportunities related to plants and environmental science are available to K-5 students?*

Survey participants were asked to give an example of a hands-on learning activity they have used in the classroom. The responses resulted in 27 usable answers. The examples were written in the respondents own words, so I interpreted the meanings and grouped them with similar activities in order to summarize the results in Table 4. My interpretation of each respondent's example, the possibility of respondents' examples not being thorough, and the fact that they gave one example but may utilize more than one hands-on activity in the classroom are all factors that might have affected the results. Most of the answers to this question referred to growing plants from seeds (9, 33%) and charting plant growth. The second most common example was observing plant roots (5, 19%). Several reported that they dissect flowers and other plant parts for observation (4, 15%) and compare plant growth in different environments (4, 15%). Table 3 provides a distribution of responses regarding hands-on activities among grade levels.

Another survey question related to experiential learning opportunities asked participants to give an example of an outdoor environment other than a school garden that they have used for teaching purposes. Eleven teachers (35%) reported they have not used any outdoor space other than a school garden. Twenty (65%) reported that they have used another outdoor space for teaching purposes. Eleven (55%) reported their outdoor lessons took place on the school grounds. Several did not specify

where the outdoor space was located. Only one teacher specifically reported going off school grounds for outdoor lessons.

Table 4 shows the grade level distribution of responses to a survey question that asked teachers if they incorporate field trips as a means of providing students with outdoor educational opportunities. The question allowed for a choice of three responses: no I prefer not to, no but I would like to, and yes. All respondents answered the question. Twenty (65%) of the teachers indicated that they do use field trips.

Table 3

Hands-on Learning Activities

Activity	K	1	2	3	4	5	Total
Grow plant from seed	1	2	2	0	4	0	9 (33%)
Observe plant roots	0	2	1	0	1	1	5 (19%)
Dissect and observe							
flower and plant parts	0	0	1	0	3	0	4 (15%)
Compare plant growth							
in different environments	0	1	1	1	1	0	4 (15%)
Graph plant growth	1	1	0	0	1	0	3 (11%)
Observe vascular vs.							
nonvascular plants	0	0	0	0	0	3	3 (11%)
Diagram plant parts	0	2	0	0	0	2	2 (7%)
Harvest and save seeds	2	0	0	0	0	2	2 (7%)
Study the life cycle of plants	0	0	0	1	1	0	2 (7%)
Study herbs and their uses	0	0	0	1	0	0	1 (4%)
Plant and study bulbs	0	1	0	0	0	0	1 (4%)

Note. Twenty-seven teachers responded to this survey question, 3 from kindergarten, 6 from 1st grade, 3 from 2nd, 3 from 3rd, 8 from 4th, and 4 from 5th.

Table 4

Field Trips

Grade Level	Yes	No, but I would like to	No, I prefer not to
K	1 (3%)	2 (6%)	0
1	4 (13%)	2 (6%)	0
2	2 (6%)	2 (6%)	0
3	1 (3%)	2 (6%)	0
4	5 (16%)	3 (10%)	0
5	6 (19%)	1 (3%)	0
Total	20 (65%)	11 (35%)	0 (0%)

Note. Percentages are of the 31 who responded to this item.

Research question 5. *Are K-5 teachers interested in in-service education to strengthen their knowledge of plants and environmental science?*

To determine interest, teachers were first asked about their comfort level when teaching lessons related to plants and environmental science. According to the responses from the survey, 19 (61%) teachers reported that they were very comfortable when teaching lessons related to plants and environmental science. Twelve (39%) indicated that they were somewhat comfortable, and none of the respondents marked that they were not comfortable teaching subject matter related to plants and environmental science.

Although the results showed their level of comfort was relatively high, most teachers showed interest in strengthening their knowledge related to plants and environmental science. Participants were asked if they would be interested in in-service education to enhance their knowledge and to gain ideas for hands-on activities that they can use in the classroom. Twenty-four of the 31 (77%) responded that they were interested in teacher in-service training, while only 7 (23%) were not interested in such training.

