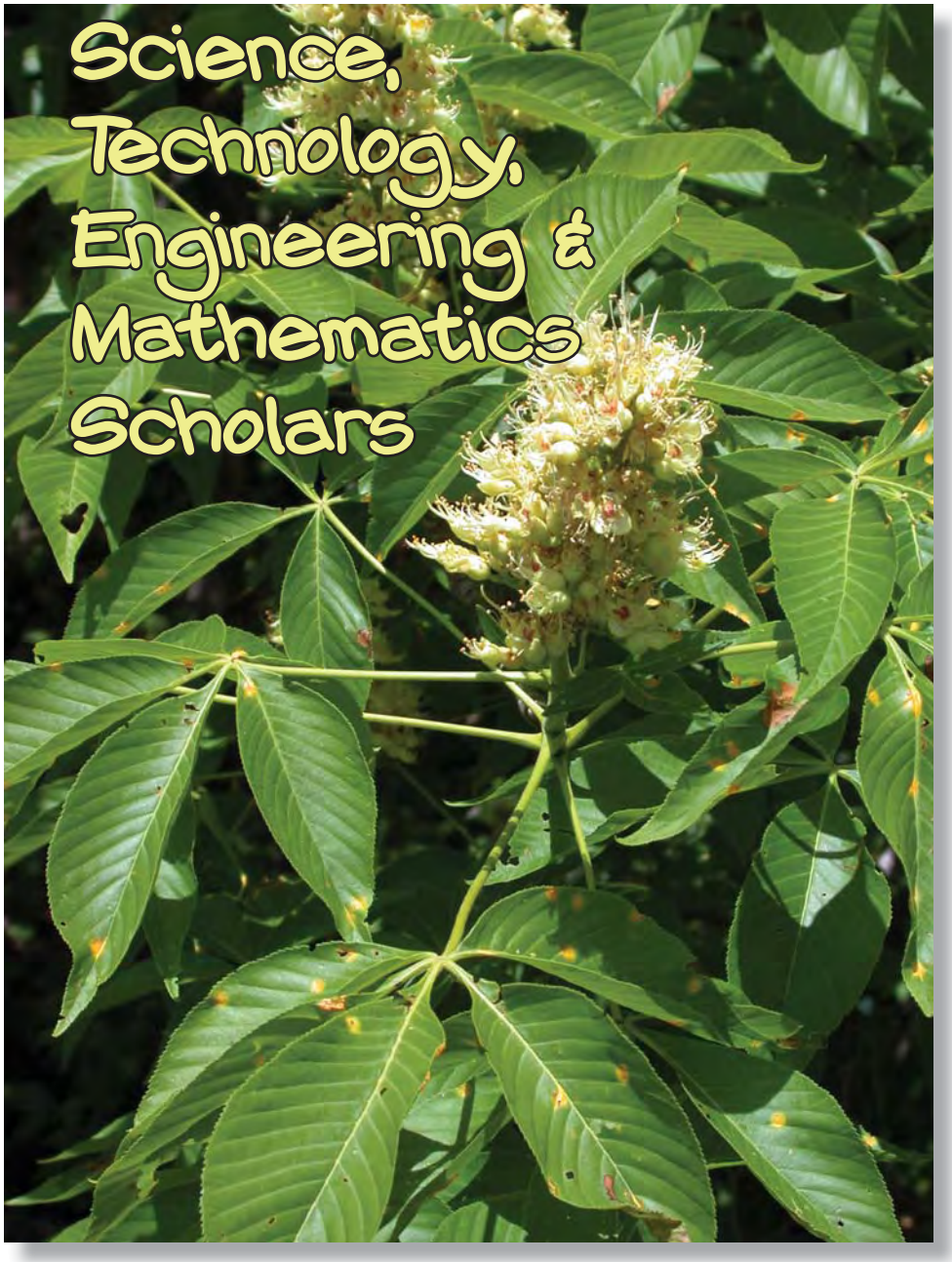
5th, 6th & 7th graders ... http://www.ohiosci.org/YBSTEMSFinalEvaluation.pdf

Final Evaluation Report

Young Buckeye STEMS



State Fiscal Years 2008-2009

***Evaluation Report**

from

The Ohio Academy of Science

to

The Ohio General Assembly and The Ohio Department of Education

June 30, 2009

Young Buckeye STEM Scholars is an 18-month, after-school, project-based program that incorporates scientific inquiry, technological design, teamwork, communications and leadership development.

*Report submitted in fulfillment of 127th General Assembly, Am. Sub. H. B. 119, SECTION 269.50.90. ACCOUNTABILITY

Rotunda of Ohio Statehouse

Young Buckeye STEM Scholars is a partnership of The Ohio Academy of Science, Ohio 4-H, local schools, public libraries and TECHColumbus supported by The Ohio General Assembly through a grant to the Academy from The Ohio Department of Education.

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The Ohio Academy of Science

Young Buckeye STEM Scholars

Year 2: Annual Evaluation Report

Version: July 30, 2009

Prepared by
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The Ohio Academy of Science
Young Buckeye STEM Scholars
Annual Evaluation Report - Year 2
Prepared by Institutional Research Consultants[1]
Version: 7/30/09

EXECUTIVE SUMMARY

Young Buckeye STEM Scholars (YBSTEMS) is an 18-month, after-school, project-based program that incorporates scientific inquiry, technological design, teamwork, communications and leadership development. STEM stands for science, technology, engineering and mathematics. During the second year of the project, students in grades 5-7 from Big Walnut and Buckeye Valley in Delaware County, North Union in Union County, River Valley in Marion County, Teays Valley in Pickaway County, Upper Sandusky in Wyandot County, and Colonial Hills and Slate Hill Elementaries and Kilbourne Middle School in Worthington Schools in Franklin County participated in the program. Sixteen teachers, two for each after-school location (two had two assignments), served as advisors and participated in one-day in-services in September and December 2008. A total of 227 students were selected to be scholars, 192 completed the first project year, and 93 were active through the project's end in June 2009. During Year 2, students displayed their 4-H projects at county fairs (76%), wrote summaries of science articles (78% completed 18 and 33% completed 36 articles), submitted science research plans (91%), participated in science fairs (86%), and developed a group technology design project that would address a community need (62%). Impacts included statistically significant increased understanding of the topics covered in the ten technology lessons. By year-end, students had more interest in problem solving (70% to 84%); more parents said their child likes to be a leader (from 58% to 82%) and writes well (from 65% to 86%). Students were split evenly between males (50%) and females (50%). The selection process was not restricted to the academically strongest students. Student and parent pre-surveys confirmed that the project successfully recruited students with a variety interests, strengths, prior experiences with science activities, and diverse family backgrounds. The majority of both groups (students=71%, parents=83%) at the end of the first year said they would recommend the program to others, and at the project's conclusion, most (students=63%, parents=75%) again endorsed the experience. Teachers confirmed that the technology lessons were a "big hit" with the students. They gave the highest ratings to "Students working together" (81% said this "went well" in Year 1 and 75% in Year 2). Although students were resistant to writing, a third of the teachers thought "writing article summaries" was "going well" by the end of the program. Teachers spoke highly of the professional development provided by program staff. They felt that the in-services met their needs and staff members were responsive. The Ohio Academy of Science (OAS) provided participating sites with all the materials needed to implement the activities and quickly responded to any problems that arose. Overall, positive comments from students, parents, teachers, and superintendents suggest that this program would likely be attractive to other school districts. The YBSTEMS teachers encountered few problems with the lessons and planned to continue using them with their classes, and one district obtained additional grant funding that was used to expand YBSTEMS-like training to elementary teachers and lessons to the regular school day. District administrators and teachers viewed it as a useful enhancement to their science curriculum. One administrator attributed student/teacher participation to an increase in the district's 5th grade science Ohio Achievement Test scores. Superintendents and other district staff especially liked the program's emphasis on hands-on activities, inquiry-based instruction, the scientific method, teamwork, and writing. The Capstone projects will likely result in long-term community benefits. YBSTEMS was an impressively ambitious after-school program that successfully focused on strengthening 5th, 6th, and 7th graders' understanding of scientific inquiry and technological design as well as associated presentation, writing, and data collection skills. The OAS did an exceptional job of developing engaging hands-on technology lessons and providing relevant professional development for the teachers.

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[1]Dr. Jan Upton, President, Institutional Research Consultants, Ltd. (IRC) www.ircorporation.com, an independent evaluation research firm, prepared this report. The YBSTEMS leadership provided review and additional input.

Introduction

Young Buckeye STEM Scholars (YBSTEMS) is an 18-month, after-school, project-based program that incorporates scientific inquiry, technological design, teamwork, communications and leadership development. STEM stands for science, technology, engineering and mathematics. Program recruitment of 5th and 6th grade students began in December 2007 at Big Walnut and Buckeye Valley in Delaware County, North Union in Union County, River Valley in Marion County, Teays Valley in Pickaway County, Upper Sandusky in Wyandot County and Brookside, Colonial Hills, and Slate Hill Elementaries in Worthington Schools in Franklin County.

YBSTEMS after-school and summer program was developed and is managed by The Ohio Academy of Science (OAS) under the direction of CEO, Mr. Lynn E. Elfner. He worked closely with two consultants, Mrs. Joanne Mann and Mr. Robert Claymier. Mrs. Mann shared responsibility for curriculum and pedagogy related to student research, student journals, and portfolios as well as the teacher in-service education through Ashland University. She also served as liaison with libraries and schools. Mr. Claymier led the development of the ten science/technology lessons, the corresponding pre- and post-assessment questions for students, and teacher training specific to these lessons and to technological design. Dr. Nadine K. Hinton provided in-service instruction on statistics, probability, and student data analysis and display. An important component of the program was that all participating sites were required to establish a 4-H club. Thus, Dr. Robert Horton played an important role as the liaison with The Ohio State University Office of 4-H Youth Development. He also chaired the YBSTEMS Advisory Committee, which included all superintendents from the seven participating school districts and representation from program partners, including statewide science/technology organizations (TechColumbus and District Science Day) and the public library systems in six central Ohio counties.

The *Year 1: Annual Evaluation Report* (July 30, 2008) documented student, parent, and teacher opinion about YBSTEMS activities through May 2008. The current report focuses on Year 2 activities (July 2008-June 2009). Nevertheless, where applicable, we include comparisons to the pre-survey data collected from students and parents in February-March 2008 and teachers in November 2007, as those results highlight student and teacher progress.

YBSTEMS Program Site Changes in Year 2

The OAS made the difficult decision of closing two initial sites. Following a review of activities of Brookside Elementary, both teachers resigned. Mr. Elfner worked with the Worthington district to identify a replacement school. Initially, Perry Middle School was selected, and two new teacher-advisors were recruited and participated in the YBSTEMS September 2008 in-service. However, student recruitment and other start-up activities that needed to occur did not progress in a timely fashion. One of the teacher-advisors at Colonial Hills offered to direct a program at Kilbourne Middle School, and so even with a later than desired start (November 2008), participating students were able to satisfy the second year requirements. The North Union site was closed in February 2009. Only six students were active at this location, so continued funding of the program was not cost-effective.

Accountability and Organization

The rest of this report is organized by the four topic areas that are part of ensuring program accountability to The Ohio General Assembly.[2] Specifically, these are:

1. A description of the services supported by the funds,

2. A description of the results achieved by those services,

3. An analysis of the effectiveness of the program, and

4. An opinion as to the program's applicability to other school districts.

[2]Per the funding guidelines specified in the 127th General Assembly, Am. Sub. H. B. 119 (state budget bill in Section 269.50.90. Earmark Accountability), for all funded projects,

1. A Description of the Services Supported by the Funds

Ten schools in seven central Ohio school districts across six counties participated in YBSTEMS. Eight of these schools (representing six districts and five counties) completed the program in June 2009. Table 1 on the following page provides an overview of each district and the participating schools from Worthington.

Worthington, with a 2007-2008 enrollment of 9,217, was the largest participating district. The other districts were rural and ranged in size from 1,492 to 3,506 students. During the first year, seven of the eight active sites experienced student enrollment growth (increasing from less than 1% in Upper Sandusky to a notably high increase of 18% at Slate Hill). The percent of economically disadvantaged students grew modestly in rural districts (increases ranged from less than 1% in Big Walnut to 5% in Upper Sandusky) with the overall range overall from 15 to 33 percent in 2007-2008. The schools in Worthington, on the other hand, reported lower percentages of economically disadvantaged students (decreased 7% at Kilbourne to a high of 18% at Colonial Hills) and the total percent in the suburban schools ranged from 12-23 percent.

With the exception of Teays Valley (increased student proficiency by 18% and met the state's 75% proficiency requirement for the first time), all the participating districts/schools lost ground on the 5th grade science Ohio Achievement Test (OAT) in 2007-2008 compared to the prior school year (2006-2007). Decreases ranged from 1-13 percent. Six of the nine program sites reporting 5th grade science OAT data (67%) in 2007-2008 did not meet the state's minimum requirement. It is important to keep in mind that YBSTEMS was just getting underway at the point that these data became available, and a third of the participating students were 6th graders who did not take this test. Although performance on the 5th grade OAT offers one possible measure of the program's impact, it is likely that more time is needed for participation in YBSTEMS to be reflected in statewide results. Reassuringly, one participating district administrator noted that her district's 2008-2009 5th OAT science scores increased, and she attributed student and teacher participation in YBSTEMS as one contributing to this gain. Nevertheless, only a small group of 5th graders was active in Year 2, the next opportunity for measuring impact using statewide test data on most of the students who participated in YBSTEMS will not occur until participants are in the 8th grade. Table 1, however, provides useful contextual information about the district and school environment. The OAT results highlight the high level of student need for additional preparation in science. OAS plans to continue monitoring the participating districts' progress to see if longer-term impacts emerge.

Eighteen teachers, two for each after-school location, were recruited in November 2007. The pre-survey, which was part of the teacher application, confirmed that they were experienced and committed to inquiry-based instruction. The results showed that they could be expected to: (1) address the learning needs of individual students, (2) anticipate and accept unexpected results in student investigations, (3) develop strategies for differentiating instruction, (4) make difficult science concepts comprehensible, (5) monitor small group discussions and activities, (6) teach in a classroom where there are heterogeneous abilities with more than one student on an Individualized Education Plan (IEP), and (7) use assessments for planning instruction. Participating teachers participated in a three-day in-service in December 2007 and one-day sessions in September and December 2008. By year-end, fourteen teachers were assigned to the eight continuing sites. Two teachers worked at two sites. Specifically, one of the Big Walnut teachers also began working at Buckeye Valley after one of the teachers moved to a different location. The Worthington teacher that offered to establish the Kilbourne MS club was already at Colonial Hills. Kilbourne then also added a teacher who was new to the program.

