GREEN SCHOOLS – THE IMPLEMENTATION AND PRACTICES OF ENVIRONMENTAL EDUCATION IN LEED AND USED GREEN RIBBON PUBLIC SCHOOLS IN VIRGINIA

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ABSTRACT

The purpose of this study was to examine the environmental education curriculum which has been utilized within Green Schools. The study defined Green Schools as educational facilities with Leadership in Energy and Environmental Design (LEED) certification or United States Education Department (USED) Green Ribbon recognition. Currently, there is no set standard for the implementation of environmental education in Green Schools or for schools that utilize the building as a teaching tool for students. The researcher surveyed Green Schools in the Commonwealth of Virginia in order to better understand what common programs and curricula were being utilized. The findings will assist in establishing pedagogical best practices for environmental education while describing how LEED certified buildings are currently being used by educators as a teaching tool to support sustainable practices. Overall, 14 Green Schools in the Commonwealth of Virginia agreed to participate in the study. Once principals and staff gave consent to participate in the study, they were asked to respond to an eSurvey, which consisted of 14 multiple choice and open response survey items. Overall, 98 principals and staff participated in the survey. Quantitative data were collected through multiple choice survey questions analyzed to report descriptive statistics about the sample population. Qualitative data were examined by emerging themes according to pedagogical strategies and programs. The findings from the study indicated that teachers are employing practices that are consistent with current emphases on environmental education. Data also supported that educators take pride in their buildings and incorporate the facility as a teaching tool in a variety of instructional practices throughout the Commonwealth of Virginia.

INTRODUCTION

Gordon (2010) defines Green Schools as the results of the planning, designing, and construction process that, "takes into account a building's performance over its entire 50-60 year live cycle" (p. 1) with a focus on creating an environment that is optimal for learning. Green Schools create this optimal environment by providing fresh air, a comfortable temperature range, with plenty of natural lighting, and minimizes distractions from nearby noises "while also maximizing resource efficiency, minimizing pollution, and teaching students the importance of innovation in the built environment" (p. 1).

While there has been a growing trend in Green School research, much of the research has emphasized the building components and energy conservation, rather than how the building features are utilized to teach students about sustainability. In order to be called a Green School, the building must teach about sustainability. Green Schools have two components that are tied directly to educating students about sustainability. The first component is that the building is utilized as a teaching tool for students to learn about sustainability. Leadership in Energy and Environmental Design (LEED) 2009 for Schools New Construction defines the school as a teaching tool when it has a curriculum based on

the green performance features of the building that is implemented within 10 months of the LEED Certification. The curriculum must meet state requirements and go beyond a mere description of the features. Instead, the building should "explore the relationship between human ecology, natural ecology and the building" (USGBC, 2012, np).

The second component a school must incorporate to maintain its Green School status is that the building must utilize a curriculum for teaching environmental (or sustainable) education. This component does not directly tie sustainability to the features of the building; rather, it infuses sustainable practices and education throughout the curricula taught in the building. However, there is no set standard with regard to environmental education curriculum.

The United States Department of Education (USED) recently launched its Green Ribbon Schools, the first comprehensive federal policy for schools that relates environment, health, and education. This award recognizes the work and programs in place at schools reaching high levels of achievement in environmental impact, healthy environment, and environmental literacy. This seemed to be one of the closest efforts in creating a standard for a curriculum that supports environmental education in Green Schools. At the same time teachers and administrators in LEED Schools were implementing the educational components of that certification requirement. To date the degree that this implementation adheres to the intent of the educational LEED requirement is more of an individual matter than a specified effort.

Higher accountability, higher energy cost, and shrinking school budgets are some of major issues many school systems currently face. In addition, school divisions and administrators are carrying the heavy burden and increased pressure to improve student's achievement levels with less money and resources (Kats, 2006; Okcu, 2011). One subject that has recently grown in interest over the past decade is the development of sustainable or Green Schools. Another recent trend in research related to Green Schools was the use of the building as a teaching tool for sustainability. However, this was not emphasized in research and there are no set of standards or consistency with regard to school implementation and little research has been conducted on the subject (Chan, 2013; Cole, 2013).

RESEARCH QUESTIONS

This study sought to answer the following research questions:
The major research question is:
How do USED Green Ribbon and LEED schools in Virginia implement environmental education into the curriculum?