Teachers were asked when the most convenient time would be for them to attend in-service training. They were asked to check all answers that applied to them. Table 5 illustrates the most convenient times for teachers to attend in-service training. The most popular times were after school (16, 52%) and early release days (15, 48%).

Table 5

Teacher In-service Education

Grade	After school	Summer	Weekend	Early release	Evening
K	2 (8%)	2 (8%)	0	3 (13%)	0
1	4 (17%)	1 (4%)	0	5 (21%)	0
2	0	0	0	2 (8%)	0
3	1 (4%)	1 (4%)	0	0	0
4	1 (21%)	1 (4%)	3 (13%)	4 (17%)	3 (13%)
5	4 (17%)	2 (8%)	1 (4%)	1 (4%)	2 (8%)
Total	16 (52%)	15 (48%)	8 (26%)	5 (16%)	4 (13%)

Note. Percentages are of the 31 who responded to this item. Teachers were able to choose all times convenient for them.

Chapter Summary

This chapter presented the results obtained from the Science Teacher Survey. The data collected provided information that answered the research questions for this study. The data also provided valuable information that will facilitate the development of educational outreach programs offered by the Hahn Horticulture Garden at Virginia Tech.

Chapter 5

Summary, Conclusions, and Recommendations

This final chapter includes a summary of the study, conclusions, and recommendations for practice and future research.

Summary of Study

This study provided an assessment of the needs of K-5 science teachers and how their needs can be met through educational programs offered by the Hahn Horticulture Garden at Virginia Tech. The study focused on the need for supplemental programs to enhance the K-5 school curriculum in the areas of plants and environmental science. The responses to the study's survey instrument provided information on existing programs as well as perceived needs for such programs. Data were collected through a needs assessment survey sent to K-5 public school teachers in Montgomery County, Virginia. Survey results indicated existing programs, the need for programs, and how programs can best be implemented.

The objectives for the study were:

1. Identify the stakeholders,
2. Construct a survey to determine existing programs and perceived needs,
3. Evaluate the information gathered from the survey, and
4. Create a plan for developing and implementing the program.

The objectives for the study were met and outcomes have been presented throughout this paper. The stakeholders for educational and outreach programs include the students, teachers, school administrators, parents, and volunteers. The second objective was met by the development and implementation of the survey instrument. Existing programs and perceived needs were determined by analyzing the results of the survey and were presented in Chapter 4. Evaluation of all information

gathered from the survey was addressed in Chapter 4 of this report. Plans for developing and implementing programs will be discussed later in this chapter.

Conclusions

The Science Teacher Survey provided important information that will aid in the development of educational and outreach programs that will be offered by the Hahn Horticulture Garden at Virginia Tech to the local K-5 school community. The K-5 teachers who participated in the survey provided information on current teaching methods used, existing experiential learning opportunities for students, participants' desire for supplemental programs, and details regarding convenience for such programs. The results of the research allowed for conclusions to be drawn to obtain necessary information for program development. The conclusions are linked to the research questions for this study.

Research question 1. *Do the elementary schools in Montgomery County Public Schools have school gardens? To what extent do K-5 teachers use those gardens?*

The results of this study indicate there is a need for plant and environmental science programs that will supplement and enhance the school curriculum. The results showed that 42% of the responding teachers indicated that their school has a school garden, but only 13% of those use the school garden more than once per month. This may be due to a number of factors including the teacher's knowledge of how to effectively utilize a garden for teaching across the disciplines, administrative support, and possibly time and weather restrictions.

Research question 2. *What type of support is desired by K-5 teachers to enhance the Virginia Standards of Learning related to plants and environmental science?*