Table 1: YBSTEMS Overview[1]

School District	County	Description	Total Enrollment			Percent Economically Disadvantaged			5th Grade Science OAT		
			2006-07	2007-08	% Diff.	2006-07	2007-08	% Diff.	2006-07	2007-08	% Diff.
COMPLETED 18 Months of YBSTEMS											
1. Big Walnut	Delaware	Rural	2,522	2,691	6.7	15.1	15.4	0.3	86.7	85.8	-0.9
2. Buckeye Valley	Delaware	Rural	2,219	2,256	1.7	14.5	16.3	1.8	82.7	76.8	-5.9
3. River Valley	Marion	Rural	1,930	1,994	3.3	23.9	26.5	2.6	61.6	57.8	-3.8
4. Teays Valley	Pickaway	Rural	3,438	3,506	2.0	21.5	24.4	2.9	70.6	88.1	17.5
5. Upper Sandusky	Wyandot	Rural	1,726	1,728	0.1	25.2	30.5	5.3	74.4	73.5	-0.9
6. Worthington City	Franklin	Suburban	8,911	9,217	3.4	14.1	9.5	-4.6	84.6	79.2	-5.4
Colonial Hills	Franklin	Suburban	311	327	5.1	31.5	13.9	-17.6	72.9	69.0	-3.9
Kilbourne MS[2]	Franklin	Suburban	367	361	-1.6	18.1	11.6	-6.5	NA	NA	NA
Slate Hill	Franklin	Suburban	392	463	18.1	34.1	23.1	-11.0	85.7	73.2	-12.5
COMPLETED 12 Months of YBSTEMS											
North Union	Union	Rural	1,514	1,492	-1.5	28.3	32.8	4.5	74.4	63.8	-10.6
COMPLETED 6 Months of YBSTEMS											
Brookside[2]	Franklin	Suburban	304	298	-2.0	28.9	14.5	-14.4	81.6	72.7	-8.9

[1]School district statistics are from the Ohio Department of Education's online report card database http://ilrc.ode.state.oh.us/default.asp.
[2]Brookside stopped participating in YBSTEMS in July 2008. The program was moved to Perry MS and then to Kilbourne MS. Kilbourne MS enrolls 7th and 8th grades. Thus, 5th grade OAT results are not applicable. The YBSTEMS students are from feeder elementary schools.

Student recruitment also began in November 2007. Table 2 presents the project student enrollment trends. A total of 227 students were initially selected for the program. Most (85%) stayed in the program through the first school year. In September 2008, 48 new students joined those continuing, resulting in a total of 176 students. Ninety-three students completed the program. The Ohio Academy of Science anticipated a 40 percent attrition rate. Initial plans were to recruit a pool of "alternates" that could fill openings as they became available. However, due to the tight timeframe for implementation, student recruitment did not exceed the available slots. Although attrition was higher than desired, given the intensity of the experience and its challenging requirements, OAS should be commended for involving approximately 200 students in engaging hands-on activities and encouraging nearly half of this number to stay involved through the Capstone event in June. It is noteworthy that the recruited students were split evenly between males (48%) and females (52%), and equal gender for the project overall was maintained (see Appendix 1), though a few sites were more skewed by project end (Upper Sandusky was 90% male and Kilbourne was 67% female). Student and parent pre-surveys highlight that the project successfully recruited students from a variety of backgrounds. The selection process was not restricted to the academically strongest students. The student pre-survey responses confirmed that they entered the program with a wide range of interests, strengths, and prior experiences with science activities. In addition, the family backgrounds were also diverse. For example, 55 percent of the students had a least one parent whose

highest education was a high school diploma or less (See Appendices 13 and 14). We did not repeat these questions on the post-survey.

Table 2: YBSTEMS Students – Participation Counts – Years 1 and 2[1]

	Initial Enrollment	Feb. 2008	May 2008	June 2008	Sept. 2008[2]	Feb. 2009	April 2009
Big Walnut	26	22	18	16	15	15	15
Buckeye Valley	27	27	27	23	19	15	11
River Valley	23	22	18	16	22	10	12
Teays Valley	25	23	20	20	21	17	14
Upper Sandusky	26	25	19	17	19	9	9
Colonial Hills	24	24	21	18	18	11	11
Kilbourne MS	0	0	0	0	21	16	14
Slate Hill	30	30	30	30	20	10	7
North Union	21	21	16	12	21	6	0
Brookside	25	25	23	20	0	0	0
TOTAL	**227**	**219**	**192**	**172**	**176**	**109**	**93**

[1]Self-report from each site.
[2]OAS records indicated that 48 of the Year 2 students were new enrollments.

Each scholar received a high quality journal and laboratory notebook, subscriptions to *Science News* and *Scientific American*, and a 2-gigabyte flash drive with FM radio and MP3 player. Students were also eligible for up to $200 of bookstore gift cards.[3] Following an initial $50 gift card upon enrollment subsequent gift cards were tied to specific milestones (presenting a 4-H display at a county fair, submitting an acceptable research or design plan, writing 18 science article summaries each program year, participating in a local science day or fair, and actively contributing to their site's Capstone project).

During the program's first "year," which actually only represented February–June 2008, most students participated in the ten science/technology lessons developed by the YBSTEMS leadership. Given the limited amount of time available during the school year, several clubs met during the summer to complete these hands-on activities. In addition, from the program onset, students at each site set up a 4-H club and learned how to manage their meetings. Students kept journals in which they documented their activities, pre- and post-test assessment responses for each lesson, and personal reflections about the activities. They were also required to read journal articles from their magazine subscriptions and submit written summaries. During the summer, students displayed their selected 4-H projects at their local county fairs. Beginning fall 2008, they were encouraged either to extend their 4-H project or to develop a new project that would qualify as a Science Day or local science fair project. Finally, in spring 2009, students developed a club-wide technology project designed to address a community need. One club completed two projects. In addition, teachers noted that students intend to continue pursuing official approval from school districts and local governments (depending on which is applicable) for their Capstone projects. All clubs also have planned to continue their 4-H involvement through the dates of the summer 2009 county fairs.

[3]Parts of this section come from the OAS press release, "Young Buckeye STEM Scholars: Ohio 4-H Helping to Spark Interest in Science, Math" (9/13/07) and the YBSTEMS student application.

Table 3 presents the number of students who met each of the YBSTEMS milestones. High proportions of the completers (91% and 86%) respectively submitted a research plan and participated in a local Science Day or science fair.[4] More than three-quarters (76%) had an initial 4-H display, and participation in 4-H is likely underreported, as many of the Year 2 participants will present at their 2009 county fairs that will take place in late summer or fall 2009. Seventy-eight percent of the students completed 18 article summaries, and 33 percent of this group wrote an additional 18 summaries by the end of the project. Finally, although teachers indicated that nearly all the students who were active at year-end participated in their sites' Capstone projects, only 62 percent submitted the required documentation verifying their involvement.

Table 3: YBSTEMS Students – End of Year 2 – Milestone Accomplishments

	First 4-H Display[2]	18 Summaries	36 Summaries	Submitted Research Plan	Local Science Day	Capstone Project
Big Walnut	11	13	7	13	13	9
Buckeye Valley	11	9	3	11	11	11
North Union	11	0	0	0	0	0
River Valley	4	5	1	10	10	6
Teays Valley	14	16	10	15	15	8
Upper Sandusky	5	8	5	8	9	9
Colonial Hills	9	7	2	10	6	3
Kilbourne MS	7	8	0	11	11	9
Slate Hill	7	7	5	7	5	3
TOTAL	**79**	**73**	**33**	**85**	**80**	**58**

[1]From OAS database that requires documentation for students to receive gift cards and other incentives.
[2]Many of the participating students will also likely present at county fairs during summer 2009.

Appendix 10 includes additional information about the participation of YBSTEMS students in a variety of STEM activities. This is presented also with teachers' reports of the involvement of their regular classroom students in the same activities.

[4]Ninety-three students completed the program. For the 4-H display percentage, the 11 North Union students are added to this total.

2. A Description of the Results Achieved by Those Services

Evaluation Overview

Institutional Research Consultants, Ltd. (IRC), directed by Dr. Jan Upton, is the external evaluator of YBSTEMS. All aspects of the evaluation are developed with input from the program leadership. Year 2 evaluation activities included:

- *September and December In-service Surveys* – We surveyed teachers at the end of each one-day in-service session as part of verifying that the professional development activities met teachers' needs. They confirmed that each in-service provided applicable training that helped them prepare students for 4-H, science fair, and the Capstone event. In interviews, teachers repeatedly attested to the value of the professional development and the materials provided by the OAS.

- *Year-end Surveys* – We designed year-end surveys for the teachers, students, and parents.[5] The results from those surveys are incorporated throughout this report. Where applicable, we also include comparisons of the pre-survey and post-survey results. Since there were a few site changes in Year 2, we did two sets of statistical analyses on the student and parent surveys. The first set is based on analysis of the total pre-survey compared to the total post-survey. In the second set, surveys from Brookside, Kilbourne, and North Union are omitted from the analysis. Since the teacher pre- and post-surveys included individual identifiers, we included only those who had completed both surveys in the statistical analyses. The Year 2 student and parent survey administration process was reviewed and approved by The Ohio Academy of Science Institutional Review Board (IRB). The OAS mailed the student and parent pre-surveys and consent forms to students' home addresses in May 2009. Included in the packet was a postage-paid return envelope to IRC. Dr. Upton emailed the teacher year-end surveys.

  A total of 50 students and 51 parents returned their year-end surveys (see Table 4), resulting in a response rate above 50 percent for each group (53% for students and 54% for parents). Although the response rate is lower than desired, it exceeds the 41 percent response to the survey at the end of Year 1. In all surveys, respondents appeared to make an effort to give carefully considered responses. Nearly all parents and students shared additional opinions about the program in the open-ended comments. Twelve of the 14 teachers returned their surveys via email or regular mail.

  On this year's student survey, we included *The Science Process Skills Inventory* questions that were developed and used by Oregon State University with 4-H students (Bourdeau and Arnold, 2007). With permission from the developers, we used these items as a measure of YBSTEMS participants' rating of science-process skills. In addition, we obtained permission to compare the YBSTEMS students' responses to the Oregon State University students' post-test results.

[5]Although we used the term "parent/guardian" on the surveys, we will use the simplified "parent" in this report to denote the broader group.

Table 4: YBSTEMS Students and Parents – Year 2 Survey – Response Rates

Program Site	Total in Program[1]	Students		Parents	
		Surveys Received	Response Rate	Surveys Received	Response Rate
Big Walnut	15	8	53.3	8	53.3
Buckeye Valley	11	3	27.3	3	27.3
River Valley	12	2	16.7	2	16.7
Teays Valley	14	8	57.1	8	57.1
Upper Sandusky	9	6	66.7	7	77.8
Worthington City	**32**	**22**	**68.8**	**22**	**68.8**
Colonial Hills	11	7	63.6	7	63.6
Kilbourne MS	14	11	78.6	11	78.6
Slate Hill	7	5	71.4	5	71.4
TOTAL	**93**	**50**	**52.6**	**51**	**53.7**

[1] Number site reported by teachers as active in April 2009

- *Telephone Interviews* – Dr. Upton interviewed seven teachers (one representative from each site, and this round of interviews included the two teachers who worked at two sites) in December 2008-January 2009. Between November 2008 and January 2009, an IRC Consultant conducted phone interviews with six 4-H educators in the participating counties and nine steering committee members.[6] IRC submitted an interim report to Mr. Elfner that summarized the interview findings which highlighted some variation in site implementation, especially with respect to how each club was handling the connection with 4-H. In addition, toward the end of 2008, most sites were experiencing difficulties with student retention. In June-July 2009, Dr. Upton again interviewed a teacher representative from each site. By year-end, a core group of students at each club had completed the project and many had achieved the specified milestones (see Table 3). Dr. Upton also interviewed two Advisory Committee members (one superintendent and a curriculum director who was more directly involved than the listed superintendent was) and received a written response to all the interview questions from another superintendent. Finally, she conducted interviews with Mr. Elfner, Ms. Mann, Mr. Claymier, Dr. Horton, and Ms. Hinton.

- *Site Progress Reports and OAS Student Incentive Database* – IRC designed a 1-page report on which the teacher-teams documented the number of students active at a specified time and their involvement in additional activities. We reviewed the site reports in conjunction with OAS Student Incentive Database. We used counts from each of these as appropriate. Each provides a measure of students' accomplishments and progress.

- *Pre- and Post-test Results from Technology Lessons* – OAS designed a tool that teachers were asked to use in documenting students' scores on a series of questions designed to measure their understanding of science concepts associated with each of the ten technology lessons. Five of the eight sites submitted their data

[6] In addition to interviewing seven teachers, Dr. Upton did email follow-up with two additional teachers as part of covering summer activities.

to IRC for analysis. Kilbourne did not do the Year 1 lessons and two other sites failed to record the data before students took their journals home.

In summary, YBSTEMS has been regularly evaluated since its onset in November 2007. This report offers a comprehensive overview of its progress through the end of its funding in June 2009. Compared to the Year 1 report, since we are covering a longer timeframe, we are able to speak more definitively about the project impacts as well as some of the aspects that the leadership may want to modify in future implementations.

Student and Teacher Opinion of Activities

The purpose of YBSTEMS is to encourage participating students' life-long interest in STEM; increase their exposure to science and technology; improve their performance in science, writing, and presentation skills; and enhance their ability to work with others. The Year 2 surveys focused on these areas and revisited many of the questions that were included on the Year 1 surveys. Students, parents, and teachers had numerous opportunities to express their feelings about the program overall and comments on specific aspects. Table 5 below shows students' opinions about the activities, MP3 players, and gift cards.

Table 5: YBSTEMS Students – Year 2 Survey – Opinions about Activities – In Percent

Science/Technology Lessons	Students *N=50*			
	Of Those Who Did Activity			Did Not Do This
	Liked this a lot	This was okay	Did not like this	
a. Doing 4-H Club projects	35.4	52.1	12.5	0.0
b. Participating in the county fair	45.7	45.7	8.6	23.9
c. Reading science magazine articles	21.3	38.3	40.4	0.0
d. Doing online research	10.9	78.3	10.9	4.2
e. Working with other students	47.9	45.8	6.3	0.0
f. Writing summaries of news articles	4.3	29.8	66.0	2.1
g. Taking notes and recording data in my journal	6.7	57.8	35.6	2.2
h. MP3 player	74.5	23.4	2.1	2.1
i. Bookstore gift card(s)	84.8	15.2	0.0	2.1
j. Preparing science fair project	23.9	63.0	13.0	4.2
k. Planning technological design project for the whole class	31.7	56.1	12.2	14.6
l. Field trips	70.6	26.5	2.9	29.2
m. Guest speakers	60.5	34.2	5.3	20.8

Consistent with the Year 1 results, high percentages of students said they liked the bookstore gift card (85%) and MP3 player (75%) a lot. Although not all the sites offered field trips or guest speakers, students at clubs in which these activities were available enjoyed them. All but one liked the field trips (97%) and there were only two students who did not like the guest speakers (95%). In the open-ended comments, six students urged the addition of more field trips. For example, one said, "*I would like to see more field trips and more fun experiments added to the*

program." Another emphasized the value of the guest speakers and recommended linking them more closely to the hands-on activities, *" Have fewer lessons, but make lessons large, and have guest speaker for each unit that works in and is very knowledgeable in that field."* Most also agreed that working with other students (94%) as well as doing online research (89%) and 4-H Club activities (88%) were at least "okay." The majority of students who participated in the county fair (91%), science fair (87%), and the technology design project (88%) rated the experience as "okay" or "liked a lot."