The sub-questions are:

a. In what way is environmental education included in the curriculum of the school division?

b. To what extent is the implementation of environmental education directed by individual classroom teachers?

c. What common practices and strategies are used to implement environmental education?

d. What level are the practices used to implement environmental education formally evaluated?

e. How do LEED schools in Virginia utilize the building components as teaching tool?

SIGNIFICANCE OF THE STUDY

While considerable research has been conducted linking building conditions to student achievement and staff performance, there has been little research linking any added benefits of newly designed sustainable school buildings, and even less on the topic of Green Schools as a teaching tool (Barr, 2013; Chan, 2013; Cole, 2013; Edwards, 2006; Issa, 2011; Kats, 2006; Okcu, Ryherd, & Bayer, 2011; Olson & Kellum, 2003). Green buildings have criteria of an educational program to help students become aware of their environment (Barr, 2011; Chan, 2013; Cole, 2013). While Green Schools are designed to utilize a curriculum for environmental education which uses the building as a teaching tool, there is no set standard or criteria of implementation (Barr, 2012). LEED and USED Green Ribbon schools provide a framework for the implementation of environmental education which can be further examined to assist in establishing what common themes are currently found in environmental education curricula.

As an educational leader, it is important for principals to consider the economic impact the school program has on the school division and the community as tax payers. It is equally important to understand how environmental education can positively influence staff, and students, and how the surrounding community can assist in the promotion of civic and environmental responsibility. Each of these components is important to consider as a responsibility of the school system.

This study will add to the current, but limited, body of research involving Green Schools with regard to usage of the building as a teaching tool and implementation of environmental education. The findings from this study will help educators and planners see current trends of sustainability curricula in Green Schools and how Green Schools are used as a teaching tool for sustainability.

REVIEW OF LITERATURE

Research has shown that the quality of school facilities is associated with student and staff health, attendance, and performance. LEED design aims to improve elements such as lighting, acoustics, and indoor air quality, while utilizing design features to support environmental education practices. Further research is needed to investigate the impact of LEED building design on outcomes such as environmental education/sustainability, student achievement, student and staff attendance rates, and occupant satisfaction. The studies examined in this review all attempt to build a foundation of empirical evidence that supports the idea that green schools improve student achievement and decrease absences for students and staff (Bruick, 2009, Edwards, 2005; Issa, 2011; LaBuhn, 2010; Oetinger, 2010). Currently, there is no formal educational research that examines the implementation

of environmental education and sustainability program in Green Schools. Three of the studies reviewed utilized a collection of regional data from smaller samples sizes to compare student achievement and attendance in green schools with non-green schools (Bruick, 2010; Edwards, 2005; Issa, 2011). The other two studies utilized a sample population from across the United States (LaBuhn, 2010; Oetinger, 2010). While many of the studies did not find a positive relationship between green schools and student achievement and attendance that was statistically significant, the studies did show improvement in both dependent variables (Bruick, 2010; Edwards, 2005; Issa, 2011; Oetinger, 2010). LaBuhn's study (2010) was the only study where green schools were significantly outperformed by non-green schools across many populations throughout the United States. However, it should be noted that the design did not utilize matched pairs when setting up the samples as part of the design methodology. Instead, the study compared green schools to non-green schools in the same district or geographic location and analyzed data using a simple linear regression (LaBuhn, 2010).

More research on LEED and Green Schools is needed to add to the foundation of knowledge regarding the impact of Green Schools on occupants and implementation of environmental education linked to these schools.

Outside of the referenced research, there is still little empirical research related to Green Schools. Presently, there is no educational research that examines Green Schools as a teaching tool for environmental education or how this might affect student performance. As popularity of Green Schools continues to grow, it is important that the educational components of these facilities also grow in order to increase student, staff, and community understanding of the energy performance features and learning outcomes that are offered within these buildings. Students spend many years inside school facilities, as school divisions move forward with new construction, it is important that these facilities also serve to supplement the curricula and engage students, staff, and the community with regard to environmental education and sustainable practices.