Seventy-seven percent of participants expressed interest in assistance with an SOL-friendly gardening program during regular school hours. A staff member from the Hahn Horticulture Garden at Virginia Tech should develop and/or utilize engaging lessons to assist teachers with gardening programs. Interest in such programs was also indicated in a previous study by Dobbs, Relf, and McDaniel, (1998) in

which 88% of K-6 teachers in the state of Virginia reported interest in using horticulture in the classroom. Other methods of enhancing lessons that correlate with the Standards of Learning that participants of the current study expressed interest in included taking a field trip to the Hahn Horticulture Garden at Virginia Tech (84%), having a guest speaker in the classroom (74%), receiving curriculum support from professionals at Virginia Tech (65%), and incorporating a gardening program into their curriculum (61%). Staff from the Hahn Garden should develop engaging field trips and offer to be a guest speaker in the classroom. Curriculum packets, lesson kits, and other materials should be developed and made available for teachers. The study by Dobbs, et al. (1998) found that teachers were willing to incorporate horticulture into their curriculum with the help of horticulture-based lesson plans, activities, posters, and a monthly newsletter for teachers to provide children's gardening activity ideas. This finding by Dobbs, et al. corresponds to the similar finding in this study that there is a need for supplemental curricula and programs to aid teachers with incorporating gardening and horticulture into their lessons. A study conducted by Phibbs and Relf (2005) also found similar results that verified the need for supplemental curricula and support for teachers. Results of the survey by Phibbs and Relf showed a need for new publications or programs for school enrichment. A list of available support materials, curriculum, and contacts was highly requested as resource needs.

Research question 3. *What is the best way to offer supplemental programs to the local schools?*

Because such a large number of teachers expressed interest in taking their class on a field trip to the Hahn Horticulture Garden, staff from the garden should develop garden tours that correlate with the Virginia Standards of Learning for each grade level. To maximize their visit, a pre-visit lesson can be created by garden staff and sent to the teachers. As suggested in the literature review, this will help to reduce anxiety often associated with exposing students and teachers to new surroundings; a pre-visit lesson can help make the most of the field trip experience (Haynes, Pieper, & Trexler 2005). Post-visit lessons and evaluations should also be incorporated so the students can share what they learned. The

field trip should also reinforce and coincide with lessons in the classroom. Supplemental programs should also be offered by bringing engaging lessons to the indoor or outdoor classroom. Lesson plans, activity kits, posters, and monthly newsletters with activity ideas would also be beneficial to teachers.

Research question 4. *What experiential learning opportunities related to plants and environmental science are available to K-5 students?*

The results from the survey indicated that the most common hands-on activity related to plants and environmental science teachers used with their class was growing plants from seeds. This activity was most commonly used by fourth-grade teachers. According to the Virginia Standards of Learning (2003), this activity links to several Standards of Learning (SOL) for fourth grade. The teachers might have the students make a hypothesis about growing plants from seed, record environmental conditions, and make a graph of plant growth; this would be covered under Virginia SOL 4.1 titled “Scientific Investigation, Reasoning, and Logic” and SOL 4.5, “Living Systems.” Another common activity used by fourth grade teachers was dissecting plants and observing their parts. This activity links to SOL 4.4 titled “Life Processes” (see Appendix F). Most of the activities that teachers listed in the survey can be linked to SOL for the corresponding grade levels. Teachers can manipulate the activities to satisfy the SOL for their grade. They can also expand on the activities to integrate other discipline areas in to the lessons.

Research question 5. *Are K-5 teachers interested in in-service education to strengthen their knowledge of plants and environmental science?*

Although 61% of the responding teachers reported that they are very comfortable when teaching plant-related SOL, 77% indicated interest in teacher in-service training to enhance their knowledge and to gain ideas for hands-on activities. Teachers may have the knowledge but lack methods to incorporate their school garden into their curriculum and across disciplines. As noted in the literature review, gardens are not only useful for teaching plant science, but can be used to teach across the curriculum. Concepts and skills from virtually every subject area can be learned through a garden

(Smith & Motsenbocker, 2005). Teacher in-service training workshops offered through the Hahn Horticulture Garden at Virginia Tech could provide teachers with multidisciplinary lessons that utilize their school garden. Of those interested in training, slightly over half (52%) chose after school and nearly half (48%) chose an early release day to be the most convenient time to attend training. This finding correlates with findings from a previous study which found that teachers felt they needed more training to effectively incorporate school gardening into the curriculum (DeMarco, Relf, & McDaniel, 1998).