As discussed in the Year 1 report, reading and writing continued to frustrate some of the students. Since YBSTEMS was open to all students, there were participants whose reading and writing abilities were below grade level. Despite the OAS change to science magazines that were designed for grades (4-6) rather than grades 5-7 and teachers' efforts to help students complete the writing assignments during club time, nearly two-thirds (65%) said that they did not like writing the article summaries. Although it may have been a challenge for them, 73 students finished 18 summaries and 33 of this group submitted 36 summaries (see Table 3). In addition, it is encouraging that the majority classified writing in their journal (65%) and reading science magazine articles (60%) as "okay" activities.

Table 6 shows that teachers' opinions about how well these activities proceeded are generally consistent with the students' responses. For example, they again gave the highest rating to "Students working together" (75% said it went well and 25% said it was okay). They gave the same high rating to their experience with the whole class technological design project.

Table 6: YBSTEMS Teachers – Year 2 Survey – Opinions about Activities – In Percent

Activity	Teachers *N=12*		
	Went well	Okay, but had to make some adjustments	Did not go well
1. Doing 4-H Club projects	58.3	33.3	8.3
2. Participating in the county fair	58.3	41.7	0.0
3. Reading science magazine articles	25.0	58.3	16.7
4. Doing online research	41.7	50.0	8.3
5. Students working together	75.0	25.0	0.0
6. Writing summaries of news articles	33.3	41.7	25.0
7. Taking notes and recording data in their journals	25.0	66.7	8.3
8. Using MP3 player	41.7	0.0	58.3
9. Preparing science fair projects	58.3	33.3	8.3
10. Planning technological design project for the whole class	75.0	25.0	0.0
11. Field trips	58.3	8.3	33.3
12. Guest speakers	66.7	0.0	33.3
13. Regular attendance of students	33.3	41.7	25.0
14. Retention of students	9.1	45.5	45.5

One area in which teacher opinion diverged from the students was specific to the MP3 player. More than half of the teachers (58%) said that the MP3 did not work as expected. One of the teachers felt strongly that the work that students were attempting to save onto the MP3 was more effectively and efficiently handled by having them write the information in their journals. While acknowledging that this approach made it more difficult to share the documentation electronically, she explained, "*We got more results from the kids by having them write with us in the classroom on paper right there."*

About a third of the teachers (33%) felt writing article summaries "went well," 42 percent said this was okay, and only a quarter (25%) said that it "did not go well." This is a major improvement over the first year in which none of the teachers thought the summary writing was going well at that time. Encouragingly, a few of interviewed teachers noted that some of the students were highly engaged by the science articles: "*The evidence most predominant is that they will come in and be excited about having read Science World magazine and talk about their summaries without being prompted. Not typically the way 5th and 7th grade students would behave."* A second teacher made the same comment: *"Some of them shared their summaries because they found something they really liked."* Slightly more than half (55%) felt retention was at least "okay"; however, it was viewed as a problem by 46 percent.

We also asked students to rate each of the ten technology lessons (see Table 7).[7] The proportion of participants in the respective activities said they "did not like this" ranged from a low of zero ("Manufacturing - Car Assembly Line" and "Medicine & Health – Genetics, ReeBops") to a high of 19 percent for the "Greenhouse Effect" project. The ones that received the highest "liked this a lot" ratings were "Flight & Space - Fizzy Rockets" (63%), "Materials – Glubber" (52%), "Manufacturing - Car Assembly Line" (48%), "Construction – Building Big" (45%), "Medicine & Health – Genetics, ReeBops" (42%), and "Energy - Designing and Testing a Wind Turbine" (42%).

Open-ended comments further confirmed that the students enjoyed the hands-on lessons and would have appreciated having more of these types of activities. Students shared the following:

> *Everything is perfect, but I wish we had more experiments.*
>
> *More hands-on learning. Not hard science. Easier experiments.*
>
> *It's fun to try new things and work with friends on projects. I liked to do experiments!*
>
> *More experiments and activities.*
>
> *More fun projects (fun, fun, FUN projects).*

[7]Since the Year 1 survey was administered in May 2008 and sites continued the activities through the summer, and possibly the fall, we again asked these questions, though students entering in September 2009 did not participate in the ten science/technology lessons.

Table 7: YBSTEMS Students –Year 2 Survey – Opinions about Lessons – In Percent

Science/Technology Lessons	Students N=50			
	Of Those Who Did Activity			Did Not Do This
	Liked this a lot	This was okay	Did not like this	
a. Agriculture & Food Production - Protecting Our Soil	18.5	66.7	14.8	42.6
b. Construction - Building Big (bridge design)	45.2	48.4	6.5	34.0
c. Energy - Designing and Testing a Wind Turbine	42.3	50.0	7.7	44.7
d. Environment & Natural Resources - Square of Life (observing, collecting data in the field)	22.7	63.6	13.6	53.2
e. Flight & Space - Fizzy Rockets	63.0	33.3	3.7	42.6
f. Information Technology - Square of Life (actually recording and analyzing data online on the website)	5.3	89.5	5.3	59.6
g. Manufacturing - Car Assembly Line	47.6	52.4	0.0	55.3
h. Materials - Glubber	51.9	37.0	11.1	42.6
i. Medicine & Health - Genetics, ReeBops	42.3	57.7	0.0	43.5
j. Transportation - Impact of the Automobile on American Culture	20.8	66.7	12.5	43.5
k. *Brassica* (growing demonstration and data collection)	21.2	63.6	15.2	48.9
l. Greenhouse Effect (demonstration and data collection)	25.9	55.6	18.5	31.3

Table 8 provides teachers' description of their experiences with the lessons. For all activities (where they were implemented), all of the teachers described them being at least "okay" with respect to their ease in leading the activity with the students. Everyone agreed that "Manufacturing - Car Assembly Line," "Materials – Glubber," "Medicine & Health – Genetics, ReeBops" went well. Teachers' opinion about the student favorites was consistent with the student endorsements.

Because the Kilbourne club was not established until November 2008, these students did not do the initial ten technology lessons; Kilbourne students did "Brassica" and the "Greenhouse Effect" only. Disconcertingly, Buckeye Valley reported completion of only five of the technology lessons and only four clubs (Buckeye Valley, River Valley, Upper Sandusky, and Colonial Hills) did the "Greenhouse Effect" experiment. Buckeye Valley and River Valley also did not cover the "Brassica" activity. Teachers discussed obstacles (often time/scheduling limitations and weather conditions) that prevented them from completing all the activities.

> *We ran out of time to compute the Square of Life lesson. We also had trouble finding a sunny day to complete the Greenhouse Effect experiment.*
>
> *We didn't get Brassica done because we planned on doing it in the spring. It fell at spring break time, but we were in technological design, and we said it would have to be on the back burner. Maybe if we would have done it last year, it would have given kids an idea of what the science fair was about. I think that was the point, but it wasn't ideal for us. [This teacher explained that he and the other teacher are*

in different buildings.] So having plants, dealing with logistics, and taking pictures was a snag for us.

Table 8: YBSTEMS Teachers–Year 2 Survey – Opinions about Implementation – In Percent

	Teachers *N=12*		Sites *N=8*	
	Of Those That Did Activity			
	Went well	Okay, but made some adjustments	Did activity	Student Favorite
1. Agriculture & Food Production – Protecting Our Soil	80.0	20.0	87.5	0.0
2. Construction – Building Big (bridge design)	77.8	22.2	75.0	50.0
3. Energy – Designing and Testing a Wind Turbine	77.8	22.2	75.0	33.3
4. Environment & Natural Resources - Square of Life (observing, collecting data)	60.0	40.0	87.5	0.0
5. Flight & Space - Fizzy Rockets	81.8	18.2	87.5	57.1
6. Information Technology - Square of Life (recording, analyzing data)	75.0	25.0	75.0	0.0
7. Manufacturing - Car Assembly Line	100.0	0.0	75.0	83.7
8. Materials - Glubber	100.0	0.0	87.5	71.4
9. Medicine & Health - Genetics, ReeBops	100.0	0.0	87.5	57.1
10. Transportation - Impact of the Automobile on American Culture	88.9	11.1	75.0	0.0
11. Brassica	85.7	14.3	75.0	33.3
12. Greenhouse Effect	75.0	25.0	50.0	0.0

Several teachers also noted that their clubs often spent more days on the lessons than scheduled, as they felt that extended lessons resulted in the students having more inquiry-based experiences.

We tended to spend several meetings with one experiment, and so instead of trying to do all experiments, we tried to go more in-depth and talk about all the characteristics. For glubber, we spent three meetings on it. The kids had a blast with it. We did the same thing with fizzy rockets, changing the designs, and graphing the results. The kids had a lot of fun with that.

I think the kids absolutely loved the science exploration. And, we have enough of those activities left that we can still do them throughout the rest of our time together. I think focusing on that is what lures the kids into this program. I don't think there's enough hands-on science at school, and I think that the kids were just ecstatic that they actually got to build things and make things and experiment with them.

We spent 3 or 4 meetings on some of the projects because the kids were interested in collecting more data and doing further experimentation. We felt the value of that was better than just running from one thing to the next without having them actually get to test and re-test and do what scientists really do.

We did a day camp for a week, the week after school was out because we didn't have time to finish the technology lessons, the 10 lessons, well, they were counted as 10, but some were included inside others. So, we did a day camp where we completed those lessons.

One teacher underscored the difficulty of completing all the YBSTEMS requirements activities in the given time frame, especially within an after-school environment.

In the future, being more realistic about the kids' busy schedules and time constraints of meetings. It is very difficult to have them write summaries, do experiments, conduct a meeting, research on the computer, and prepare data graphs during a two-hour meeting.

All eight teachers who were interviewed said students spent most of spring 2009 working on science fair and Capstone projects. In addition to science fair and Capstone, four said they worked on reading and writing summaries. One club took three field trips: to a wind farm, to a factory whose owner and inventor described how he had designed and patented his device, and to a tour of the green 4-H building at OSU after the Capstone event. Two clubs missed this year's 4-H filing deadline, but both still have several students participating. A third club, whose county fair is late in the summer, managed to have their Capstone project judged as a 4-H project. This club's students made individual posters about their own part in the Capstone project, presented at the high school, and all received As. The other five clubs had all or some of their students participating in 4-H. Of those five, two indicated that the students were doing 4-H projects on their own rather than during club time. The club whose fair is early had 75 percent participation in 4-H (several students were on vacation).

Student, Parent, and Teacher Overall Opinions

We measured overall opinion of the program by asking students, "Would you recommend the Young Buckeye STEM Scholars program to other kids?" We invited parents to respond to a similar question: "Would you recommend the Young Buckeye STEM Scholars program to other families?" Table 9 presents the results at the end of each project year.

Table 9: YBSTEMS Students and Parents – Year-end Survey – Recommend Program[1]

	Students				Parents			
	End of Year 1 *N=92*		End of Year 2 *N=50*		End of Year 1 *N=93*		End of Year 2 *N=51*	
	N	%	N	%	N	%	N	%
Yes	63	70.8	30	62.5	77	82.8	38	74.5
No	5	5.6	8	16.7	0	0.0	7	13.7
Not Sure	21	23.6	10	20.8	16	17.2	6	11.8

[1]Percentages are based on those with valid response to item.

The majority of both groups (Year 1: students=71%, parents=83%; Year 2: students=63% and parents=75%) would recommend the program; however, the percentage recommending the program decreased for both groups in the second year (8% fewer of both groups would recommend the program). In addition, more of each group indicated that they would <u>not</u> recommend the program. The number of students who would not recommend YBSTEMS

increased from five (6%) to eight (17%). At the end of Year 1, although 17 percent of the parents said they were "not sure" about whether they would recommend the program, by the end of Year 2, 17 percent said they would not recommend it.

Table 10 provides the Year 2 responses to the "Would you recommend the program" question by site. Table 11 provides a comparison of the percentage saying "Yes" they would recommend YBSTEMS by year and site. These two tables make it clear that several sites were highly endorsed by parents and students. Other sites, however, were less well received. Table 11 also highlights the changes in opinion within the past year.

Table 10: YBSTEMS Students and Parents – Year 2 Survey – Recommend Program by Site[1]

Program Site	Would You Recommend Program?					
	Students N=50			Parents N=51		
	Yes	No	Not Sure	Yes	No	Not Sure
Big Walnut	71.4	14.3	14.3	62.5	12.5	25.0
Buckeye Valley	100.0	0.0	0.0	100.0	0.0	0.0
River Valley	100.0	0.0	0.0	100.0	0.0	0.0
Teays Valley	75.0	25.0	0.0	62.5	12.5	25.0
Upper Sandusky	16.7	50.0	33.3	28.6	71.4	0.0
Colonial Hills	85.7	0.0	14.3	71.4	0.0	28.6
Kilbourne MS	60.0	10.0	30.0	100.0	0.0	0.0
Slate Hill	20.0	20.0	60.0	100.0	0.0	0.0

[1]Percentages are based on those with valid response to item.

Table 11: YBSTEMS Students and Parents – Year 2 Survey – "Yes" Recommendation by Site[1]

Program Site	Students				Parents			
	End of Year 1 N=92		End of Year 2 N=50		End of Year 1 N=93		End of Year 2 N=51	
	N	%	N	%	N	%	N	%
Big Walnut	8	66.7	5	71.4	11	91.7	5	62.5
Buckeye Valley	14	87.5	3	100.0	15	93.8	3	100.0
River Valley	7	87.5	2	100.0	6	85.7	2	100.0
Teays Valley	7	63.6	6	75.0	11	84.6	5	62.5
Upper Sandusky	5	55.6	1	16.7	6	66.7	2	28.6
Colonial Hills	5	71.4	6	85.7	7	87.5	5	71.4
Kilbourne MS	NA	NA	6	60.0	NA	NA	11	100.0
Slate Hill	8	80.0	1	20.0	9	75.0	5	100.0

[1]Percentages are based on those with valid response to item.

Buckeye Valley and River Valley were highly recommended at the end of both years by students and parents. By the end of the second year, all responding parents said they would recommend the program at four sites (Buckeye Valley, River Valley, Kilbourne, and Slate Hill). Parental opinion of Big Walnut and Teays Valley declined by the end of Year 2. For students, the number of favorable opinions increased by the end of Year 2 for Teays Valley and Colonial

Hills, whereas the level of student recommendations of Big Walnut stayed about the same. Kilbourne and State Hill students were much less likely to recommend the program than their parents (see Table 12). However, as shown in Table 10 above, students at these two sites were much more likely to say "not sure," and only one student at each of these sites said they would not recommend the program.

