Broadening Perspectives: Educating Under-Represented Youth about Food and Agricultural Sciences through Experiential Learning[1]

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Abstract

Despite growing opportunities for college graduates in the agricultural sciences, many high school and college students are not pursuing careers in the agriculture industry. Youth equate agriculture with farming, which is perceived as boring, stressful, and hard physical labor with low pay. This study was aimed at broadening youths' perspective of agriculture, and ultimately attracting them to pursue careers in the food and agricultural sciences. A Kindergarten to 12 agriculture curriculum was developed and integrated into the curriculum of two established summer programs at the University of Maryland Eastern Shore. The 2006-2008 AgriScience Education Summer Program exposed under-represented youth, ages 8 to 18, to careers and opportunities in the food and agriculture industry through experiential learning. Three hundred, 100, and 145 youth, respectively, learned new knowledge about the food and agricultural sciences. Pre and posttest results indicated that the agriculture curriculum increased participants' knowledge of agriculturally related careers and the science applications incorporated in the study of agriculture. The youth gained a better appreciation of agriculture and how it affects their daily lives. Some program participants also indicated that they acquired an interest in pursuing careers in the agriculture industry.

Introduction

Agriculture remains vital to the survival and well-being of every citizen throughout the world. Recruiting and retaining students in agricultural sciences, the multidisciplinary study of agriculture, is one of the most difficult problems facing many institutions today. Despite growing opportunities for college graduates in the food and agricultural sciences, enrollment in colleges of agriculture nationally continue to decline (Myers et al., 2004; Russell, 1993). With fewer students going into agriculture, the long-term future of the agricultural industry is in question. This decrease in enrollment has created profound effects on many higher education institutions, especially land-grant institutions. Several 1890 land-grant institutions have lost agricultural science programs due to low enrollment, lack of funds, and the need for program innovations (Lynch, 2001). Universities are responding to decreased enrollments by downsizing agricultural departments and programs and transforming courses to appeal to students (Esters, 2007; Speer, 1998). Colleges of agriculture and the agricultural industry will face serious problems if the current decrease in enrollment is not stabilized and reversed soon.

Historically, agriculture has not attracted some groups, particularly minorities (Fields et al., 2003). Studies have shown that minority students are less likely to view agriculture as a career choice due to negative perceptions (Myers et al., 2004). Students equate agriculture with farming, which is perceived as boring, stressful, and hard physical labor with low pay (Holzj-Clause and Jost, 1995; Talbert et al., 1999). In addition, limited exposure to agriculture, a narrow understanding and awareness of agricultural professions, and the lack of minority role models currently in the field may contribute to the seemingly low interest of minorities in agriculturally related careers. According to Rudd and Smick-Attisano (1995), this lack of exposure can negatively affect a person's perception and attitude towards the agricultural sciences. Therefore, colleges of agriculture need to raise youth development to a college-wide concern and long-term commitment, and a focus on the development of youth as the major human resource is required for a viable agricultural industry in the coming years (Priest, 2008; Russell, 1993). However, if youth have not been exposed to the various facets of agriculture, they may not be aware of the extensive nature and diversity of career opportunities that exist for graduates in the food and agricultural sciences (Esters and McCulloh, 2008).

Initiatives aimed at communicating a positive image of agriculture and reaching a larger pool of youth can help address some of these complex issues (Russell, 1993). Research has shown that students who had exposure and previous experiences in agriculture were more likely to enroll in agricultural programs (Lynch, 2001). Therefore, a substantial need exists to enhance efforts to educate youth about agriculture careers and ultimately attract them to

[1]Acknowledgements: The authors would like to thank Janet Hawkes and Jamie Picardy for their assistance in developing the K-12 agriculture curriculum. We would also like to thank Courtney Harned for proofreading this manuscript.
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prepare for careers as food and agricultural scientists and professionals (Esters, 2007; Thoron and Myers, 2008). In order to respond to this need, faculty within the Department of Agriculture, Food, and Resource Sciences at the University of Maryland Eastern Shore (UMES) created and implemented a five-week K to 12 agriculture outreach summer program that was conducted during the months of June and July for three summers (2006 to 2008). The UMES AgriScience Education Summer Program was designed to enhance the awareness of youth about diverse career opportunities in the agricultural industry and to communicate a more positive image of agriculture through experiential learning, which has been proven to enhance students' knowledge and attitudes towards the subject matter (Gliem, 2001). It was hypothesized that a prolonged exposure (at least three years) and engagement in agricultural sciences would help to shape and broaden youths' perceptions and improve attitudes towards agriculture.