Recommendations for Practice

Previous research results agree with my findings that supplemental programs in plants and environmental science would be beneficial to teachers. As recommended by Phibbs and Relf (2005), school garden programs should focus on issues that are currently important to school administration, such as compliance with state-mandated standards, time and cost efficient stimulation of academic achievement, and improving the health and nutrition of students. Administrators also encourage experiential learning opportunities. School gardens and other outdoor environments are ideal for such lessons. The main idea behind most school garden programs is hands-on, experiential learning (Klemmer, Waliczek, & Zajicek, 2005). School teachers in Montgomery County Public Schools can partner with and utilize resources offered by organizations such as the Hahn Horticulture Garden at Virginia Tech, VT-STEM, and Virginia Cooperative Extension. Teachers should also take advantage of professional development offerings to increase their knowledge and gain ideas to use in the classroom. In-service training opportunities will be offered through the Hahn Horticulture Garden at Virginia Tech. Teachers can also attend classes through Agriculture in the Classroom, Project Learning Tree, Junior Master Gardeners, and other organizations.

Recommendations for Future Research

Further research should be done to expand on the findings from this study. The information obtained from this study will be most beneficial to the Hahn Horticulture Garden at Virginia Tech as its staff members expand their educational and outreach programs. The results revealed information that will enable appropriate program development to best serve the local school community.

This study included a limited sample of K-5 science teachers from Montgomery County Public Schools in rural southwestern Virginia. Future studies might include a similar needs assessment survey intended for middle or high school teachers. Special education or career and technical education teachers are other potential study participants. The survey instrument should be given to rural, suburban, and inner-city teachers to compare the need for plant and environmental science support in different areas. A similar survey should also assess the needs of teachers in other areas and how their local public garden can assist with programs.

Because of the low response rate from the teachers, a different approach might be taken to obtain the same types of information. With the overload of emails teachers receive and the difficulty some participants encountered in accessing the survey instrument, a better response rate might be obtained by a different mode of delivery for the survey. A paper and pencil survey might have resulted in a better response for this particular survey. Personal interviews with the teachers would allow for more in-depth information to be gained. Due to time constraints and participant anonymity, personal interviews were not selected for this particular study.

A future study might focus on the benefits specific to a school garden or specific to another outdoor space. This would provide a different focus from this study, which considered all outdoor learning environments.

It would be informative to create another survey instrument to assess the benefits of teaching through school gardens and other outdoor environments. That study might include participants who

have utilized experiential teaching methods for plant and environmental science topics. Personal interviews might be the best mode to obtain personal experiences related to using such lessons in the curriculum.

Chapter Summary

There is an overall desire by teachers to supplement their lessons in plants and environmental science. There is also a need for programs to assist teachers with enhancing such lessons. The conclusions drawn from the results of this and similar studies will provide educators with a good foundation for developing and implementing programs that will supplement the K-5 curriculum and assist the teachers with lessons in plants and environmental science. With the increasing endorsement of experiential learning opportunities, teachers will continually strive to find ways to supplement their curriculum. School gardens and other outdoor environments not only offer experiential learning opportunities, they also instill in children an appreciation for their natural world.

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Science Teacher Survey

1. What grade do you teach?

2. What is the size of your class?

3. Do you have a school garden?

- No, please move on to question 5.
- Yes, please answer question 4.

4. How frequently do you use your school garden?

- At least once per week
- A couple of times per month
- Less than once per month

5. Please give one brief example of a hands-on learning activity you use in your classroom for SOLs related to plants.

6. Other than a school garden, have you utilized any outdoor space for teaching purposes?

- No, please move on to question 8.
- Yes, please answer question 7.

7. Please give one brief example of an outdoor space you have utilized for teaching purposes.

8. Do you incorporate field trips as a means of providing students with outdoor educational opportunities?

- No, I prefer not to.
- No, but I would like to.
- Yes

9. What is your level of comfort when teaching plant-related SOLs in the classroom?

- Very comfortable
- Somewhat comfortable
- Not comfortable

10. I would be interested in the following ways of enhancing plant-related SOLs:

- Incorporating a gardening program into my curriculum
- Having a guest speaker in the classroom

- Receiving curriculum support from professionals at Virginia Tech
- Taking a field trip to the Hahn Horticulture Garden

11. Would you be interested in teacher in-service training to enhance your knowledge of plants and to gain ideas for hands-on activities you can use in the classroom?