Table 12: YBSTEMS Students and Parents – Year 2 Survey – "Yes" – Students vs. Parents[1]

Program Site	Said "Yes" to Would You Recommend Program?				
	Students *N=50*		Parents *N=51*		Students Compared to Parents
	N	%	N	%	
Big Walnut	5	71.4	5	62.5	8.9
Buckeye Valley	3	100.0	3	100.0	0.0
River Valley	2	100.0	2	100.0	0.0
Teays Valley	6	75.0	5	62.5	25.0
Upper Sandusky	1	16.7	2	28.6	4.7
Colonial Hills	6	85.7	5	71.4	14.3
Kilbourne MS	6	60.0	11	100.0	-40.0
Slate Hill	1	20.0	5	100.0	-80.0

[1]Percentages are based on those with valid response to item.

Upper Sandusky was less likely to be recommended than other sites at the end of Year 1, and unfortunately, both student and parent opinion further decreased by the second year. Three students at Upper Sandusky and two at Teays Valley said they would not recommend the program. There was only one student respectively at other sites where students said "no" in response to this question (Big Walnut, Kilbourne, and Slate Hill). Similarly, five Upper Sandusky parents would not recommend the program, along with one each at Big Walnut and Teays Valley. Two parents respectively at Big Walnut, Teays Valley, and Colonial said they were "not sure" if they would recommend YBSTEMS to other families. The open-ended comments from each group highlighted the aspects that participants liked best about the programs as well as offering a means for both groups to share their frustration about issues that made the experience less than fully satisfying.

Comments from Students and Parents Who Recommended Program

Nearly half (45%) of the 31 students who said they would recommend the program mentioned enjoying the things they did. Comments included:

> *I liked building the bridge and the cars.*
>
> *I liked doing the science fair projects and doing the competitive engineering things.*
>
> *It's a fun and exciting program and you get to learn a lot of fun stuff, like how to build an owl box.*

In addition, among the things that students liked best about the program, five mentioned the science fair, four said they liked 4-H, and four appreciated the gift cards and MP-3 players.

Twelve of the 30 students (40%) specifically noted the academic benefits. Several simultaneously noted that it pushed them to work harder than they may have expected:

> *I liked the challenges and thinking hard.*
>
> *The engineering part and math. Lots of work, though.*
>
> *It teaches you a lot, even though it is a lot of work.*
>
> *We had fun while learning! A fun program definitely, but I don't like doing summaries.*

Parents similarly stressed their appreciation of the hand-on activities and challenging academic requirements.

> *It's a good after-school enrichment program. It challenged my son more than his regular classes.*
>
> *Involvement in science fair. Science articles review each week.*
>
> *4-H involvement and variety of science studied.*
>
> *I love the fact they got to just "do science" and not have to be worried about learning for a test.*
>
> *The chance to just "do science" and explore cause and effect. It helped them also understand they have an impact on the world around them.*
>
> *Integrating writing, hands-on activities, researching, and studying makes STEM program rich and valuable. The child has learned these steps the way a scientist creates a scientific report from designing an experiment to represent data and results on a paper.*

One noted that it was a "*great opportunity to learn in a non-graded situation, and the incentives were a nice perk."*

Parents who were satisfied with the program also commended the teachers at several clubs.

> *Great leaders—good about getting all kids involved.*
>
> *Local teachers did a great job engaging students.*

Students and Parents Who Would Not Recommended Program

Of the eight students who said "*no*" to recommending the program, four described YBSTEMS as "*boring"* and *"too long."* Another said, *"I really didn't like having to work with both STEMS and school at the same time."* One student explained that the program did not meet his expectations: *"The STEMs program said it offered fun activities and field trips. There were few fun activities and we went on one field trip."* One female participant would not recommend it to her friends because *"my friends do not like this kind of stuff."* This response is not necessarily

negative except in terms of the student's friends. The last student had the following complaint: *"I didn't get much feedback from advisors. Also, there were too many summaries to do."*

Two parents were disappointed by the mismatch of their expectations with the actual program activities.

> *I was hoping this program would increase my child's interest and knowledge in science. It did not do this! My child hated STEMS.*
>
> *He hated the science fair project! He hates writing the articles. He didn't care about the rewards.*

Another parent found the program to be too much like a school science class.

> *I was very disappointed that the children did not participate with hands-on activities. My child received STEMS as an extension of school. It was a "sit down shut up" program. My child thought she was getting a "hands-on" tech class.*

Other comments emphasized the workload, "*Too much stress"* and *"Too much outside work."*

Of the seven parents who would not recommend the program (five from Upper Sandusky and one each from Big Walnut and Teays Valley), three parents felt the advisors were not sufficiently responsive. For example, one wrote, *"The advisors did not know how to deal with elementary/middle school students or motivate them."*

Students and Parents Who Were Not Sure If They Would Recommended Program

Ten students (six who endorsed the program and four who were "not sure") emphasized their desire for more field trips, including COSI. One student in the "not sure" category requested, "*More student input in things we do*." Two others asked for "*more organization*," and one of these added, "*The club started to fall apart after the first half*." Other suggestions were to work with animals, to have more hands-on activities, and to eliminate the summaries.

The six parents who were not sure whether they would recommend YBSTEMS represented three clubs (two each from Big Walnut, Teays Valley, and Colonial Hills). Four of these parents had good things to say about the program:

> *My child liked taking pictures outside and loved demonstration day*.
>
> *She liked the hands-on building done at the beginning of the program better than the reading and writing of summaries at the end of the program. She loved getting rewarded for her work with the gift cards.*
>
> *When it started, the leaders were wonderful. They let the kids discover on their own. The kids worked in groups and developed skills.*

One of these parents clearly demonstrated having mixed feelings:

> *Yes, I would recommend this program because of the "team" and teacher involvement! The teachers kept the program going with their knowledge of child development. No, on the other hand I wouldn't recommend this program due to*

projects having unclear direction and it not being age appropriate. This program would have kept more members if the projects didn't have to be done at home and if the program had not run so long.

These parents complained that the program was too teacher-centered, not age-appropriate, lasted too long, and required too much work at home by students and their parents. Parents had the following comments:

Meetings were repeatedly not scheduled [due to conflicts with one teacher's personal schedule]. Meetings were too directed and boring (adults could hear in the hall). It was too school-like with not much "doing." Kids also were unable to interact with each other. After a full day of school, it was hard for my daughter to sit for two more hours. The teacher dominated meetings, prevented kids from working in a peer group, lacked knowledge on working with this age of kids, and treated them as younger kids. She lacked science skills. A middle school leader is needed, as this person would know what skill level the students are at.

I would recommend [the program] with some added clarity of goals and better use of club time to organize projects, check progress, and motivate results. This program has left parents doing the heavy lifting.

The materials used at the beginning were way too advanced for the student's comprehension level. Very thankful the teachers altered that!

She lost interest after 1½ years. Maybe 1 year would have been better.

One of these parents, however, noted appreciation for "*the OAS letter stating goals/expectations and referred to it repeatedly." This respondent also added that, "Through the program, my daughter has become more scientifically curious and confident and through the magazines and projects, a world of new ideas was opened to her."* Thus, although this group felt the experience could have been improved, they also acknowledged that the OAS did a good job of communicating and that their children benefitted.

Additional Parental Concern about YBSTEMS Intensity and Challenging Requirements

Even parents who said they would recommend the program expressed caution about the amount of work required by the program. For example, one said:

I would recommend this for students who are already doing well in school. This program is time consuming and difficult for kids in 5th grade to keep up with. The field trips have been the most fun for my son. The article reviews have improved his interest and confidence with writing skills.

One "not sure" parent experienced firsthand a child who increasingly felt the experience was not always "*fun*."

I feel the program had both a positive and a negative impact on my child. He enjoyed some of the projects and activities and disliked many activities. The workload was too much, which turned him off. The activities at STEM meetings changed over time from "fun" to "un-enjoyable" The program needed to be more consistent and information needed to be more effectively communicated to

parents. I think the program could be excellent if changes were made to address these issues.

Parents who would not recommend the program spoke even more strongly about the need and expectation for YBSTEMS to be fun, engaging, and focused on hands-on activities.

At this age, the kids want hands-on labs at their meetings and science-related field trips. The teachers were wonderful! It was the STEM curriculum that my son didn't like and that is also why many of the members quit.

Whatever was going on in STEMS, she and several other gifted and talented kids did not like it. I know [the advisors] are wonderful teachers, but all of the homework assignments and "forced" reading of science magazines were bummers. We were all led to believe this was hands-on.

The concept of YBSTEMS is good. The program should not be like "another class." It should be more like a functioning research lab. Science and technology is fun and so should YBSTEMS.

Teacher Opinion about the Program

We asked teachers a series of open-ended questions on the year-end survey. The eight interviewed teachers also gave additional detail about their experiences. Seven of the interviewees reported positive feelings about YBSTEMS, with the eighth teacher describing her feelings as "*very mixed*." Teachers said that they or their students *"enjoyed"* the program, that it was "*positive"* and "*wonderful.*" One teacher described the past six months as both the *"best and most difficult"* time of the program. A second teacher was *"ready for a break"*, although she liked the program. Overall, teachers emphasized the following YBSTEMS strengths:

- Hands-on technology lessons
- Integration with 4-H
- Capstone project
- Professional development from OAS staff and consultants

Seven teachers reported positive parent feedback. At three clubs, parents attended meetings or made a point of speaking to one of the teachers after meetings. An interviewee said:

Parents typically come in and visit for a moment or two or even longer when they pick up their kids. They would make sure their students were doing what they should be, that their behavior was good, and they would say what a good opportunity this was for their kids.

A second teacher shared: "*They encouraged us, and they thanked us for our time. They were impressed with the kids' interest in science and 4-H."* She described her parents as *"always willing to help."* A third teacher noted that his parents were flexible in the face of variable meeting times and "*They understood the value of what we were doing and how we were trying to accomplish it and how hard it was to put all of this together."* Two teachers whose clubs had high attrition rates said that their parents were *"very supportive."* However, the parents and

students who were not supportive had already left the program, and the core group that was left *"loved it."* Four teachers received both positive and negative feedback from parents. These comments included:

> *Other than parents who came to the club to pick up the kids, two or three would usually come in and really talk. One parent is a local 4-H leader. Her daughter qualified to go to district and probably would have made it to state, but she wasn't interested because she was so overwhelmed. Parents of two kids were really glad their kids did it and they thought the program was good and they had lot of fun and learned a lot.*

> *Kids that did local science fair, we got positive feedback on that—they were glad that they had their kids there. Me being a teacher, I always hear the moaning and groaning about projects, even from the parents. They gripe about the work, but once it's done, everyone has a sense of accomplishment and pride, and they're glad they did it. They're happy to have had that experience.*

The eighth teacher reported only negative parent feedback, specifically about the science fair. However, her comments included a suggestion from a parent:

> *Instead of a science fair project, we should do little lessons like the technology lessons about collecting data and putting it a spreadsheet, kind of like building it up to the science fair. More like little experiments. They thought that would be much more feasible, much more enjoyable, because the technology lessons were such a hit.*

In response to a question about obstacles that they had encountered, three teachers noted that time was a problem, one due to a very early county fair, which pushed 4-H, Capstone, and end-of-school into one small window of time. One also pointed out that students are generally pressed for time. As an example, one student attended most meetings via email. One club started in November rather than September/October and had some trouble catching up, although they eventually did. Two clubs saw science fair as an obstacle because students did not want to participate.

Teachers had mixed feelings about the science fair. Although teachers overall viewed the science fair experience as potentially beneficial to students, especially with respect to giving them a better understanding of the scientific method, a few also believed that many students dropped out of the second year due to the program's focus on longer-term projects—specifically, the science fair and the Capstone project. With more hands-on activities and fewer requirements, students who were more marginally interested in science or had less parental involvement might have remained in the clubs. The one teacher who had negative feelings about the program was discouraged by the retention rate at her club, which she attributed to the science fair requirement. She explained:

> *I like the hands-on. I like the very different technology lessons, I like trying to put it into the kids' hands, but the second phase, phase 2, the science fair killed it. At one point we had 29 kids, we ended up with nine and that was after recruiting two more times. We only ended up with five of our original kids from 2008 and that was very frustrating.*

Another teacher contrasted the hands-on lessons and the science fair, highlighting students' need for a deeper understanding of the scientific method:

> *The hands-on lessons were terrific. They held the students interest and taught new concepts. The science fair projects were difficult because the students had little background in the scientific method and/or technological design. I wish we had worked on the scientific method the first year.*

More than one teacher noted that science fair was more time-consuming than anyone had imagined, although interviewees appreciated how much students learned from the experience. One shared, "*Even though it's a difficult process and caught some of kids and parents by surprise as to how much work it is, I think it opened their eyes to looking at science in an in-depth way and really brought them into the focus of what science is all about."* Teachers confirmed that the students who continued and participated in the longer-term projects were proud of their accomplishments and learned a lot. For example, another club encountered student resistance to the science fair, but students who stuck with the program were pleased with their success.

> *But I know kids that did [science fair] learned a great deal about what it takes to do a science project or a technological design—definitely a lot of things with the interview process and how to present and how to refine their presentation as they moved forward. We had one student that went to the state level and he learned a great deal about the process of how to continually improve his presentation based on the judge's comments. So learning what the judges were looking for and making the presentation go in that direction was a good learning experience as well as all the science that came with that.*

One club called their science fair success "phenomenal." All seven students at this site participated and received "*excellent*" ratings. In addition, the teacher elaborated:

> *They also all did the Invention Convention. They had a great time. One student got the spirit award that is only given out occasionally by the director of the convention.*

In one school district, conflicting middle school and elementary school buildings and schedules made it a challenge to retain the sixth graders when they went into middle school. That teacher felt that "*If you could do 6th and 7th, then you could do 7th and 8th the following year. That would work out fine. But if you're going to target 5th grade, it needs to go with 5th. We had a lot of 6th graders, and they were the kids we lost when they went to 7th grade."*

Teachers' greatest frustration was the sheer number of requirements that clubs needed to complete within a tight timeframe. Like some students and parents, several teachers recommended the inclusion of more hands-on activities throughout and extension of the program over a longer period. Six of the eight teachers recommended scaling back activities. One teacher noted: "*Parents want to have their kids involved in as many things as they can, but sometimes they don't realize that the kids have a breaking point, too."* He further commented:

> *At this time of year, students are involved in a lot of major projects during the school day and sports activities or extracurricular like ballet and soccer. If there were some way to scale back the amount of routine work we expected of them, that might be more helpful to retention. We lost a few for that reason. It was too*

overwhelming for parents and students. Scaling back on the amount of hours. I think the interest was there, but there aren't enough hours in the day.

Teachers suggested ways that this scaling back might occur, such as *"maybe science fair projects could be spread over two years and gradually work into it."* Similarly, two teachers preferred doing fewer activities, more in-depth. One suggested: "*Maybe have kids take an activity and change it so they come up with own activity along the same lines. They would have to set up the experiment themselves. They could have topics, but write their own."*

Four teachers commented on the reading/writing requirement. Two valued the reading/writing emphasis of the program, saying, *"Writing is a very important key*," but thought it might be *"a little over-ambitious"* and suggested reducing the number of summaries required. One of these teachers described student resistance to summary writing:

The feedback I got was they enjoyed getting the magazines and would always look through the magazines and look through articles, but doing the summaries, that was a bitter fight at home and often not a pleasant experience in STEM club too, so I'm not sure about that impact on kids. Sad to say, only four students completed the 18 summaries this year out of the kids we had left in the program. I'm not happy about that outcome.