The United States Department of Education (USED) developed a program in 2011, USED Green Ribbon Schools, that recognizes and honors "schools and districts that are exemplary in reducing environmental impact and costs; improving the health and wellness of students and staff; and providing effective environmental and sustainability education, which incorporates STEM, civic skills and green career pathways" (USED Green Ribbon Schools, 2013, np). According to the USED Green Ribbon, the recognition award is part of an effort to identify and inform the public about "practices that are proven to result in improved student engagement, higher academic achievement and graduation rates, and workforce preparedness, as well as a government wide goal of increasing energy independence and economic security" (USED Green Ribbon Schools, 2013, np).
USED Green Ribbon criteria seems to further explain the criteria of LEED. USED Green Ribbon's aim is not only to construct buildings that are energy efficient and healthier for occupants, but also to educate students about sustainability and the responsibility that individuals have with respect to their impact on the environment. In the future, these programs may lead the way in developing standardized criteria for implementation of environmental education within schools, both new and old.

METHODOLOGY

The purpose of this study was to ascertain the educational practices implemented in Green School to meet the educational requirements for LEED and USED Green School certification. Therefore, the building population of the study were the school buildings that were certified as either LEED or USED Green Schools. At the time of the study, there were 17 public schools in the Commonwealth of Virginia that were LEED or USED Green Ribbon certified. Of those schools, 14 agreed to participate in the study. An eSurvey with both multiple choice and open-ended questions was utilized to for data collection. The population of the study included all principals and faculty from the schools, and communication to invite participates was filtered through the principals of each school. The study included all schools that were currently certified as LEED; schools that have completed construction, have been utilized for a minimum of one year, and were pending or completed certification from USGBC; and USED Green Ribbon Schools for the population. A complete listing of the LEED and USED Green Ribbon schools in the Commonwealth of Virginia is contained in Appendix A. This mixed methods study analyzed quantitative data through descriptive statistics. The qualitative data were coded and examined for common themes that existed in implementation practices between schools and divisions.

SUMMARY OF FINDINGS

Research Question a.

In what way is environmental education included in the curriculum of the school division?

Almost half of the participants (49%) responded that environmental education was included in the curriculum of the school division. Nearly one-third (32%) of the participants responded that environmental education was not included in the curriculum, or they were unsure if it was included in the curriculum of the school division. Nearly one-fifth (19%) of the participants did not respond to this particular survey item. Since a non-response does not necessarily negate the inclusion of environmental education, it was coded separately. (See Table 1.)

Table 1 – Integration of Environmental Education in the Curriculum

Responses	Percent of Responses
Yes	49
No or Unsure	32
No Response	19

Positive responses from participants varied and were coded according to common themes that developed: Building, Community, Curricula, Learning Garden, and School Programs. The two themes mentioned the most were curricula and school programs and many responses incorporated more than one theme. It was evident that there are many ways to incorporate environmental education into the formal and informal curricula that exists in Green Schools.

Several examples include incorporating sustainability concepts into the formal curriculum through STEM, cross-curricular assignments, research assignments, using informational and fictional text, class debate/discussion on current events, field trips, outdoor classroom, learning garden, and class projects. There are also ways to include environmental education and sustainable practices informally into the curriculum. Some examples from the survey instrument include recycling programs, environmental clubs, civic and community service projects, fieldtrips, and by reducing energy usage. There are many ways to create school-wide opportunities for students to learn about sustainability and the added benefit of school-wide programs is that it works to establish a culture of sustainable practices throughout the school.

Research Question b.

To what extent is the implementation of environmental education directed by individual classroom teachers?

Almost half of the participants (48%) responded that implementation of environmental education occurs by individual classroom teachers initiative. Many participants (30%) responded that implementation was a school-wide process. While only 8% responded that implementation took place by grade level or department level.

When implementation takes place as a school-wide process, it also supports a culture of sustainability within the Green School. One participant stated, "I think the most unique practice I've seen at this school is how most of the kids and staff (most of them) will automatically pick up a bug and take it outside, rather than squish it." (R30). However, at the individual level, it may be difficult to establish and maintain a whole-school program over time. One participant stated, "…in past years we monitored the weight of paper collected from each source within the school and created displays of the data using Excel spread sheets, formulas and graphics. This monitoring encouraged participation by teachers." (R66).

As an instructional leader, it is important to consider how implementation should occur within the school. When implementation takes place as a school-wide process, it also supports a culture of sustainability within the Green School. However, at the individual level, it may be difficult to establish and maintain a whole-school program.