Methods

UMES, the state's Historically Black 1890 Land-Grant Institution, engages in numerous collaborative efforts to increase access and opportunity for a broad spectrum of students including the economically and educationally disadvantaged, low-income adult learners, and first generation college students. In this study, we developed and implemented an educational and outreach program that engaged under-represented youth between the ages of 8 to 18. A Kindergarten to 12 agriculture curriculum was created for integration into two established summer youth programs at UMES, the Upward Bound Program and the National Youth Sports Program (NYSP). The target area for both Upward Bound and NYSP is the tri-county area of Maryland (Somerset, Wicomico, and Worcester Counties) with a total population of 156, 000. Nearly half of the families in this area have incomes below 150% of the poverty level and 78% of adults do not have a baccalaureate degree. Upward Bound is a feeder program for the academic programs at the university. Upward Bound is a year-round program that helps to motivate and prepare high school students (ages 14 to 18) for college entry and completion. The students are required to have a minimum grade point average of 2.5 and be first generation college students. Special concern is given in enrolling and serving higher risk academic students. NYSP is a feeder program for Upward Bound on our campus and is a federally funded program held at about 190 college campuses around the country. It provides comprehensive sports and educational activities and is open to all qualified 8 to 16 year old boys and girls within the tri-county area surrounding the university.

The K to 12 agriculture curriculum was developed through collaboration with the Maryland Agriculture Education Foundation, Inc., a curriculum specialist, and the program director. The agriculture summer program provided the youth with first-hand skills and knowledge in practical subject areas such as plant and soil science, food science and technology, and animal science. The curriculum focused less on production agriculture and more on the science applications integrated into the study of agriculture. The interactive lessons informed youth about agriculturally related career opportunities and confirmed the importance of agriculture in today's society. The curriculum was conducted during 50-minute class sessions and the students were divided into seven groups according to age (NYSP: 8- to 10-year olds; 11-year olds; 12-year olds, 13-year olds and 14- to 16-year olds; Upward Bound: 13- to 15-year olds and 16- to 18-year olds). Each activity in the AgriScience Education Summer Program was directed to the appropriate age group and educational capabilities of the youth. The NYSP students participated in the program four days a week for five weeks while the students in Upward Bound participated in the program two days a week for five weeks. College students were hired as instructors to teach the curriculum with the assistance of the project director on some of the more advanced activities. The project director and the curriculum specialist trained the instructors on how to deliver the content. Each lesson in the curriculum was very detailed and descriptive and provided systematic instructions on curriculum delivery, timing for each activity, and ways to engage youth in discussions and hands-on activities. Each instructor was assigned two age groups and was solely responsible for the delivery and implementation of the curriculum to those groups each year. One instructor participated in the program all three years while two instructors participated the last two years. Since the high school curriculum was more advanced, the project director, with the assistance of the three instructors, delivered the content of the hands-on activities to ensure consistency in delivery and implementation.

The experiential activities educated the youth about careers in agriculture, products derived from agriculture commodities, the ornamental horticulture industry, medicinal plants, water quality, plant propagation, microbiology, food science, and agriculture biotechnology. The lessons were designed to be interactive and educate students on science applications and technology that are integrated into the study of agriculture and agriculturally related careers. The students learned about careers associated with each hands-on activity in the Career Connect section of each lesson. The Career Connect provided details such as educational requirements, job responsibilities and salary information. There were over 90 lessons and activities in the curriculum that are too numerous to name; however, some of the popular activities are highlighted below. The elementary school students conducted a light effects experiment comparing the growth of vegetables grown with and without light. The students learned what would