- No, please move on to question 13.
- Yes, please answer question 12.

12. Which of the following times would be most convenient to you for teacher in-service training?

- After school (4 pm)
- Evenings (7 pm)
- Early release day
- Weekend
- Summer

13. When would you prefer to be assisted with an SOL-friendly gardening program?

- during regular school hours
- before school program
- after school program
- summer club such as 4-H or Junior Master Gardeners

14. Have you utilized any of the following outreach education programs?

4-H

Cooperative Extension

VT STEM Science Outreach Programs

other: please describe briefly

15. Are you interested in receiving more information on outreach programs offered through Virginia Tech?

No

Yes

Thank you for taking time to participate in this survey!

Appendix B

Dear Investigators:

The Virginia Tech IRB has reviewed your research protocol entitled “**Enhancing the Educational Programs at the Hahn Horticulture Garden and Virginia Tech: Survey of Needs.**”

As of **September 10, 2007**, the IRB has **conditionally approved** the project contingent upon receipt of approval from Montgomery County Public Schools (MCPS). This conditional approval indicates to MCPS that the research protocol meets VT IRB requirements. To seek approval from MCPS, please send your IRB-approved protocol and supporting study documents to Laura Williams, Grant Writer, at lwilliams@mail.mcps.org.

If MCPS approval is received, please forward the approval to me via email, fax, or mail (see below). You will then receive your official IRB approval letter under which you may conduct research activities involving human subjects.

Sincerely,

Brandi Evans

Office of Research Compliance

Appendix C



Laura Williams, Grant Writer

Montgomery County Public Schools

208 College Street

Christiansburg, VA 24073

(540) 381-6158

September 13, 2007

Stephanie Huckestein

Education and Outreach Coordinator

Hahn Horticulture Garden

at Virginia Tech

301 Saunders Hall

Blacksburg, VA 24061

Dear Ms. Huckestein,

I have reviewed the research proposal you submitted to Montgomery County Public Schools, in consultation with the MCPS Supervisor of Science. This letter serves as notification that MCPS

has approved at the district level your proposal to conduct the study, *Enhancing the Educational Programs at the Hahn Horticulture Garden at Virginia Tech: Survey of Needs*.

According to your proposal, you hope to survey MCPS 4th grade teachers. This letter gives you permission to approach the principals at our eleven elementary schools to request their teachers' participation in your study. The decision as to whether to participate will rest with each individual MCPS elementary school. It is our understanding that teachers will participate in this study on a voluntary basis, and that you will not identify any individuals or schools in your thesis or any other published works that result from your research.

If you have questions or need any further assistance in implementing this study, please don't hesitate to contact me.

Sincerely,

Laura Williams

Cc: Lois Graham, Director of Elementary Education
Patty Gaudreau, Supervisor of Science
MCPS Elementary Principals

Appendix D

Survey Invitation Email

Dear Science Teachers,

I am a graduate student at Virginia Tech working on my Masters of Science in Career and Technical Education with a concentration in Agricultural Education. I am also the Education and Outreach Coordinator for the Hahn Horticulture Garden at Virginia Tech. I would like to invite you to participate in an online survey developed to assess the needs of science teachers at Montgomery County Public Schools, and how your needs can be met through educational outreach programs through the Hahn Horticulture Garden at Virginia Tech. My thesis is titled "Enhancing the Educational Programs at the Hahn Horticulture Garden at Virginia Tech: Survey of Needs."

As part of a land grant university, the Hahn Horticulture Garden at Virginia Tech would like to increase its outreach efforts to the local public and private schools. The survey will allow the researcher to assess the needs of science teachers, and identify or discover how their needs can be met through educational programs. The school programs that will be developed will link all curriculum and activities to the Virginia Standards of Learning.

You are being asked to participate in this study as a science teacher in the Montgomery County School system, and your participation is totally voluntary. The survey specifically relates to school gardens and methods of teaching SOLs related to plants.

The results of this study will be used in my thesis, and will also help in program development that will integrate fun, inquiry-based programs to enhance your plant and environmental science lessons.