Research Question c.

What common practices and strategies are used to implement environmental education?

There were several resources, practices, and programs used to implement environmental education. The internet (21%) and project based learning (20%) were the most common resources provided in responses among participants. Other themes that developed from responses included multimedia, learning garden, community partnerships/field trips, and none. The most common programs utilized in Green Schools included recycling programs (26%) and community outreach/partnerships (22%).

Throughout the study, it was evident that teachers are employing practices that are consistent with current emphases on environmental education. This was evident by the response from (R59); "We gathered school heating and cooling data from the county's environmental compliance manager to study the current efficiency of managing the school's temperature using Newton's Law of cooling." Furthermore, participants seemed

to show a sense of pride for the school and the sustainable programs that are implemented. One participant (R42) stated; "We have a wonderful horticulture program that teaches sustainable farming." Another stated; "In my opinion, we are the most unique school in the state. Our ability to have an on campus laboratory specifically built and designed for environmental studies puts The Gereau Center/CEED on the cutting edge of environmental education." (R31). However, overtime, if environmental education and sustainability were not part of a whole-school culture then practices and awareness were utilized less by teachers. This is evident from the response of participant (R68); "There are plaques on the walls, but I bet it's been a long time since anyone read them." Also, (R63) stated; "It is my understanding that with LEED certification our school is to be recycling paper, aluminium and plastics, as well as composting leaves and grass clippings. The only program we actually implemented is paper recycling. I find this discouraging."

Implementation of environmental education does not occur overnight; instead it is a process that should be planned out with annual goals or benchmarks. For example, many of the Green Schools in Virginia incorporated a recycling program and/or community partnership/ outreach as part of the environmental educational practices. A recycling program is relatively simple to start up and can include a variety of items (paper, aluminium, plastic, cell phones, batteries, etc.) while including all staff and students. Community outreach/ partnerships vary according to the location and geography of the school division. Some of the common activities included field trips and sponsorships through local environmental agencies such as, Save the Bay Foundation, James River Association, Culpeper Soil and Water Conservation District, and Virginia Department of Environmental Quality.

Building a learning garden on the school grounds was another common qualitative response from the participants. This strategy can be utilized in a variety of ways while offering students hand-on learning experiences. Project-based learning activities were a common quantitative response and participants provided a variety of qualitative examples. These examples included: STEM projects; field trips to examine stream health; collecting and monitoring data on recycling, energy usage, and water usage in the building; and creating videos to advertise sustainable aspects of the building and programs.

The practices and strategies mentioned are valuable additions to the formal and informal curricula of the school. They incorporate real-world concepts and high engagement hands-on activities which assist in creating 21st century learning opportunities and authentic experiences for students. These are educational aspects that all instructional leaders can find value. However, in LEED schools where the building is used as a teaching tool, it is important for educational leaders to consider on-going staff development, so they are aware of the sustainable features and learning opportunities that exist within the building. Refer to table 1 for specific examples environmental education practices by school level.

Research Question d.

What level are the practices used to implement environmental education formally evaluated?

Almost half the participants (40%) responded that environmental education was evaluated at the school level. Evaluation at school division level (4%) and evaluation by an outside agency (2%) were much lower, however, and 8% percent of the teachers responded that there were two or more agencies that evaluated the program. Participants that selected two or more items included the following: two participants selected evaluation at the district

level and by an outside agency; two participants selected evaluation at the school level and district level; three participants selected evaluation at the school level, district level, and by an outside agency; and one participant selected evaluation by an outside agency and other: Lynnhaven River Now for Pearl School recognition. No response to the survey item consisted of 25% of the participants. Lastly, 21% of the participants responded with 'other.' Those participants provided the following types of answers; "part of PLTW exam" (R67), "No," "No evaluation," "Not sure," "I don't know," and "None of the above."

As instructional leaders in the building, it is important for teachers to understand that they are the person responsible for the successes within the school. This should be a primary emphasis when it comes to establishing a Green School with a culture that supports sustainable practices.

Research Question e.

How do LEED schools in Virginia utilize the building components as teaching tool?