happen to plant growth if an essential element were taken away. The Career Connect for this activity was Plant Scientist. They also learned about the culinary arts by working in groups to design and create a healthy snack. Each snack was evaluated on market name and visual appeal by the entire class. The Career Connect was careers in the Culinary Arts and Hospitality and Restaurant Management. The middle school students learned about the health benefits of various plants that can be utilized for medicinal purposes. During this activity, students learned about Horticulture and Soil Science careers by conducting an experiment where they evaluated which soil media enhanced the growth of their chosen medicinal plants. They also learned about the Floriculture Industry by creating a floral display out of a variety of silk flowers. During the Career Connect the students learned that florists design live, cut, dried, and artificial floral arrangements for a variety of events. An experimental approach to learning about the Green Industry and the duties and responsibilities of a Landscape Architect was having the students design a recreational park. They had to work in teams to decide the various features to be included in their park as well as the cost of such features. The high school students' experiential activities were more advanced and included the use of various laboratory equipment and supplies. The students learned about diverse plant propagation methods such as tissue culture and sexual and asexual propagation. They conducted an experiment on vegetables grown in various colored mulches to observe which colored mulch enhanced plant growth. They grew stem and leaf cuttings in various growth medium (sand, soil, and rooting gel) to study which one initiates and enhances root development. The students learned about aseptic techniques and micropropagation by growing African violets through tissue culture. They studied soil science and water quality by analyzing the chemical composition of water and soil that they collected on the university farm. The students also explored food science and food safety by growing microorganisms on bread with and without preservatives and extracting DNA from strawberries. The Career Connect for the high school activities includes: Horticulturist, Plant Breeder, Botanist, Soil Scientist, Hydrologist, Food Scientist, and Microbiologist. All of the program participants were afforded the opportunity to utilize the university laboratories and facilities to conduct their projects and experiments. They conducted their plant science experiments in the greenhouses and the growth chambers.

A pre- and posttest rubric was developed to determine the students' level of knowledge about careers and the agriculture industry before and after the program each year. Responses were rated between one and four. The responses that related only to farming and food products received a rating of two. The responses that included two to three farming and food related responses plus one or two other agriculture industry responses (other careers besides farmer/farming and other agriculture commodities besides food) received a rating of three. The responses that included only one farm related response plus two to four other aspects of the agriculture industry received a rating of four. No response received a rating of one (Table 1). During the 2006 summer program, the rating of two received the highest response in both the pre and posttest in all of the age groups. Based on those ratings, the curriculum was revised in 2007 to focus more on careers. At the beginning of every class session, the instructors used posters to introduce students to two-three new careers each day. The posters included images and information on educational requirements and responsibilities of each career along with its attractive salary to educate and emphasize the economic opportunities associated with a career in the agricultural industry. The teachers organized various games to help students remember the careers they learned at the beginning of each class and during the Career Connects. Program surveys were also conducted at the end of each summer. The surveys measured the youths' perceptions of the program and knowledge gained using questions based on a five-point Likert-type scale (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree). The potential of using this program to attract these students to the food and agricultural sciences at UMES was also examined.

Table 1. Rubric Used to Evaluate the Students' Knowledge of Agriculture Before and after the AgriScience Education Summer Program

Evaluation Ratings	Pre- and Post-Test Rubric
1	No Response
2	Only Farming and Food Product Responses
3	Two-Three Farming and Food Related Responses Plus One-Two Other Agriculture Industry Responses (other careers besides farmer/farming and other agriculture commodities besides food)
4	One Farm Related Response Plus Two-Four Other Aspects of the Agriculture Industry (other careers besides farmer/farming and other agriculture commodities besides food)

Results and Discussion

Youth Participation

During three years (2006 to 2008), 300, 100, and 145 students, respectively, participated in the agriculture summer program. The initial goal of the program was to educate most of the same students each year; however, we were not able to accomplish this goal. Due to reduced funding in the second and third year, the NYSP program, which provided the majority of participants, was no longer able to offer their program at no cost. Therefore, participation decreased in years two and three. It was hypothesized that if we were able to educate the same students and

provide prolonged exposure and engagement in the agricultural sciences, the students would retain the information and their responses to the pre and posttest questions would increase each year to include less farming related responses and more responses that related to other aspects of the agriculture industry. Because we were not able to reach the same students each year, we could not prove this hypothesis. However, we were able to educate a larger number of youth than previously expected due to the large percentage of new students that participated in the program in 2008.