The survey will take no longer than 10 minutes of your time to complete. Please feel free to contact me if you have any trouble accessing the survey instrument or if you have other questions or concerns. Please complete the survey by October 26, 2007. The survey can be accessed by clicking on the following link:

<https://survey.vt.edu/survey/entry.jsp?id=1186518404063>

Please see the attached documents regarding your participation in this study as required by the Institutional Review Board.

Thank you for your time and consideration. I look forward to working with you in the future.

Sincerely,

Stephanie Huckestein

vtgarden@vt.edu

540-231-5970

Survey Reminder Email

Dear Science Teachers,

Two weeks ago you received an email asking you to participate in a survey titled “Enhancing the Educational Programs at the Hahn Horticulture Garden at Virginia Tech.” Thank you to those who have completed the survey, your input will be very helpful with my thesis as well as for developing education programs through the Hahn Horticulture Garden at Virginia Tech. If you have not yet completed the survey, please consider doing so. I hope to conclude the survey on October 26, 2007. Your input will allow me to gain an accurate assessment for my survey and will lead to the development of programs that may be valuable to enhance your classroom science lessons.

The survey can be accessed by clicking on the following link or copying and pasting the link into your web browser. The survey should take about 10 minutes to complete. Thank you for your consideration.

The survey can be accessed at <https://survey.vt.edu/survey/entry.jsp?id=1186518404063>

Please feel free to contact me if you have any problems accessing the survey or any other questions or concerns.

Sincerely,

Stephanie Huckestein

540-231-5970

vtgarden@vt.edu

Interview Invitation Email

Dear Science Teachers,

Thank you for taking the time to complete the survey titled “Enhancing the Educational Programs at the Hahn Horticulture Garden at Virginia Tech.” Your response indicated that you may be interested in SOL-friendly outreach programs. I would like to take time to get further input on what types of programs would benefit you and enhance your SOL lessons related to plants. Please respond to this email if you are willing to take a bit of time to talk with me more in depth about outreach programs that can enhance your classroom lessons related to plants and environmental education. I look forward to hearing from you.

Thank you again for your time and cooperation.

Sincerely,

Stephanie Huckestein

540-231-5970

vtgarden@vt.edu

Science Teacher Survey Results

1. What grade do you teach?

31 responses [view this question](#) [view all questions](#)

2. What is the size of your class?

31 responses [view this question](#) [view all questions](#)

3. Do you have a school garden?

No, please move on to question 5. **18** (58%) 

Yes, please answer question 4. **13** (42%) 

no answer **0** (0%)

4. How frequently do you use your school garden?

At least once per week **1** (3%) 

A couple of times per month **3** (10%) 

Less than once per month **10** (32%) 

no answer **17** (55%) 

5. Please give one brief example of a hands-on learning activity you use in your

classroom for SOLs related to plants.

30 responses [view this question](#) [view all questions](#)

6. Other than a school garden, have you utilized any outdoor space for teaching purposes?

No, please move on to question 8. **11** (35%) 

Yes, please answer question 7. **20** (65%) 

no answer **0** (0%)

7. Please give one brief example of an outdoor space you have utilized for teaching purposes.

21 responses [view this question](#) [view all questions](#)

8. Do you incorporate field trips as a means of providing students with outdoor educational opportunities?

No, I prefer not to. **0** (0%)

No, but I would like to. **11** (35%) 

Yes **20** (65%) 

no answer **0** (0%)

9. What is your level of comfort when teaching plant-related SOLs in the classroom?

Very comfortable **19** (61%) 

Somewhat comfortable **12** (39%) 

Not comfortable **0** (0%)

no answer **0** (0%)

10. I would be interested in the following ways of enhancing plant-related SOLs:

Incorporating a gardening program into my curriculum **19** (61%) 

Having a guest speaker in the classroom **23** (74%) 

Receiving curriculum support from professionals at Virginia Tech **20** (65%) 

Taking a field trip to the Hahn Horticulture Garden **26** (84%) 

11. Would you be interested in teacher in-service training to enhance your knowledge of plants and to gain ideas for hands-on activities you can use in the classroom?