There were seven themes that developed from the analysis of data. These themes include: lighting, water reduction, learning garden, signage, building monitoring system, building design and energy savings, and community involvement. While, many responses included various features of the LEED buildings, many did not provide specific details regarding how teachers used the building as a teaching tool. Refer to Table 3 for specific examples regarding how teachers utilized the building as a teaching tool.

It was evident that many participants utilize features of the building and share information about the sustainable features with students in their classes. This took place in both the formal and informal curricula of the schools. It was also evident that school staff took pride in teaching in a Green School. One participant stated; "We have the coolest school ever!" (R28). Another stated; "This is a fabulous beautiful school. There are signs all about put in by the contractor denoting all the green aspects of the building." (R58).

While all the responses of participants varied in detail, the data collected did provide useful information regarding the implementation of environmental education in Green Schools. According to the responses of participants, knowledge of environmental education and Green Schools varies from school to school and person to person. This was evident with the number of responses that included detailed information about the sustainable aspects of the school, environmental programs, and staff knowledge about curricula used to teach about environmental education and the building as a teaching tool. This was also evident with regard to the number of responses that included answers such as 'I don't know,' 'Unsure,' and no response at all for particular survey items.

There is a large variety of activities in LEED schools that utilize the building components as a teaching tool. Many of the activities that incorporated the building components within the learning process were developed around conversations related to community service/clubs, conservation, recycling, natural resources, pollution, engineering, and alternative sources of energy. These topics were related to many different aspects of the building also. Many of the topics utilize the building signage are part of the lesson. Lessons related to conservation, recycling, reduction of energy often utilized aspects of the building such as various lighting features that save energy or support an increase of natural light within the building. Teachers also discussed components that reduced water and energy usage. Many of the community service projects and clubs took advantage of various types recycling and outdoor learning spaces such as courtyards, learning gardens,

compost bins, and retention ponds. While specific lessons were not provided within the data collected by the survey instrument, it was evident that many the participants actively utilized components of the buildings and/or discussed specific building features with students.

SUGGESTIONS FOR FUTURE STUDIES

Future studies may also consider modifying the survey instrument to include only those Green Schools that utilize the building as a teaching tool for those specific survey items. While there were only three schools that were not LEED certified it was evident that not all participants were knowledgeable with regard to the identification of LEED versus USED Green Ribbon. For example, participant (R63) stated; "I don't know what the LEED building design is. We know we are a green school and how to work to obtain and keep that classification but what is LEED? If you don't define it don't use the term." Lastly, future studies may also consider incorporating focus groups and/or phone interviews as part of the data collection. This addition to the methodology would allow the researcher to ask follow up questions and expand on responses to help ensure clarity and data saturation for future studies.

REFLECTIONS

Overall, this was a successful study with regard to working with several school divisions across the Commonwealth of Virginia and several principals from all school levels. Many of the school divisions were supportive and interested in the study. However, because of the timing for the survey, there were some environmental factors that may have affected the number of participants that responded to the survey instrument. Many schools across the state of Virginia were closed for several days due to inclement weather on the first day that surveys were to be sent to teachers by the school principals. As a result, this required much more follow up on the researchers part to ensure that surveys were sent out in a timely manner and that all participants had an equal time to complete the survey.

Overall, the research study was a positive experience and it was interesting to see how schools from a diverse population implemented environmental education and sustainability. However, responses did differ with respect to in-depth details. Some of the responses were quite detailed and utilized several aspects of the building as a teaching tool, for example, the building monitoring system was used by many to track and monitor energy usage. The researcher's assumption was that many participants would respond with familiar aspects of the LEED building such as informational signage and increased natural lighting.

Educational leaders should understand that the implementation of a Green School does not occur overnight; instead it is a process that should be planned out with annual goals or benchmarks. For example, many of the Green Schools in Virginia incorporated a recycling program and/or community partnership/outreach as part of environmental educational practices. A recycling program is relatively simple to start up and can include a variety of items (paper, aluminium, plastic, cell phones, batteries, etc.). This can also be a school-wide program, which will support buy-in from all staff and students. Community outreach/partnerships vary according to the location and geography of the school division. Some of the common activities included field trips and clean up around the school grounds or nearby parks. Throughout the study, it was evident that teachers are employing practices that are consistent with current emphases on environmental education.