The third *"really liked the summaries although I know most people don't."* The fourth teacher described student benefits:

The summaries were difficult, but it was interesting because the kids learned to do a summary correctly by having to write all those. They started out with three page summaries, and ended up with a paragraph by the end. Even though writing started out really hard, it became a positive at the end. They learned how to take information and put down the essence of what was in the article.

One teacher wanted guidance about the time his club should spend doing 4-H. He was willing to do the meetings and found them valuable, but "*the expectations were not clear."* He explained:

We need more clarification of what should happen in those meetings. Is it necessary to do it every meeting or once a month? We spent a tremendous amount of time to conduct the 4-H meeting. We spent an hour doing that and trying to get the kids to understand the process. I think it was worthwhile, but I would like more direction.

A teacher who appreciated the "rigor" of the program said that she nevertheless felt that the same rigor tended to exclude students who did not have strong support at home. She wondered whether it would be possible to have in addition to regular STEM "*another kind of program, less rigorous, that has all the opportunities, but isn't so overwhelming and intense for all those kids that deserve to have a chance at science and math and STEM."* In this teacher's opinion, "S*ome of the underprivileged kids, if it wasn't so demanding, they would have stayed even without incentives, because they just love attention and support and that would have been enough for them."* Additional suggestions:

In a group of five, you're going to get kids who are sitting out and not doing anything and they get very frustrated. So whenever we had a project we always

ran around and we got extra materials for the kids, so we could put them in twos or threes. That was just more beneficial for those kids. They're looking to be active after school. They don't want to come and look and just sit. They need the materials in their hands.

Field trips, I know the parents were disappointed because they didn't do eight or ten field trips as promised, and then that kind of fell through and parents were upset with that. If any kids needed field trips, these did. Get special permission and take kids out of school because they're in the STEM program. It would also highlight the program and give the kids special notoriety in the halls of the school.

They loved the activities, but follow through for 4-H was really difficult. I would probably change the approach and would assign a project to the kids rather than letting them choose and not really totally following through. As a group, we may choose one, like if we did food and all work on it as a group and do that approach and bring in all the equipment for food, and follow through to show them how to do a 4-H project because they had a difficult time doing it on their own.

Teachers were positive about OAS support, saying things such as:

Any time we called, they called back immediately. They were just wonderful to us."

Generally, the staff, Lynn and Joanne and Bob, did a fantastic job with projects, and I think support was there. All we had to do was ask, and we received. So I have to give them an A plus for that."

Two noted *"some communication problems"* but noted that staff were willing to *"make adaptations"* and that they did *"make concessions and had patience, which we were appreciative of." One suggested the following improvement, "In the future, planning better and letting teachers know in advance of things, but other than that, it was pretty good*." Two teachers recommended email reminders about 4-H deadlines. An interviewee explained:

I would have liked to have had a very set schedule with reminders of dates and times for the 4-H. We had a tremendous amount of stuff to do at end of the school year so we missed the filing. If I got an email reminder from support staff that this is due, turn in ASAP, that would have been most helpful."

A teacher suggested that a YBSTEMS teachers' blog would have been helpful, pointing out that "*It would have saved time for everybody to be able to communicate."* He said also:

I would have loved to be able to communicate easily with the rest of the STEMS teachers and say, "We did this. How did it work for you?" We talked about a blog—how to communicate easily and share ideas. It would have been effective and would have helped everybody, and it would have brought the groups closer together. It would have made us as a group feel closer to the whole STEMs community. We would have shared information and ideas. It would have been a good way to make those adjustments

A final request for support referenced the OAS. According to the teacher, his student's technological development project was judged at the district science fair by a judge who was

looking for the scientific method (as stated on his judge's sheet) and was unaware that technological development and problem solving were a qualified substitute. Since YBSTEMS had told the teacher that technological development was a viable project for science fair, the teacher felt that the judges should have been notified, too.

> *I don't think this is YBSTEMS, but maybe the Academy itself, in two instances with one student who went all the way to state. The judges didn't understand what technological development was, so he had "Problem solving of technological development," and on the judge's sheet, it said using "Scientific Method." They didn't know technological development could substitute for that, and so he got really low scores. That was the only thing that was disappointing to me—when the judge didn't understand. I don't know if technological development is new in science fair. I talked to teachers and they didn't know.*

All the teachers found the YBSTEMS program to be worthwhile, and all hoped that funding would continue. A typical comment was: "*I think I probably would just reiterate what a wonderful opportunity it was for the students. It was also an opportunity for teachers to grow professionally."* Teachers enjoyed working with the students and their advisor partner. One summed up the experience with: "*Team teaching is a great experience. Brainstorming, creating, and interacting with the scholars was amazing—the more we did, the more they brought to the table."*

3. An Analysis of the Effectiveness of the Program

Analysis of YBSTEMS Students' Pre- and Post-test Results

We also did analyses on the pre- and post-test results tied to the ten science/technology lessons. Five sites submitted data. Colonial Hills and Buckeye Valley no longer had access to students' Year 1 journals when we requested these data. Since Kilbourne entered the program in Year 2, their students did not do these activities. Table 13 presents the average scores across the five sites for each set of lessons. Students were significantly better able to provide acceptable answers to all the areas covered in by the technology lessons following their participation in the hands-on activities.

Table 13: YBSTEMS Students – Pre- and Post-test Results – Technology Lessons

		YBSTEMS Pre-test		YBSTEMS Post-test		Mean Difference
	N	*Mean*[1]	*S.D.*	*Mean*[1]	*S.D.*	
1. Construction #1	56	40.43	35.047	93.74	10.846	53.31***
2. Construction #2	79	46.53	32.383	93.02	13.968	46.49***
3. Construction #3	76	48.75	37.153	90.25	19.508	41.50***
4. Energy	91	46.38	24.996	81.72	25.254	35.34***
5. Environment/Agriculture	76	61.46	31.801	98.02	2.954	36.56***
6. Manufacturing	92	43.85	26.837	96.89	3.538	53.04***
7. Materials	85	52.23	43.003	93.49	10.545	41.26***
8. Medical/Health	90	29.42	27.735	78.97	34.304	49.55***
9. Space Technology	93	53.18	18.028	93.33	10.865	40.15***
10. Transportation	95	56.67	43.461	97.83	3.943	41.16***

[1]Average percent of students who gave an acceptable answer.
***Statistically significant pre-post difference with p-value < .01 based on *t*-test results for mean differences.

It was not uncommon for sites to report that none of their students was able to answer some of the questions initially, indicating that many of the students did not have any prior knowledge of the issues covered in the technology lessons. Students showed significant gains on 28 of the 29 of technology lesson questions. The only question on which they demonstrated adequate knowledge prior to the lesson was, "What is the difference between renewable and non-renewable energy resources."

YBSTEMS Students' Science Process Skills

On the Year 2 survey, we included *The Science Process Skills Inventory* questions that were developed by Mary Arnold and Virginia Bourdeau at the Oregon State University as part of measuring the progress that 4-H students were making in their understanding of activities that are critical to doing science (Arnold and Bourdeau, 2007). We used their instrument exactly as it was designed and asked students, "How much can you currently use each of the following skills when you work on a science investigation?" for each item listed in Table 14. In order to make the YBSTEMS group as comparable as possible with the Oregon students, we restricted

analysis to 6th and 7th graders only, which restricted the sample to 38 YBSTEMS students and 70 Oregon students.

Table 14: YBSTEMS Students – Year 2 Survey – *The Science Process Skills Inventory*[1]

	6th and 7th Graders Only				YBSTEMS Mean Difference Compared to Oregon
	YBSTEMS Students N=38		Oregon Post-survey N=70		
	Mean[2]	S.D.	Mean[2]	S.D.	
a. I can use scientific knowledge to form a question	3.11	.727	3.47	.631	0.36***
b. I can ask a question that can be answered by collecting data	3.05	.695	3.57	.627	0.52***
c. I can design a scientific procedure to answer a question	3.03	.677	3.44	.629	0.41***
d. I can communicate a scientific procedure to others	2.95	.804	3.31	.671	0.36**
e. I can record data accurately	3.39	.595	3.49	.608	0.10
f. I can use data to create a graph for presentation to others	3.55	.602	3.66	.535	0.11
g. I can create a display to communicate my data and observations	3.49	.651	3.49	.654	0.00
h. I can analyze the results of a scientific investigation	3.19	.776	3.31	.671	0.12
i. I can use science terms to share my results	2.89	.798	3.21	.679	0.32**
j. I can use models to explain my results	3.27	.652	3.44	.581	0.17
k. I can use the results of my investigation to answer the question that I asked	3.47	.603	3.57	.554	0.10

[1]Question is from Bourdeau, V. D. & Arnold, M.E. (2007), *The Science Process Skills Inventory*. Corvallis, OR: 4-H Youth Development Education, Oregon State University.
[2]Higher mean score indicates a higher level of self-reported skill, as the values were: "Never" = 1, "Sometimes"=2, "Usually"=3, and "Always"=4.
**Statistically significant pre-post difference with p-value < .05 based on *t*-test results for mean differences.
***Statistically significant pre-post difference with p-value < .01 based on *t*-test results for mean differences.

The Oregon students reported a stronger level of competence in five areas:

- I can use scientific knowledge to form a question (+.36)
- I can ask a question that can be answered by collecting data (+.52)
- I can design a scientific procedure to answer a question (+.41)
- I can communicate a scientific procedure to others (+36)
- I can use science terms to share my results (+.32)

Reassuringly, the YBSTEMS students felt most confident with the following science process skills:

- I can create a display to communicate my data and observations (mean=3.49),
- I can use the results of my investigation to answer the question that I asked (mean=3.47),
- I can use data to create a graph for presentation to others (mean=3.55),
- I can record data accurately (mean=3.39).

There were no statistically significant differences between the YBSTEMS students and Oregon sample on this last set of items. Both groups gave reasonably high ratings with regard to their ability to use these skills in a science investigation. **NOTE: We have limited data on the YBSTEMS students and the Oregon sample, so we cannot control for additional, possible differences between the groups that might explain the Oregon students' greater confidence with five of the process skills.** In addition, we did not ask YBSTEM students these questions on the pre-survey, so that we cannot measure growth over the course of the program. Parents, however, attested to the growth in the students' presentation skills. The YBSTEMS students overall gave higher ratings to the skills most emphasized in the Capstone and science fair projects. Thus, it is likely that their participation in YBSTEMS contributed to their high level of confidence in these areas.

Impact of the Capstone Project

Each YBSTEMS club developed a "Capstone Project." Participating students were required to work as a group to develop a technology design project that was to address a specific community need. As instructed in the December 2008 in-service workshop, teachers were expected to have students use various "need identification" or brainstorming techniques created by IDEO, a leading design and innovation firm in California, to discover and refine a "needs" statement (IDEO, 2003). Thus, the students invited local officials and experts to speak at their club meetings, did background research, established design criteria, created a preliminary design, tested prototypes, and finally produced a finished project. Project titles by site were as follows (Ohio Academy of Science, 2009):

Big Walnut - *Crush Those Cans*, a recycling project

Buckeye Valley - *The Sloan Digital Sky Survey* in cooperation with the U.S. Army Corps of Engineers at the Delaware Dam, to create an all-weather, permanent outdoor educational kiosk

River Valley - *Project Patio*, an outdoor, multi-purpose study, lunch and class area

Worthington (Colonial Hills) - *Going Batty*, an environmentally safe insect control program

Worthington (Kilbourne MS) - *Screechers*, an all-weather screech owl nest box for the Ohio Wildlife Center

Worthington (Kilbourne MS) - *Plan BEE*, a new healthy beehive in cooperation with the Columbus Zoo

Worthington (Slate Hill) - *Improved Home for Bats*, a bat house

Teays Valley - *Future Fun*, comprehensive plan for school and community multi-use of an intramural field

Upper Sandusky - *Red Bin Brigade* - Multi-media effort to encourage citizens of Upper Sandusky to recycle

On June 12, 2009, the YBSTEMS clubs presented their project posters to peers, teachers, parents, and YBSTEMS staff at a recognition luncheon at the Nationwide--Ohio Farm Bureau 4-H Center on The Ohio State University campus.

Fifty-five students completed a survey about their experience. Students from all sites except for Colonial Hills were represented in the survey. Only three students from Colonial Hills attended the Capstone Event. The day was the last of day of school, which included an awards ceremony, which students did not want to miss (this was a make-up day due to windstorm damage in September 2008 that was not on the calendar when the Capstone Event was scheduled). Table 15 presents the results. Most students (95%) said they prepared preliminary designs, plans or sketches. They majority (94%) also felt good about their final poster (94%). They also verified that they worked as a team (93%); however, as is typical with this age group, only 69 percent agreed that they like to work in teams. Nearly two out of five students (38%) confirmed that they had not heard of "technological design" before this year. Appendix 2 provides the responses by site. There are numerous club differences, most of which were likely impacted by the choice of project. For example, all of the students at Buckeye Valley and Upper Sandusky said they worked with adults other than the teachers, whereas only a third of the Big Walnut students agreed that this happened at their site.

Table 15: YBSTEMS Students – Capstone Survey – Opinions about Capstone Tasks[1]
—Questions Ordered by High to Low Total Percent—

	Capstone Event Students *N=55*	
	N	**%**
We prepared preliminary designs, plans or sketches.	52	94.5
I feel good about our final poster presentation today.	51	94.4
We worked as a team to conduct the project.	51	92.7
We built one or more prototypes and tested them.	47	85.5
Defining a "need" or problem is the first step of technological design.	44	80.0
We established a design statement or criteria for success.	44	80.0
We worked with adults (other than teachers) either as speakers or as someone we could talk with about the project to get background ideas or information.	40	78.4
I like to work in teams.	38	69.1
We collected and analyzed the results of testing the prototype(s).	37	67.3
We searched for patents online (Google™ Patent) to find design ideas or to compare existing designs with our ideas.	26	47.3
I was able to use design or visualization software (e.g. Google™ *Sketchup*).	20	38.5
I never heard of technological design until this year.	21	38.2

[1]Percent of participants who indicated that they "Strongly Agree" or "Agree" with each statement. Percentages are based on those with valid response to item.

Students at the luncheon were also asked to respond to two open-ended questions. The first item was specific to their Capstone experience, "Please complete the following sentence: *If I were to do this technological design project over, I would make sure that…"* Twelve students answered in concrete terms about their particular projects, mentioning changes or additions they wished they had made. Examples said, "*I would make sure that*:"

I handed out more recycling bins.

The slats in our bat box fit easier.

We would build more benches.

We would have shade over the picnic tables.

I would make the first prototype more stable at the base.

I would've added more interesting facts on the poster.

I would test the prototypes more.

We would make 3-D prototypes of what we did.

It would work with other features that I came up with.

There would be more choices on the survey.

We took pictures of the whole process.

For eight other students, this question prompted an assessment of their work and ideas about how they might improve it. These answers included*:*

I would be at every meeting.