Table 2. Students' Knowledge of Agriculture Before the 2007 and 2008 AgriScience Education Summer Program

Pre-Test Evaluation Question	2007				2008			
	1	2	3	4	1	2	3	4
	%	%	%	%	%	%	%	%
1. List three jobs in the agriculture industry.	4	51	19	26	4	37	30	29
2. Describe three ways agriculture affects your daily life.	18	14	17	52	11	28	27	35
3. List four agriculture products that you use everyday.	16	19	29	37	33	14	24	30

Note: N= 71 in 2007; N= 113 in 2008
*See Table 1 for Pre-Test Rubric

Table 3. Students' Knowledge of Agriculture After the 2007 and 2008 AgriScience Education Summer Program

Post-Test Evaluation Questions	2007				2008			
	1	2	3	4	1	2	3	4
	%	%	%	%	%	%	%	%
1. What new things did you learn about agriculture this summer?	7	4	5	84	10	25	8	56
2. Describe how agriculture affects your life.	11	3	7	80	12	9	4	75
3. What agriculture careers did you learn about this summer?	4	2	13	81	20	26	22	33

Note: N= 42 in 2007; N=113 in 2008
*See Table 1 for Post-Test Rubric

In 2007, 56% of the participants had participated in the 2006 program. Seventy percent of the participants were NYSP students and 30% were Upward Bound students. In 2008, 90% of the participants were participating in the agriculture program for the first time. Fifty-three percent of participants were Upward Bound students and 46% were NYSP students. The posttest results received higher ratings of four in 2007 than in 2008 (Table 3). These results suggest that continued exposure and engagement learning about the food and agricultural sciences helped to increase knowledge and perceptions of agriculture. The NYSP students, who accounted for 70% of the participants in 2007, participated in the agriculture program four days a week for five weeks, while the Upward Bound students only participated in the program two days a week for five weeks. In 2008, there was a larger percentage of Upward Bound students (n=78) than NYSP students (n=67) and a large percentage of new students (n=130), which may account for the lower percentage receiving a rating of four in the 2008 posttest evaluations (Table 3). Although the percentage of student participants varied, the results of both the 2007 and 2008 pre and posttest indicate that the K to 12 agriculture curriculum increased youths' knowledge about careers and opportunities in the food and agricultural sciences (Tables 2 and 3).

Development of the K to 12 Agriculture Curriculum

The agriculture curriculum was designed to be interactive and motivating in order to engage youth in educational activities highlighting the broader aspects of the food and agricultural sciences. We wanted the youth to realize that agriculture encompasses a system of interdisciplinary approaches that include such areas as biotechnology, food safety, natural resource management, and veterinary medicine. The curriculum incorporated scientific applications to reveal the science and technology associated with the agricultural sciences and to communicate a more positive image of agriculture. We sought to provide the youth with stimulating experiences and authentic learning through tasks and activities that promoted team building, problem solving, critical thinking, synthesis of knowledge, and application of skills in real-life situation. Fifty percent of the curriculum included scientific/experimental project-based activities. Project-based, experiential learning offers students the opportunity to discover that learning can be interesting and stimulating, that everyone can bring insight and expertise to the group, and that learning can be fun (Miller, 2003). We also wanted the curriculum to reveal to the students how important agriculture is to our society and to their daily lives. The other half of the curriculum focused on agricultural careers, agriculture by-products and other aspects of the agriculture industry such as the Ornamental Horticulture Industry and the Green Industry. Students learned about by-products such as ethanol derived from corn and soaps, shampoos, crayons, and sporting goods derived from cattle. We planned for student learning to be fun and enjoyable so that students would be open minded to learning about the diversity of career opportunities in the agriculture industry, and help to dissolve negative attitudes towards agriculture. When the students were asked what they liked the most about the program on the program survey, comments included the following: the projects, learning about new things and jobs, and

the games and experiments. Many of the students commented on how the program was very interesting and fun. A high school student wrote that he/she liked, "*Getting a chance to learn about something we probably wouldn't learn about in high school.*" Another high school student indicated that he/she liked "*doing activities and learning things we need to survive.*" These responses indicate that the agriculture curriculum was successful in making learning enjoyable through the type of instructional delivery system, which was experiential learning. Experiential learning enhanced the quality and effectiveness of the program and helped to communicate a more positive image of agriculture.