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Appendix A: List of Green Schools in Virginia

School	Division	Type of Green School
Albemarle High School	Albemarle County	LEED - Silver
Brownsville Elementary	Albemarle County	LEED - Gold*
Stony Point Elementary	Albemarle County	USED Green Ribbon
Fluvanna High School	Fluvanna County	LEED - Silver
Gereau Center/CEED	Franklin County	USED Green Ribbon
Glen Allen High School	Henrico	LEED - Gold*
Holman Middle School	Henrico	LEED - Silver*
Magna Vista High	Henry County	USED Green Ribbon
Sandusky Middle School	Lynchburg City	LEED - Certified
Locust Grove Middle School	Orange County	LEED - Gold*
Kettle Run Elementary	Prince William County	LEED - Silver
Piney Branch Elementary	Prince William County	LEED - Silver*
Fishburn Park Elementary	Roanoke City	USED Green Ribbon
College Park Elementary	Virginia Beach	LEED - Platinum
Hermitage Elementary	Virginia Beach	LEED - Certified
Virginia Beach Middle	Virginia Beach	LEED - Silver
Windsor Oaks Elementary	Virginia Beach	LEED - Silver*

Note. * indicates that the school earned a point on the LEED application for utilizing the building as a teaching tool.

Table 2 - Environmental Education Practices by School Level

School Level	Environmental Education Practices
Elementary	• Have discussions about natural resources/conservation and use examples of ways the school helps to use fewer resources. Further, discuss alternative energy and power sources such as wind and solar power.
	• Use an outdoor garden space at the school for each grade level. Students use the outdoor space to grow a choice salad food, to harvest and eat together as a class later in the spring or to grow indigenous plants.
	• Create Recycling Programs, Environmental Clubs, and community service projects
	• Create an overarching theme for grade levels to teach how systems work.
	• Utilize science units on the water cycle to discus and teach about conservation.
Middle	• Integrate concepts such as zero net carbon and energy building that actually produces its own energy through solar arrays and wind turbines. Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy.
	• Use the science curriculum where several standards relate to the environment and sustainability. Have students cover alternative energy sources, point source and non-point source pollution, and renewable vs. nonrenewable resources.
	• Create Recycling Programs, Environmental Clubs, and community service projects
	• Utilize School Announcements.
	• Use the English research unit to focus on students selecting an environmental issue, researching it, and presenting pros and cons.
	• In Language Arts, use informational texts and fictional texts about the environment, pollution, and its effects.
	• Discuss renewable and nonrenewable energy resources and complete an in-class project about energy conservation.
	• Allow student to enter a poster in the James River Association's poster contest titled 'What a Healthy River Means to Me.'
	• Educate students about the cost of building and operating solid-waste facilities and the value of recycling different products.
High	• Utilize the science curriculum concepts that discuss reduction of materials, reuse of materials, and recycling.
	• Utilize units that include learning about renewable energy options and analyzing the viability for renewable energy in VA.
	• Use data contacts and operators for the air quality monitoring station and information available for teachers. Use curriculum links for

	NEED.org that is available to teachers.
	• Use science courses to teach sustainability, model it, and survey students and teach about our footprint. Incorporate stream study into the curriculum and create a 'pond in the classroom to teach concepts about ecology.
	• Use the engineering class to introduce concepts from the curriculum, especially those concerning energy and clean water.
	• Discuss current topics in other countries, which often deal with pollution and other environmental concerns (i.e., clean water).
	• Utilize the course on environmental science.
	• Use the STEM curriculum.

Note. STEM is an acronym for Science, Technology, Engineering, and Mathematics

Table 3 - Environmental Education Practices that use the Building by School Level

School Level	Environmental Education Practices	Building as a Teaching Tool
Elementary	• Have discussions about natural resources/conservation and use examples of ways the school helps to use fewer resources. Further, discuss alternative energy and power sources such as wind and solar power.	• Use open spaces for class discussions to show how light harvesting tiles, special lights, use of windows for optimal light, and plumbing - toilets that use less water, waterless urinals, motion sensor facets, rain collection, and retention ponds conserve energy and utilize natural resources.
	• Use an outdoor garden space at the school for each grade level. Students use the outdoor space to grow a choice salad food, to harvest and eat together as a class later in the spring or to grow indigenous plants.	• Use interior and exterior gardens for hands-on learning and explain how natural materials are used for building.
	• Create Recycling Programs, Environmental Clubs, and community service projects	• Use recycling cans throughout the building, create various recycling programs, compost bins, learning gardens, and utilize informational signage throughout the building to teach about sustainability.
	• Create an overarching theme for grade levels to teach how systems work.	• Study and research how various systems in the building work - Wind Turbines, Solar power, rain collection, green roof, etc.