I would contribute a little bit more for ideas.

I would do more research.

I would get more done than I did and do less socializing.

I would look over my work twice.

I would make it a little more organized.

Five students mentioned time constraints. Three students wanted more time for the project in general, and two wanted more time to survey and talk to people. Four students mentioned the desire to improve the group dynamics. One claimed, *"It would be a group project and everyone would agree on everything."* Two others (from different groups) said they would make sure that *"more people attended."* Eight students wanted to do the project the same, often with some unspecified improvement to make it *"work even better."* Two students emphasized the potential community value of their projects:

People would actually use the design and not break it or hurt themselves with it.

We met a need that the whole world could use.

The second question encouraged the Capstone presents to provide additional comments about any aspect of the YBSTEMS program. Thirty students strongly endorsed the program and hoped that it would continue, saying, for example, *"I am happy I got the experience to try out STEMS. I definitely want to do it next year" and* "*It was awesome, fun, and should continue."* Of these comments, 18 were general, saying that they liked the program, but not citing specifics. Those who did mention specific features of the program said they liked the rewards, field trips, science fair, Capstone, experiments, and making a lot of friends. One participant said: *"I really liked the Capstone project and learning about science and how it's in everything."* Three said they *"learned a lot"* or found it *"educational."* Three of the surveyed students cited the summaries/articles as features of the program that they did not enjoy. There were three student suggestions, and the third has already been implemented:

Should have given MP3 players at the end so that people didn't drop out.

Fewer articles and more experiments.

First, I would like to say fewer articles—around 28-30. Also, change the magazine mailed from Science News to Science World.

Teachers and staff spoke highly of the Capstone projects. One teacher and some students were unable to attend the event due to a scheduling conflict for a make-up day. Of the seven teachers who commented on the event, four felt that the Capstone event was valuable for students because it enabled them to talk to their YBSTEMS peers and see the other student projects. They noted that it was the first time any of the students had met other YBSTEMS club students. One said: "*It gets them to see what their peers are doing as well. They didn't have very much interaction with other groups so this is a way for them to see how everybody else did things and their thought processes and what they went through."* A teacher was impressed by the way the students interacted, saying:

It was wonderful. The kids were totally amazed, looking at other ideas that other students came up with. I heard the questions as I walked around the room and listened to kids asking other kids questions, and I was pretty impressed with the level of questioning and the interest that they showed. It was a wonderful, wonderful program for them.

Another teacher felt that the Capstone project epitomized the goals of YBSTEMS:

The Capstone was the ecological design, the collaboration, the best example of STEM that we could ask for. My experience is with secondary kids, so I was quite pleased and surprised with the way they did collaborate. It's not typical for elementary kids; they don't like to sit at the same table and work together. I was very pleased. I thought they mimicked very well the kind of constructivist approach we use in the middle grades using the STEM concept.

Teachers also elaborated on reasons behind students' apparent greater enjoyment of Capstone compared to the science fair:

They had fun with the Capstone because we brought in three guest speakers, a gentleman from the local recycling center, and a lady, a specialist from the soil and water department in Wyandot County. We asked them, 'What did they think the county needed?' They encouraged them to do more recycling in the county.

I think being a group project we got more buy-in because the work was shared and so some kids didn't want to write the report, so they could work on the design and building. So it helped because we did it as a big group, they were more excited and because it was a community project and they were going to see the benefits of it, they were more interested in seeing it through.

In addition to bringing together all of the skills promoted by YBSTEMS, all of the projects are expected to have longer-term benefits for the local community. One teacher felt that "*we had more impact on community with the recycling project than we have had on the school."* She added that she, her colleague, and some students would be *"going to the school board meeting and show them our big giant poster and we sent out an email to see if some of the kids wanted to come. Let them know what we've done and the kids could give their reaction and that kind of stuff. I don't think the school board themselves see too much of what's going on, that's why we decided to share."* Interviewed teachers offered additional examples of impacts that resulted from their clubs' culminating technology design products.

Upper Sandusky - *We did the video and two different fliers, one they put right in the water bill, and then after talking with the Mayor, we asked if we could pass out free recycling bins. The Mayor gave us 50 recycling bins for the Saturday morning we were supposed to do it from 9 to 11 a.m. As we got them out, people driving by would see us, and we finished at 9:10 a.m. because people wanted to get theirs now. Every single one was gone.*

Buckeye Valley - *Delaware Dam had indicated early on that they were looking for the creation of a path or information to mark a path or have people come to the top of dam to view stars, something to facilitate that, like information or a viewing platform. As a result of a chance meeting with someone out West [during one teacher's vacation], the club was able to get a donated plug plate from the Sloane Digital Sky Survey. We ended up with trying to describe the Sloane digital sky survey and incorporating the plug plate and creating an educational kiosk for the community.*

Slate Hill - *Slate Hill hosts community baseball and soccer games, and one of the major problems is mosquitoes, so they put up a bat house to cut down on mosquitoes without using pesticides.*

Teays Valley - *Their project was a grassy field used for intramurals outside the middle school. They polled a third of 6th, 7th, and 8th grades, and then took that information, tallied it up, found out what was most wanted or needed. Then they started with those items, pricing them and they arranged it so they could get as many things out there as possible to fit the needs of what kids wanted. Their idea was during the day, students could use it during the evening and weekend, and in the summer, the community could use it.*

Teachers were pleasantly surprised with students' commitment to pursuing official approval for their Capstone projects. Students planned to continue working on them during the summer and upcoming school year, even though YBSTEMS had officially ended.

Significant Impacts on Student Opinion

We repeated a series of questions on the Year 2 student survey that were originally part of their pre-survey. The full results for the two sets of questions are in Appendices 4 and 5. Below are the significant student differences that were revealed upon comparing the results from the two periods. By the end of Year 2, students were more likely to say that they:

- Like solving problems (increased from 70% to 84%).
- I understand what is meant by the terms statistics, sampling and data presentation (increased from 52% to 68%, but this gain disappeared upon controlling for Year1/Year 2 site differences).

However, disconcertingly, the students were less likely to agree that they:

- Have confidence that I can be successful in a STEM career if I choose it (decreased from 87% to 66%).
- Prefer to work in groups or teams (decreased from 63% to 36%).

The students also indicated less agreement that they would likely study or work in the following STEM related areas:

- Math (down from 73% to 54%)
- Research (down from 68% to 38%)
- Use computers (down from 87% to 71%)
- Construction (down from 51% to 21%)
- Information Technology (down from 68% to 40%)
- Manufacturing (down from 54% to 27%)
- Materials (down from 30% to 9%)

It appears that YBSTEMS succeeded in promoting students' interest in problem solving. It is also possible that the program gave the students a more realistic understanding of the skills and work required in conducting and presenting research. Similarly, their growing contact and knowledge may have contributed to their narrowing their expectations with respect to their future careers. On the bright side, student interest in studying or pursing a "science" career in general remained a high 83 percent. In addition, the percentage interested in medicine and health increased slightly (from 53% to 58%). Parent and student expectations that the students would complete advanced degrees also were higher (parents increased from 49% to 63% and students increased from 56% to 68%), though these gains were not statistically significant after controlling for the site differences (see Tables 16 and 17).

The intense group work may have added to a growing appreciation for working alone, more so than they expressed previously. Much of the work required for science fair projects required more individual-level activity, whereas teamwork and collaboration were essential aspects of the Capstone projects. Students' open-ended comments about the Capstone projects suggested their realizations that their projects would have gone more smoothly had they worked more as a team. Moreover, only 6 percent of the students indicated that they did not like working with other students (see Table 5).

Table 16: YBSTEMS Parents/Guardians – Pre vs. Post – Educational Expectations[1]

	Pre-survey Parents *N=121*		Post-survey Parents *N=51*	
	N	%	N	%
Do not expect child to graduate high school	0	0.0	0	0.0
High School Diploma only	1	0.8	0	0.0
Some college	8	6.7	0	0.0*[n]
College degree – Bachelor's	49	41.2	19	37.3
Advanced degree – Master's, Doctorate, Medical, or Law	58	48.7	32	62.7*[n]
Not sure	3	2.5	0	0.0*[n]

[1]Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
*Statistically significant pre-post difference with p-value < .10.
[n]Not statistically significant different upon omitting North Union, Brookside, and Kilbourne from analysis.

Table 17: YBSTEMS Students – Pre vs. Post – Educational Aspirations[1]

	Pre-survey Students *N=120*		Post-survey Students *N=50*	
	N	%	N	%
Do not expect to graduate high school	0	0.0	0	0.0
High School Diploma only	2	1.7	0	0.0
Some college	9	7.5	0	0.0**[n]
College degree – Bachelor's	30	25.0	12	24.0
Advanced degree – Master's, Doctorate, Medical, or Law	67	55.8	34	68.0
Not sure	12	10.0	4	8.0

[1]Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
**Statistically significant pre-post difference with p-value < .05.
[n]Not statistically significant different upon omitting North Union, Brookside, and Kilbourne from analysis.

Significant Impacts on Parent Opinion

We again asked parents to respond to a set of measures that asked whether YBSTEMS impacted their children in specific ways. The results from the end of each program year are presented in Table 18. It is statistically significant that more parents believed that their child was more comfortable about presenting to others (86%) by the end of Year 2. After controlling for Year1/Year2 site differences, significantly fewer parents agreed that YBSTEMS increased their child's interest in science. It is possible that more of the students who completed the program were already interested in science, and thus an "increase" would be less likely. Although not statistically significant, there was a noticeable growth in the proportion of Year 2 parents (57%) who agreed that their child's writing had improved. Finally, reasonably high percentages of parents in both years confirmed that the program increased their child's understanding of science (81% and 82%) and that it effectively engaged their child in science activities (79% and 78%).

Table 18: YBSTEMS Parents/Guardians – Year-end Survey – Impacts on Child
—Questions Ordered by High to Low Percent for Year 2 Survey—

	End of Year 1			End of Year 2		
	Parents N=93			Parents N=51		
	% Agree[1]	Mean	S.D.	% Agree[1]	Mean	S.D.
My child is more comfortable about presenting to others.	46.2	2.55	.787	86.3***+++	1.98	.547
My child's understanding of science has increased.	80.6	2.10	.609	82.4	2.04	.747
The program effectively engaged my child in science activities.	78.5	2.00	.834	78.4	2.00	1.077
My child's interest in science has increased.	74.2	2.12	.819	66.7++	2.25	.956
My child's writing has improved.	45.2	2.60	.782	56.9	2.41	.779

[1]Percentages are based on those with valid response to item.

Table 19 provides a breakdown of these measures of program effectiveness items by club. Most encouraging is that a high percentage of parents in each site agreed that their children were being impacted in at least one of the listed areas (71-100%). These results are also generally consistent with the overall ratings that parents gave to each site. In six of the eight sites (Big Walnut, Buckeye Valley, River Valley, Teays Valley, Colonial Hills, and Slate Hill), all of the parents agreed that their children had made progress in at least one of the listed areas. At Kilbourne, all but one parent (91%) agreed that as a result of YBSTEMS, their child's understanding of science had increased and that the program had engaged their child in science activities. Although fewer Upper Sandusky parents confirmed the listed benefits, an encouraging 71 percent agreed that their child was more comfortable with presenting to others and more than half (57%) said their child's writing had improved.

Table 19: YBSTEMS Parents/Guardians – Year 2 Survey – Impacts on Child by Site[1]
—Questions Ordered by High to Low Total Percent—

	Big Walnut	Buckeye Valley	River Valley	Teays Valley	Upper Sandusky	Colonial Hills	Kilbourne	Slate Hill	Students TOTAL
	N=8	*N=3*	*N=2*	*N=8*	*N=7*	*N=7*	*N=11*	*N=5*	*N=51*
My child is more comfortable about presenting to others.	100.0	66.7	100.0	100.0	71.4	85.7	72.7	100.0	86.3
My child's understanding of science has increased.	87.5	100.0	100.0	62.5	42.9	100.0	90.9	100.0	82.4
The program effectively engaged my child in science activities.	75.0	100.0	100.0	62.5	42.9	100.0	90.9	80.0	78.4
My child's interest in science has increased.	62.5	66.7	100.0	50.0	42.9	85.7	72.7	80.0	66.7
My child's writing has improved.	50.0	33.3	50.0	75.0	57.1	42.9	45.5	100.0	56.9

[1]Percent of participants who indicated that they "Strongly Agree" or "Agree" with each statement. Percentages are based on those with valid response to item.

We also compared the parents' opinions about their child's interests and abilities at the end of Year 2 to those who responded to the pre-survey administered in February 2008 (see Table 20). There were four significant differences between the two groups. More Year 2 parents agreed that:

- Child likes to be a leader (increased from 58% to 82%).
- Child writes well (increased from 65% to 86%).
- Child likes to work alone (increased from 41% to 65%).
- Child is not afraid to speak before his or her class (increased from 63% to 83%, but this was not statistically significant after controlling for the Year 1/Year 2 site differences).

YBSTEMS appears to have had a positive impact on the students' leadership and writing skills. Unfortunately, the extensive group work may have had the unintended effect of making the students less excited about working with others. Students' responses similarly attested to this phenomenon. Although Year 2 parents viewed their children as less afraid to speak before their class, this appears to reflect the site difference; specifically, more Kilbourne students had this trait, whereas North Union and Brookside parents (participated in Year 1 only) gave lower ratings to their children's confidence with public speaking.

In their open-ended survey comments, parents expressed their belief that their children's interest in science increased. One affirmed, "*It got my child engaged in science."* Another further elaborated on the program's impact:

It has definitely improved the logical thinking of my child. Cultivated interest in the field of science and math. Helped her to plan, design, gather information about her project topic, and developed the confidence to work both independently and in a team towards solving a problem. I am really grateful to this program for developing my child's interest in science.

Table 20: YBSTEMS Parents/Guardians – Pre vs. Post – Opinions about Child's Interests —Questions Ordered by High to Low Percent on Post-survey—

	Pre-survey			Post-survey		
	Parents N=121			Parents N=51		
	% Agree[1]	Mean[2]	S.D.	% Agree[1]	Mean[2]	S.D.
My child likes science.	97.5	1.48	.580	98.0	1.63	.528
My child likes math.	84.3	1.85	.917	84.3	1.82	.932
My child is curious about how things work.	93.2	1.54	.622	96.1	1.45	.577
My child likes solving problems.	82.8	1.83	.794	86.3	1.86	.849
My child likes to work in groups or teams.	83.9	1.97	.722	82.4	2.12	.791
My child is confident in his or her academic abilities.	75.4	2.02	.987	86.3	1.82	.865
My child writes well.	64.7	2.40	1.087	86.3**+	1.92	.771
My child is not afraid to speak before his or her class.	62.7	2.33	1.038	82.4**n	1.96	.799
My child likes to be a leader.	58.0	2.32	1.049	82.4***++	1.94	.947
My child would like to have a career in a STEM-related field (science, technology, engineering or math).	58.8	2.17	.857	56.0	2.16	.976
My child likes to work alone.	40.7	2.92	1.067	64.7**+++	2.43	.985

[1]Percent of participants who indicated that they "Strongly Agree" or "Agree" with each statement. Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
[2]Lower mean score indicates a higher level of agreement, as "Strongly Agree" was represented by the value of 1 and "Strongly Disagree" had a value of 5.
*Statistically significant pre-post difference with p-value < .10.
**Statistically significant pre-post difference with p-value < .05.
***Statistically significant pre-post difference with p-value < .01.
+Statistically significant pre-post difference with p-value < .10. Omitted North Union, Brookside, and Kilbourne MS.
++Statistically significant pre-post difference with p-value < .05. Omitted North Union, Brookside, and Kilbourne MS.
+++Statistically significant pre-post difference with p-value < .01. Omitted North Union, Brookside, and Kilbourne MS.
nNot statistically significant different upon omitting North Union, Brookside, and Kilbourne from analysis.