Change in Knowledge

The results of the 2007 and 2008 pre and posttest indicate that the agriculture curriculum increased students' knowledge about careers and opportunities in the food and agricultural sciences. The rating of two received the highest percentage in both the 2007 and 2008 pretest evaluation for question one, which asked the students to list three jobs in the agriculture industry (Table 2). The elementary and middle school students provided responses such as farming, planting, plowing, florist, chicken grower, gardener, and teachers. The responses reveal that at the beginning of both summers, the students still provided mostly farming responses; however, some of students had retained knowledge from the previous summer as indicated in their responses such as florist and teacher. The response of four received the highest percentage both years for questions two and three; however, the percentages were higher in 2007. Question two asked students to describe three ways agriculture affects their daily lives and they provided the following responses: food, clothes, medicine, sports, and oxygen from trees. Question three asked them to list agriculture products that they use every day and they provided the following responses: soap, paper, pencils, cotton, lotion, shampoo, and trees. The high school students provided the following responses to question one (Table 2): landscape architect, biochemist, engineer, chef, turf scientist, food scientist, cell biologist, soil scientist. They provided the following responses to question two: clothes, processed foods, and food from animals and plants. They provided the following responses to question three: food, fabric, forestry, and wool. Depending on the age group and previous exposure in the agriculture summer program, responses to all of the questions were very similar. The more advanced responses, especially from the elementary and middle school students on question two and three and the high school students on question one, came from the large percentage of students that retained knowledge from the 2006 program. The responses from all of the questions related directly to some of the lessons in the curriculum, which indicate that the students had retained the knowledge gained from the previous year.

The rating of four received the highest percentages for both the 2007 and 2008 posttest evaluation; however, the percentages were higher in 2007 (Table 3). Again, this may be the result of the large percentage of NYSP students (n=70) participating in 2007 that had more extensive exposure and engagement in the program than the larger percentage of new students (n=130) in 2008. For the 2007 posttest, the elementary and middle school students provided the following responses to test question one, which asked them what new things they learned about agriculture this summer: that it could be fun, glue is made from cows, florists are people who sell flowers, and leather and soap come from cows. An 11-year old male student wrote, "*I learned a lot of food that we eat and clothes that we wear come from animals. I learned about agriculture jobs, what they do, how they work, the degree you need to have to get the job, and the salary.*" Question two asked them to describe how agriculture affects their lives and they provided the following responses: clothing, food, pencil, paper, things that get me ready for school. Question three asked students what agriculture careers they learned about this summer and they provided the following responses: marine biologist, microbiologist, rancher, florist, butcher, science writer, forester, chef, veterinarian, hydrologist, agriculture teacher, engineer, botanist, and weed scientist. Since both the high school and elementary and middle school students were learning about the same careers, the responses to question three from the high school students are similar to the elementary and middle school students' responses. One high school student listed 11 jobs in his response. The advanced career responses from the elementary, middle and high school students indicate that the career education was a very beneficial and effective addition to make to the curriculum in 2007. The following statements were made by high school students responding to question one. A 14-year old male wrote, "*I've learned a lot about all different types of jobs for agriculture. I also learned where most things come from.*" A 15-year old male wrote, "*That it is not only about working outside. There are hundreds of careers about agriculture.*" A 14-year old female wrote, "*I learned that it is not just all about farming.*" The following statements were made by high school students responding to question two. A 14-year old male wrote, "*Agriculture is basically everything that I'm wearing, eating, and basically using.*" A 14- year old female wrote, "*If it was not for cotton than we would not have clothes.*"

Since the same agriculture curriculum was utilized in 2007 and 2008, the responses to the pre and posttest questions were very similar in all of the age groups both years. The posttest responses indicate that students' perspectives and awareness of agriculture were broadened and enhanced. These findings support Russell's (1993) study supporting the creation of initiatives aimed at communicating a positive image of agriculture. The students' responses to the test questions focused less on

production agriculture and farming, and focused more on agriculture careers and other aspects of agriculture such as agriculture by-products and the understanding that agriculture affects their daily life (food, clothing, personal hygiene products, school supplies, sports equipment, etc.). Question three referred to agriculture careers the students learned about during the summer (Table 3). The high percentage of responses receiving a rating of three and four in the posttest evaluation questions support Talbert's (1995) study that expressed the need to utilize career information so minority students may perceive agricultural occupations in a more competitive and attractive manner. Lynch's (2001) research also supports the need for students to see agriculture as providing good economic opportunities and increasing the exposure of students to successful agricultural professionals.