	• Utilize science units on the water cycle to discus and teach about conservation.	• Discuss how solar panels and rainwater collectors help conserve resources. Also, use plaques throughout the building that tell students about the sustainable features of the building, and small plaques at every classroom door with names and pictures of flora and fauna indigenous to the region, with QR codes that link to websites about them.
M i d d l e	• Integrate concepts such as zero net carbon and energy building that actually produces its own energy through solar arrays and wind turbines. Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy.	• Use the design, solar orientation, daylighting, solar hot water and different types of solar panels to demonstrate how things change. Discuss how low e glass, insulation principles, CO2 monitoring, use of local and recycled materials, water harvesting, green roof and surrounding gardens, and wind generators and weather monitoring, information kiosk dashboard help monitor our energy usage.
	• Use the science curriculum where several standards relate to the environment and sustainability. Have students cover alternative energy sources, point source and non-point source pollution, and renewable vs. nonrenewable resources.	• Have students tour the school and discuss the green features. They then tour the grounds to evaluate the school on weathering and pollution found. The school uses sustainable supplies, showing students that large buildings don't need to devastate the land to complete construction. The school also uses less water and electricity, but is still able to perform as a normal school.
	• Create Recycling Programs, Environmental Clubs, and community service projects	• Use recycling cans throughout the building, various recycling programs, compost bins, learning gardens, and informational signage throughout the building.

	• Utilize School Announcements.	• Provide information about the building and sustainable features and concepts.
	• Use the English research unit to focus on students selecting an environmental issue, researching it, and presenting pros and cons.	• No specific response included.
	• In Language Arts, use informational texts and fictional texts about the environment, pollution, and its effects.	• Use building signage that explains the types of recycling waste.
	• Discuss renewable and nonrenewable energy resources and complete an in-class project about energy conservation.	• Monitor the recycling program and discuss the use of natural light throughout classrooms.
	• Allow student to enter a poster in the James River Association's poster contest titled 'What a Healthy River Means to Me.'	• No specific response included related to the building.
	• Educate students about the cost of building and operating solid-waste facilities and the value of recycling different products.	• Monitor the weight of paper collected from each source within the school and created displays of the data using Excel spreadsheets, formulas, and graphics.
H i g h	• Utilize the science curriculum concepts that discuss reduction of materials, reuse of materials, and recycling.	• Discuss signage that describes the environmental educational concepts of the building. For example, the green roof. Use the outdoor garden and compost bins. Discuss how the building is designed to save energy. That is a powerful teaching concept in itself.
	• Utilize units that include learning about renewable energy options and analyzing the	• Discuss the green roof and design plans for energy and water conservation.

	viability for renewable energy in VA.	
	• Use data contacts and operators for the air quality monitoring station and information available for teachers. Use curriculum links for NEED.org that is available to teachers.	• Discuss how the green roof system is monitored by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity. Discuss how the school website hosts an ambient air quality monitoring station operated by the Virginia Department of Environmental Quality.
	• Use science courses to teach sustainability, model it, and survey students and teach about our footprint. Incorporate stream study into the curriculum and create a 'pond in the classroom to teach concepts about ecology.	• Discuss various building materials throughout school and use signage to clarify.
	• Use the engineering class to introduce concepts from the curriculum, especially those concerning energy and clean water.	• Discuss the energy efficient building (new high school). Discuss various features such as films on windows, the white roof, thermal glass, automatic lights, and types of lighting.
	• Discuss current topics in other countries, which often deal with pollution and other environmental concerns (i.e., clean water).	• Discuss the water reduction features of the building - such as automatic faucets, and low flush toilets, and adjustable lighting.
	• Utilize the course on environmental science.	• Discuss and utilize the learning garden for hands-on activities.

Note. Many common responses were combined and some responses were edited for readability. As a result, specific participants are not noted in the responses.