Parents also felt that it had "*improved"* their children's skills in writing and presentation as well as their self-confidence. They shared:

It increased knowledge in not only science, technology, engineering and math, but increased skills for writing, reading, and summarizing.

I feel this opportunity has helped my student a lot. It has built not only academic abilities, but also self-confidence.

Increased confidence in herself and her abilities.

Parents noted the benefits of *"strong friendships"* and teamwork.

> *My son enjoyed working on projects with others and learning more about science, technology and science techniques.*
>
> *My child enjoyed his experience and will miss meeting with the other students. He liked discussing the topics and working together on projects.*

Thus, even though parents revealed that their children had a strong preference for working alone by year-end, parents valued the group interaction that was an integral part of the YBSTEMS experience.

Teacher Opinion about the Impact on Students

All eight interviewed teachers felt that the YBSTEMS club activities had impacted students in positive ways, although two were less sure about the positive impact of the science fair. Three made general comments about successful outcomes without relating them to a single activity, for example: "*They definitely learned what scientists do and about the realm of science."* Other comments:

> *It gave them a chance to really think out loud, problem solve, look at a situation and see what do I have to do. It gave them an opportunity to really understand the scientific method and how to do inquiry projects. They were able to take something from the beginning, make questions, form hypotheses, and take it from there and answer questions that they had.*
>
> *I think they have a much better understanding of the scientific process. I know that for the Capstone we even required our kids to write a paper. Lynn didn't require that, the program didn't, but we did, because that goes right along with what we teach them, the scientific method, so they have to write the paper. So I was very impressed with what our kids learned, just in that respect.*
>
> *Their science learning, a lot of it was their own learning, things they discovered on their own. One student in particular did a thing on baked potatoes and his study of how you wrap a potato with foil and how that affects the cooking of the potato and the conductivity of the aluminum and reflection of heat and all the things he researched to find out. That was pretty neat and pretty impressive what he was able to glean all that on his own.*
>
> *I think the experiments and activities were high interest and age appropriate and enabled the kids to really immerse themselves in science and look at projects and how to solve problems and how to form their ideas and solving them in a scientific way. I think that was great exposure to them. They don't get to do that in the classroom. As they get older and have more labs, they will have that opportunity. This gives them an introduction and a kick-start in getting interested in science. I look forward to seeing what this particular group of ours ends up doing—if they stay interested in the science discipline and will they choose more classes in those areas when they get in higher grades. I have great things to say about the program. I'm sorry to see that it's over, but I think a lot of kids will continue. From a 4-H standpoint, I think a lot will continue 4-H, so that's encouraging.*

Two teachers spoke of the new experiences and opportunities provided by YBSTEMS, in this case, through science fair and Capstone:

> *They had some experiences that they never would have had if it weren't for the STEM program. The kids that went to the science fair would never have gone to the local science fair. We had two kids who went on to the District fair and that never would have happened. So they had some life experiences that in my 22 years of teaching in that elementary school, no other kids have had these opportunities. That was good for them. That was an impact. To my knowledge, they have never done patent research at the elementary level, researching the information about bats and bat houses and inviting an expert in. That's not something that regularly occurs, at least not at our school. Then all of the work that they did actually making the bat house. The kids went over to the middle school, which was a different experience for them. We went and did woodworking, measuring, and my teammate got them on a computer program that helped them design and use dimensions for the bat house, so they had those opportunities*

A teacher noted the "*soft skills*" like presentation that Capstone developed in students: "*They really got a lot of pride in the school also and ownership doing something as a service project and not just all about them. They got a lot of soft skills that we don't touch on as much in the classroom but they'll pick up through the STEM program."* Capstone also generated a comment about research skills:

> *Through the program, their research skills were refined and their questioning skills definitely were developed. They were able to ask questions that took them toward their goal rather than silly questions. They really were high quality, in-depth questions that they wanted to do research on and they generated their own list of questions.*

Teachers emphasized the following additional benefits to students:

> *They bonded like a family. Become much more interested in science and inquiry. Gained confidence in public situations. Learned how to take technical information and transform it into layman's terms. Thought like scientists. Became proficient at writing summaries.*
>
> *Many have gained self-confidence. They are more willing to share info and to take a risk. Students became more organized. They realized that working as a team can be both rewarding and challenging.*
>
> *Students gained collaborative skills while participating in these activities. They were excited to share the information they each had found with their peers.*

One teacher also expressed surprise at results he did not anticipate. He said, "*These kids have become really good friends who wouldn't have become friends, across grade levels."* In addition, the STEM connections eased the middle school transition because "*they'd been there in the middle school building once a week for six or eight months, they knew kids who were 7th graders, knew me, and seemed to transition to middle school more easily which was something I really hadn't thought about as an impact."* Two of the teachers were waiting to see what

academic impact there might be at the middle school level for students who had been in YBSTEMS clubs.

Impact on Teachers

Teachers emphasized prior training and experiences in technology and inquiry-based pedagogy that had prepared them for this opportunity. Appendices 5-9 provide pre- and post-survey results on the teachers' demographics and classroom experience. Overall, most had taught for at least six years and were experienced with inquiry-based instructional practices. Nevertheless, it is clear that participating teachers were also impacted by their involvement in YBSTEMS. At the end of the program, they acknowledged growth in their science content knowledge and confidence with using hands-on activities, technology, and math applications. Comments from the teacher surveys included:

> *I'm more experienced and comfortable (confident). I employ more varied techniques and take opportunities to encourage my students to explore STEM fields.*
>
> *Reinforced the idea that my method of hands-on learning and student-led discussion and activities are effective.*
>
> *I have learned the importance of teaching scientific method and using inquiry with my 3rd grade class. They are <u>not</u> too young to learn these concepts and to be independent thinkers.*
>
> *The program has increased my knowledge of inquiry in the classroom.*
>
> *Tech design projects are no longer intimidating. It reaffirmed what I do daily in class. Many of the STEMS lessons align with the 7th grade standards. I now use those lessons in my science classes. I also gained self-confidence.*
>
> *I have started thinking about creating a "capstone" project curriculum for my 8th grade technology classes.*
>
> *I try to use more hands-on materials and lessons. I want to use more spreadsheets as part of my lessons. The challenge is that with 5-7th graders, you must take extra time to teach the use of these programs because they have never used them before. I still struggle with math, but I have increased my awareness of it and its applications. I had my regular classroom students interview someone and ask how they used math in their daily life/job.*
>
> *I found myself using tech design in other subjects (e.g., social studies and language arts). It has renewed my sense of the importance of inquiry lessons, data collection, and using scientific tools for discovery.*
>
> *Any time you are investigating a topic (or facilitating that investigation), you will grow in content knowledge. I certainly know more about bees and bats than I had in the past. The pedagogy used in the YBSTEMS program is consistent with my teaching style in the regular classroom. My master's degree was in using technology, so I already had the application skills used in the program. However, I learned much about teaching advanced applications to younger students.*

In addition, they reported gains in their understanding of technology topics covered by the ten YBSTEMS lessons (see Table 21). The extent to which they rated their knowledge as "strong" increased significantly in "Medicine & Health Technologies" (from 0% to 50%), "Flight & Space Technologies" (from 18% to 58%), and "Construction Technology" (from 12% to 50%). In addition, none of the teachers on the post-survey indicated "willing to learn," as all of them felt that they had a least some knowledge in each of the listed areas.

Table 21: YBSTEMS Teachers – Pre vs. Post – Knowledge of Technology[1]

Activity/Incentive	Pre-survey Teachers N=18				Post-survey Teachers N=12			
	Strong	Average	Weak	Willing to learn	Strong	Average	Weak	Willing to learn
1. Agriculture & Food Technology	11.1	50.0	11.1	27.8	33.3	66.7	0.0	0.0
2. Construction Technologies	11.8	47.1	11.8	29.4	50.0*	33.3	16.7	0.0
3. Energy Technologies	31.3	37.5	12.5	18.8	66.7	33.3	0.0	0.0
4. Environment & Natural Resources	52.9	29.4	5.9	11.8	75.0	25.0	0.0	0.0
5. Flight & Space Technologies	17.6	47.1	17.6	17.6	58.3*	41.7	0.0	0.0
6. Information Technology and Communications (including computers)	35.3	47.1	11.8	5.9	58.3	33.3	8.3	0.0
7. Manufacturing Science & Technology	17.6	29.4	17.6	35.3	50.0	41.7	8.3	0.0
8. Materials Science & Technology	23.5	29.4	0.0	47.1	50.0	33.3	16.7	0.0
9. Medicine & Health Technologies	0.0	70.6	5.9	23.5	50.0***	41.7	8.3	0.0
10. Transportation Technologies	17.6	47.1	5.9	29.4	58.3*	33.3	8.3	0.0

[1]Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
*Statistically significant pre-post difference with p-value < .10 of teachers who responded to both surveys. ***Statistically significant pre-post difference with p-value < .01 of teachers who responded to both surveys.

There was additional non-statistically significant growth in their preparedness to do the following activities. The full pre- and post ratings of the extent they felt prepared to use a wide variety of instructional practices is available in Appendix.

- Implement engineering or technological design learning (from 56% to 100%)
- Make math concepts comprehensible (67% to 83%)
- Use math equipment (including information technology) as an integral part of math instruction (61% to 83%).
- Use technology (not just computers) as an integral part of math instruction (67% to 83%).

Two teachers specifically said that they had increased their knowledge of science. Additional comments are below:

> *It's been a lot of fun. I learned a great deal about science for myself, what it is, what it takes. I enjoyed working with [my partner] and the kids. I really developed some student-teacher relationships that I wouldn't have otherwise because I only see them for nine weeks and then they go. I got to know students a lot better.*
>
> *It's been quite an experience; I've enjoyed most of it. There have been some frustrating moments, but I've definitely increased my level of science. I am not a science teacher, but it has helped me with my level of science and working with [my partner] was definitely fun and we got to do a lot of neat things, go to neat places, and meet neat people.*

Teachers also reported an unexpected decrease in their emphasis on writing in science. They were less likely to have students "Write their reasoning about how to solve a scientific problem" (decreased from 28% to 8%) at least weekly. Most said they had students do this "Once or twice a month." On the other hand, there were modest (not statistically significant) increases in their use of the following practices:

- Use Internet resources to find general or secondary science information (increased from 38% to 58%).
- Use local online public or school library catalogs or search mechanisms such as *WorldCat®.org* (increased from 22% to 42%).

The complete results on their teaching practices are in Appendix 9. Information about their professional development activities are in Appendices 10 and 11.

4. An Opinion as to the Program's Applicability to Other School Districts

This program is applicable to other school districts and could be expanded beyond central Ohio. With training and support, most 5th and 6th grade teachers should be able to implement the technology lessons, especially those who have a background in science and experience with inquiry-based instruction. The YBSTEMS teachers encountered few problems with the lessons. The OAS also provided participating sites with all the materials needed to implement the activities and quickly responded to any problems that arose. Given the organization's experience with large statewide projects such as the science fair, expanding this program is feasible. An advisory board member shared the following opinion at the end of YBSTEMS:

> *I just think personally that it exceeded its goals. The leadership from Lynn Elfner was second to none. He was absolutely tireless in making this a success— and it was something that was certainly a model best practice initiative for other school districts to consider.*

District administrators and teachers viewed YBSTEMS as a useful enhancement to their science curriculum. Interviewed district administrators from YBSTEMS described it as a useful program that was consistent with the state standards and needed to be expanded to more students. One district administrator attributed student/teacher participation to an increase in the district's 5th grade science OAT scores. Interviewed superintendents and other district staff especially liked the program's emphasis on hands-on activities, inquiry-based instruction, the scientific method, teamwork, and writing. One teacher, for example, described "huge support" throughout his school and district for the science fair and 4-H portions of YBSTEMS. He further explained:

> *The science teachers were supportive and knew we were there at least in the background. In my school district, River Valley, our superintendent was the only one who came to the Capstone meeting. Our district is supportive and they talk about how to incorporate it into other classrooms so it's been a positive experience in our school district and supports what our superintendent already thinks and is where he is trying to go, so it's a real shame funding would not be continuing. It ought to continue at least next year to gather data and figure out how to implement it. Now, we have a knowledge base to continue from, and could do even more.*

All of the teachers who went through the training expressed plans to continue using many of the technology lessons. One also planned to incorporate reading *Science World* and writing article summaries in her language arts class. In addition, one of the teachers in the Worthington district successfully obtained a Board of Regents *STEM Programs of Excellence* grant that enabled him to build upon and expand elements of YBSTEMS to elementary classrooms. The teacher explained that although the grant was for 2008-2009 only, "*It's entirely sustainable now because the teachers have been trained and are excited about teaching technological design as a part of their daily program, and they see that it's a great way to teach math and science."*

The Worthington school district went a step further by integrating the YBSTEMS curriculum into the science curriculum of three elementary schools. This is exactly the type of activity that is likely to result in long-term sustainability, as it is evident that the district has bought into the program and is striving to expand it system wide. The YBSTEMS teachers involved in this district spoke excitedly of additional potential impacts.

All of these students will be coming to my middle school this year, so I anticipate that not only will they know each other, they know me, they will know the program, and I anticipate a long-term impact on those kids. If we could have expanded that, it would have been a much greater impact. I think it's a tremendous exemplar, a tremendous model of the way we should be teaching.

The whole school uses STEM lessons. There was a staff workshop. All staff classroom teachers received a laptop to use to do some of STEM lesson work with students. I used mine all the time to do work.

The teachers also believed that their YBSTEMS training helped them successfully pitch the grant to their schools. In addition, one district administrator, the "teacher leader for science," was especially supportive and helped them understand the science fair guidelines. One of the teachers pointed out that, *"He played a key role in helping me feel relaxed and able to tackle it and handle it for STEM club kids at school."* The Worthington district is also planning to have an after-school science club in the 2010-2011 school year, which will include the YBSTEMS technology lessons. One of the YBSTEMS teachers is seeking *"community support"* through business sponsors to fund the clubs, and he is recruiting additional teachers to assist with activities including a *"4-H lifer"* who is interested in helping promote student involvement in 4-H. Thus, there will likely be some type of ongoing continuation of YBSTEMS-influenced programs in Worthington's elementary and middle schools.