Table 4. Students' Perceptions of the UM ES AgriScience Education Summer Program

Statement	2006		2007		2008	
	M	SD	M	SD	M	SD
1. Overall Quality of the AgriScience Education Summer Program	3.7	0.66	3.5	0.63	3.3	0.46
2. Performance of Instructors	3.9	0.75	3.8	0.68	3.6	0.59
3. Quality of Program Activities and Projects	3.8	0.68	3.4	0.56	3.6	0.56
4. I learned new skills and techniques during the program	3.9	0.78	4	1.14	3.1	0.81
5. I was exposed to new concepts and ideas	3.9	0.78	4	0.96	3.1	0.84
6. I learned about careers in the Agriculture Industry	4	0.83	4.2	1.05	3.9	0.84
7. The activities were interesting and challenging	3.5	0.67	3.7	0.64	3.5	0.68
8. The activities assisted in my understanding of the subject matter	3.6	0.81	4.1	1.00	3.6	0.92
9. I learned a great deal from the AgriScience Education Summer Program	3.6	0.71	3.8	0.81	3.5	0.64
10. I would recommend the AgriScience Program to my friends	3.4	0.65	3.3	0.49	3.3	0.51

Note: N=131 in 2006; N=42 in 2007; N=113 in 2008. 1=Strongly Disagree to 5=Strongly Agree
M = Mean; SD = Standard Deviation

Program Evaluation

Results of the program evaluation conducted at the end of each summer program showed that the students perceived the UMES AgriScience Education Summer Program to be beneficial and that the agriculture curriculum increased their knowledge about careers and opportunities in the food and agricultural sciences (Table 4). During the 2006, 2007 and 2008 program surveys, 77%, 81%, and 78.8%, respectively, indicated that they would use the skills and knowledge obtained from this program in the future. Forty-three percent, 45.2%, and 49.5%, respectively, indicated that they would consider attending UMES for college. When asked if they would consider majoring in agriculture when they attend college, 25.7%, 26.2%, and 25.6%, respectively, gave a response of Yes. When asked if they would consider a career in the Plant and Soil Sciences, 16.8%, 19%, and 22.1%, respectively, gave a response of Yes. Elementary and middle school students (8 to 13 year olds) were more receptive to learning about careers in agriculture when compared to high school students (13 to 18). Many of the high school students had already made their decisions regarding career goals and college preference.

The potential impact of this program is that agriculture will be considered as a career choice when the students begin to make decisions about their future. Supposedly they will attend UMES and major in agriculture if the food and agricultural sciences is their chosen career path. The findings of this study agree with those of Lynch (2001) and Wildman and Torres (2001), who reported that students who had exposure and prior agriculture experience were more likely to enroll in agricultural programs. Participation in the AgriScience Education Summer Program may motivate more students, especially minorities, to enroll in colleges of agriculture.

Summary

Three hundred, 100, and 145 youth, respectively, gained new knowledge about careers and opportunities in the food and agricultural sciences. The UMES AgriScience Education Summer Program provided hands-on activities that educated youth about products derived from agriculture commodities, the ornamental horticulture industry, medicinal plants, water quality, plant propagation, microbiology, food science, and agriculture biotechnology. The youth also learned about various careers in the agriculture industry such as Landscape Architect, Nutritionist, Plant and Soil Scientist, Botanist, Horticulturalist, Climatologist, Veterinarian, and Microbiologist. The agriculture program increased youths' knowledge about the food and agricultural sciences. The youth have gained a better appreciation of agriculture and how it affects their lives every day. Some of the program participants have also acquired interest in pursuing careers in the agriculture industry.

The AgriScience Education Summer Program established and promoted new levels of youth engagement in agriculture at UMES while providing

mutual benefits for the youth programs and for the UMES Department of Agriculture, Food, and Resource Sciences. A strong partnership was formed with the administration of the two youth programs, especially the Upward Bound Program. Although the AgriScience Education Summer Program is concluded, we continue to work together to educate Upward Bound students about agricultural research, careers, and opportunities through experiential learning. Hopefully, through continuous exposure to the agricultural sciences, we would form a cadre of enlightened youth who have been encouraged to consider careers in the food and agriculture sciences.

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