No, please move on to question 13. **7** (23%) 

Yes, please answer question 12. **24** (77%) 

no answer **0** (0%)

12. Which of the following times would be most convenient to you for teacher in-service training?

After school (4 pm) **16** (52%) 

Evenings (7 pm) **5** (16%) 

Early release day **15** (48%) 

Weekend **4** (13%) 

Summer **8** (26%) 

13. When would you prefer to be assisted with an SOL-friendly gardening program?

during regular school hours **24** (77%) 

before school program **1** (3%) 

after school program **12** (39%) 

summer club such as 4-H or Junior Master Gardeners **2** (6%) 

14. Have you utilized any of the following outreach education programs?

4-H **6** (19%) 

Cooperative Extension **1** (3%) 

VT STEM Science Outreach Programs **0** (0%)

other: please describe briefly **2** (6%) 

15. Are you interested in receiving more information on outreach programs offered through Virginia Tech?

No **2** (6%) 

Yes **29** (94%) 

no answer **0** (0%)

Thank you for taking time to participate in this survey!

Appendix F

Science SOL Sequence by Strand K-5

Scientific Investigation	K.1 Observation of Properties	1.1 Physical properties, Classification, Measurement, Graphing	2.1 Classification, Measurement, Graphing, Data Analysis, Variables, Building Models	3.1 Classification, Measurement, Graphing, Data Analysis, Inferences, Sequencing	4.1 Measurement, Interpreting Graphs, Data Analysis, Variables, Experimental Design	5.1 Classification, Measurement, Interpreting Graphs, Data Analysis, Manipulating Variables
Physical Properties	K.2 Senses and Sense Descriptions	1.1 Physical Properties/ Senses				5.1 Dichotomous Key with Rocks/Minerals
Motion, Energy		1.2 Motion		3.2 Simple Machines	4.2 Motion 4.3 Electricity	5.3 Light 5.4 Sound
Magnetism	K.3 Magnets		2.2 Magnets		4.2 Forces 4.3 Magnetism	
States of Matter Properties	K.5 Water, States Floats and Sinks	1.3 Interactions with Water	2.3 States of Matter	3.3 Properties 3.9 Water Cycle		States/ Properties of Matter
Life Processes	K.6 Basic Needs K.8 Shapes/Forms of Common Natural Objects K.8 Animal and Plant Growth as a Pattern K.9 Change Over Time	1.4, 1.5 • Plant/Animal • Life Needs • Characteristics 1.7 Process and Cycles	2.4 Life Cycles/ Development	3.4 Adaptations 3.8 Animal/Plant Life Cycles 3.10 Interdependency of Plants/Animals	4.4 Plant Anatomy and Life Processes	
Living Systems			2.5 Living Systems and Habitats	3.5 Food Chains 3.6 Water/Land Environments and Community Population	4.5 Ecosystems 4.8 Watershed/Water Resources Animals/Plants	5.5 Cells

					Forests, Soil, Land	
Earth/Space	K.7 Light and Shadow	1.6 Relationships	2.6 Weather	3.7 Soil	4.6 Weather	5.6 Ocean
Strand	Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
		and Earth		Phases, Tides; Daylight 3.8 Animal/Plant Life Cycles (K,1)	4.7 Earth, Moon, Sun	5.7 Identification of Rock Types
Patterns and Cycles	K.8 Shapes/Forms of Natural Objects; Animal and Plant Growth as a Pattern; Routines, Weather	1.7 Process and Cycles	2.7 Adaptation Weathering, Erosion 2.4 Life Cycles/ Development	3.8 Animal/Plant Life Cycles	4.7 Earth, Moon, Sun	5.7 The Rock Cycle <ul style="list-style-type: none"> • Earth History • Earth's Interior Structure • Plate Tectonics • Weathering and Erosion
Resources	K.10 Recycling / Conservation	1.8 Recycling, Reusing, Natural Resources; Air/Water Quality	2.8 Plant Products	3.10 Conservation /resources 3.11 Energy Resources	4.8 Energy Sources; Minerals, Rock Sources	5.7 Identification of Rock Types