Teachers spoke highly of the OAS professional development. In addition, they were introduced to the technology lessons and other resources, such as the *Inspire*™ data program, that they may use at their schools in the future. Thus, it is clear that YBSTEMS will have long lasting impacts at the participating schools and districts. With continued funding, they envision the implementation of modest improvements, especially adjustments in the requirements that will help them met the YBSTEMS goal of serving <u>all students</u>. Concluding comments from teachers included:

Other than I wish it would continue, we could put this into place from kindergarten on, so kids would have these opportunities early on. That's the way they learn. It's such a great concept. I think it's a great learning tool for kids, and if we could start it at younger grades, just little things. I know in 5th grade, we do science fair projects anyway, but up until that point, the kids aren't doing that much with it. I would love to see this implemented in school. I worked with some fabulous kids and really terrific leadership with Lynn Elfner's group. I'm really glad I had the opportunity. Job well done.

I think it's a topnotch program. Everything Lynn did, I thought was the best. I wouldn't kick anything out, but I would reach a balance for kids— it was a little bit too much for some. I've been accused of being a teacher who is a driver who pushes kids to do their best and excel, not one who says, "Oh, it's too much, they can't do it." I say, "Yes, you can, sure you can."

All in all, it was a great program. Lynn and his staff have done a really good job of putting this together not really knowing what to expect, and they were willing to make adjustments, which I think is great.

Thanks for the opportunity and we're thrilled that the kids had a chance to do this.

I hope the program continues. It's a wonderful program, and I hope that funding gets through. I don't know that I would change anything. The first year there are always bugs to work out in anything. We know pretty much what needs to be changed—summaries, not rushing through one lesson to get to the next lesson, and thorough feedback. Hopefully those things would be tweaked. But, I really hope funding goes through because this is a marvelous program.

Conclusions and Recommendations for Future Implementations

YBSTEMS was an impressively ambitious after-school program that successfully focused on strengthening 5th, 6th, and 7th graders' understanding of scientific inquiry and technological design as well as associated presentation, writing, and data collection skills. The OAS did an exceptional job of developing engaging hands-on technology lessons and providing relevant professional development for the teachers. The leadership needs to review the requirements for students. Although maintaining a challenging program is important, this goal needs to be balanced with their goal of keeping the program accessible to all students. Establishing just the right mix of high expectations and accommodation, so that retention is no longer a major problem and students do not feel overwhelmed, will be difficult. Nevertheless, this initial implementation verified that the program concept is a good one, and the students who completed the program certainly benefitted. Even the students who did not finish the second year likely expanded their understanding of science through their participation in the technology lessons and reading of the science magazine articles.

Below is a brief discussion of ways that the YBSTEMS program met the goals for informal science education that are outlined in the following six strands (Bell and others, 2009).

Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.

There was substantial evidence from students, parents, teachers, administrators, staff, and advisory board members that participating students enjoyed participating in the ten technology lessons. Their products and presentations for 4-H, science fair, and Capstone demonstrated a high level of accomplishment. Even though some students were resistant to some of the tasks required in participating in the long-term projects, nearly 100 students completed the program, which required a high level of sustained motivation and interest.

Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models and facts related to science.

The pre- and post-test results showed that students increased their understanding of the covered technology topics. Their responses to *The Science Process Skills Inventory (*Bourdeau and Arnold, 2007) highlighted their view that they had strong presentation and data reporting skills, both of which were a critical part of the science fair and Capstone projects. Future YBSTEMS programs may want to put greater emphasis on the other skills in *The Science Process Skills Inventory*. Teachers also spoke about the students' initial weak understanding of the scientific method, which made developing a science fair project more difficult. Awareness of this issue, however, underscores the need for programs like YBSTEMS to support and reinforce a strong foundation in the understanding of basic science concepts. Students also were required to demonstrate these skills in their article summaries.

Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

YBSTEMS students did all of these activities as part of participating in the ten technology lessons, Brassica, and Greenhouse Effect projects as well as developing their 4-H, science fair, and the Capstone projects.

Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.

Students selected their own 4-H, science fair, and Capstone projects and had to present their research in a variety of formats. They had to defend their 4-H and science fair projects to judges. For the Capstone event, each club prepared PowerPoint slides and selected a maximum of 12 slides for their poster presentation. For all of these projects, students had to be prepared to answer questions and explain their research to science professionals as well as peers. Eighty-five students submitted research plans, which required completion of the INTEL ISEF form (Society for Science & the Public, 2008).

Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.

An integral component of YBSTEMS was that students worked in groups on the ten technology lessons as well as the Brassica and Greenhouse Effect projects. Teamwork was also required for the Capstone project, as all club members were expected to work together on an activity designed to meet a local community need. Capstone also resulted in students interacting with additional adults as part of conducting their research and obtaining needed approval from city government, school districts, and other entities.

Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.

Parents reported increases in students' leadership skills and the students had gains in their problem-solving abilities. Parents and teachers also emphasized the students' growing self-confidence. The students had to demonstrate such an identity as part of their presentations in 4-H, science fair, and Capstone. Capstone, in particular, resulted in them contributing a science/technology product to their local communities. Teachers fully expected students to continue their involvement in 4-H and pursuit of official approval of their Capstone projects following the end of YBSTEMS.

In summary, YBSTEMS students made progress toward these six goals. It clearly had an impact on participants' (both students and teachers) understanding of science, particularly in the technology areas that were covered. Students also expanded their knowledge and ability to conduct research, develop an effective presentation, collect and process data, and present their findings (both in written and oral formats). Moreover, it is likely that the program will have a long-term impact on the students' science content knowledge, communication skills, and efficacy. The latter is a somewhat expected outcome from the success of the Capstone projects in which the students learned about their communities' needs and addressed them.

Future implementations of YBSTEMS programming should include the following:

- Better balance of requirements and age-appropriate expectations.

- Possible adjustment in the grades served. Keeping students involved once they entered middle school was a major challenge for several clubs, as they were competing with sports and other after-school opportunities. In addition, the middle school and elementaries were typically housed in different buildings, causing transportation and logistical problems.

- Additional screening of teachers. At a few clubs, teachers tended to lead the club in a more "school-like" manner than was desired by students or parents. Due to the time frame, the OAS did not conduct in-person interviews with the teachers who had applied to be advisors. In the future, the OAS should at least conduct phone interviews with prospective advisors. Having an advisor who was a "technology expert" appeared to contribute to the success of a site. Of note is that all of these technology advisors were male. Thus, having a male "role model" may have been a contributing factor at these clubs. The project leadership is well aware of the need for ensuring that teachers are a good match for the program and have an appropriate high level of commitment to carrying out the requirements. They have also suggested that future implementations should include training of alternate teachers who can readily move into an advisor opening if needed.

- The 4-H support needed by each club varied significantly. If an advisor lacks experience with 4-H, the club should include a parent assistant or someone else who can voluntarily assist with the 4-H component. Future implementations may also want to include the 4-H office staff in the selection process as part of ensuring strong 4-H support at the county level.

YBSTEMS gave elementary students additional opportunities to experience science in ways that most rarely have during the regular school day. They were also expected to participate in long-term projects (4-H, science fair, Capstone) and read and summarize science articles. These requirements challenged students, and it was "*a lot of work*," but encouragingly the majority of the students who completed the program viewed it as a beneficial experience.

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Pre-survey and Post-survey: Student Response

Appendix 1: YBSTEMS Students – Pre vs. Post – Demographics[1]

	Pre-survey Students N=120		Post-survey Students N=50	
	N	%	N	%
Gender				
Male	55	45.8	24	48.0
Female	62	51.7	24	48.0
No response	3	2.5	2	4.0
Race/Ethnicity				
American Indian or Alaskan Native	1	0.8	1	2.0
African-American	4	3.3	1	2.0
Asian or Pacific Islander	1	0.8	6	12.0***[n]
Hispanic, regardless of race	3	2.5	0	0.0
White (not of Hispanic origin)	104	86.7	38	76.0*[n]
Mixed race	5	4.2	1	2.0
No response	2	1.7	3	6.0
Grade				
5th grade	81	67.5	12	24.0
6th grade	39	32.5	22	44.0
7th grade	0	0.0	16	32.0

[1]Chi-square measure of association was used to test for pre- and post-differences.
*Statistically significant pre-post difference with p-value < .10.
***Statistically significant pre-post difference with p-value < .01.
[n]Not statistically significant different upon omitting North Union, Brookside, and Kilbourne from analysis.

Appendix 2: YBSTEMS Students – Capstone Survey – Opinions about Capstone Tasks by Site[1] —Questions Ordered by High to Low Total Percent—

	Big Walnut	Buckeye Valley	River Valley	Teays Valley	Upper Sandusky	Kilbourne	Slate Hill	Students TOTAL
	N=9	*N=10*	*N=6*	*N=8*	*N=9*	*N=9*	*N=4*	*N=55*
We prepared preliminary designs, plans or sketches.	88.9	100.0	100.0	100.0	88.9	88.9	100.0	94.5
I feel good about our final poster presentation today.	87.5	100.0	100.0	100.0	100.0	77.8	100.0	94.4
We worked as a team to conduct the project.	77.8	100.0	100.0	100.0	100.0	77.8	100.0	92.7
We built one or more prototypes and tested them.	100.0	80.0	100.0	100.0	55.6	77.8	100.0	85.5
Defining a “need” or problem is the first step of technological design.	66.7	90.0	100.0	87.5	55.6	88.9	75.0	80.0
We established a design statement or criteria for success.	55.6	90.0	100.0	100.0	55.6	77.8	100.0	80.0
We worked with adults (other than teachers) either as speakers or as someone we could talk with about the project to get background ideas or information.	33.3	100.0	83.3	75.0	100.0	77.8	75.0	78.4
I like to work in teams.	55.6	90.0	66.7	87.5	66.7	55.6	50.0	69.1
We collected and analyzed the results of testing the prototype(s).	77.8	80.0	83.3	100.0	33.3	22.2	100.0	67.3
We searched for patents online (Google™ Patent) to find design ideas or to compare existing designs with our ideas.	22.2	20.0	100.0	87.5	22.2	55.6	50.0	47.3
I was able to use design or visualization software (e.g. Google™ *Sketchup*).	22.2	10.0	66.7	50.0	44.4	50.0	50.0	38.5
I never heard of technological design until this year.	44.4	40.0	33.3	62.5	0.0	66.7	0.0	38.2

[1]Percent of participants who indicated that they "Strongly Agree" or "Agree" with each statement. Percentages are based on those with valid response to item.

Appendix 3: YBSTEMS Students – Pre vs. Post – Opinions about Science and Math —Questions Ordered by High to Low Percent—

	Pre-survey *Students* N=120			Post-survey *Students* N=50		
	% Agree[1]	Mean[2]	S.D.	% Agree[1]	Mean[2]	S.D.
a. I like science.	91.7	1.60	.824	90.0	1.72	.834
b. I like math.	80.8	1.91	.996	76.0	2.02	1.040
c. I am curious about how things work.	89.1	1.48	.711	84.0	1.64	.749
d. I like solving problems.	70.0	2.00	.970	84.0[+]	1.84	.792
e. Many people use science daily in their work and life.	89.1	1.59	.730	96.0	1.46	.579
f. Many people use math daily in their work and life.	94.1	1.37	.687	88.0	1.46	.952
g. Science is more for boys than girls.	4.2	4.53	.894	6.0	4.42	.992
h. Math is more for boys than girls.	2.5	4.54	.800	4.0	4.46	.973
i. Science is boring to me.	4.2	4.41	.848	8.0	4.12	.940
j. Math is boring to me.	9.7	4.27	1.044	20.4	3.78	1.246
k. Kids my age can use the methods used by scientists.	60.0	2.30	.984	66.0	2.28	1.051
l. If I told my friends that I liked science, they would make fun of me.	5.0	4.36	.909	4.1	4.16	.986
m. If I told my friends that I liked math, they would make fun of me.	4.2	4.39	.903	6.0	4.14	1.050
n. Science is hard for me.	6.8	4.10	.928	4.1	4.22	.872
o. Math is hard for me.	10.1	4.08	1.051	10.0	4.18	1.082
p. I have confidence that I can be successful in a STEM career if I choose it.	86.7	1.58	.816	66.0*** [++]	2.12	1.023
q. I am comfortable speaking in front of my class.	55.8	2.48	1.316	58.0	2.42	1.401
r. I like to read about science and technology.	63.3	2.18	1.045	54.0	2.58	1.263
s. I enjoy writing.	59.2	2.49	1.328	56.0	2.62	1.398
t. I like creative work like art and music.	87.4	1.61	.856	88.8	1.54	.930
u. I am always eager to try new things.	83.3	1.70	.826	78.0	1.92	.778
v. I prefer to work alone.	30.3	3.13	1.288	42.0	2.82	1.257
w. I prefer to work in groups or teams.	63.0	2.33	1.151	36.0*** [+++]	2.80	1.088
x. I understand parliamentary procedure and how to conduct a meeting.	41.0	2.66	1.076	36.0	2.50	.953
y. I understand what is meant by the terms statistics, sampling and data presentation.	51.7	2.58	.999	68.0*[n]	2.20	.990
z. I am comfortable with taking notes and writing in a journal.	72.5	2.11	1.106	64.0	2.24	1.061

[1]Percent of participants who indicated that they "Strongly Agree" or "Agree" with each statement. Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
[2]Lower mean score indicates a higher level of agreement, as “Strongly Agree” was represented by the value of 1 and “Strongly Disagree” had a value of 5.
[**]Statistically significant pre-post difference with p-value < .05.
[***]Statistically significant pre-post difference with p-value < .01.
[+]Statistically significant pre-post difference with p-value < .10. North Union, Brookside, and Kilbourne MS were omitted.
[++]Statistically significant pre-post difference with p-value < .05. North Union, Brookside, and Kilbourne MS were omitted.
[+++]Statistically significant pre-post difference with p-value < .01. North Union, Brookside, and Kilbourne MS were omitted.
[n]Not statistically significant different upon omitting North Union, Brookside, and Kilbourne from analysis.

Appendix 4: YBSTEMS Students – Pre vs. Post – Would Like to Study and Work in the Future[1]
—Questions Ordered by Appearance on Survey—

	Pre-survey			Post-survey		
	Students N=120			***Students N=50***		
	% Agree[1]	***Mean[2]***	***S.D.***	***% Agree[1]***	***Mean[2]***	***S.D.***
a. Science	82.5	1.82	.979	83.3	1.94	.932
b. Technology (agriculture, flight & space, manufacturing, etc.)	67.5	2.24	1.309	64.6	2.29	1.148
c. Engineering (design, making devices or helpful objects, etc.)	68.9	2.16	1.295	75.0	2.17	1.078
d. Math	72.5	2.13	1.202	54.2*+	2.63	1.248
e. Research	68.1	2.08	1.035	38.3***+++	2.94	1.187
f. Use computers	86.6	1.55	.871	70.8***+++	2.35	1.194
g. Agriculture & Food Production (growing plants and raising animals)	52.1	2.50	1.365	45.8	2.85	1.337
h. Construction (such as bridges or buildings)	50.8	2.72	1.438	21.3***+++	3.57	1.098
i. Energy (such as renewable sources like wind or solar energy)	54.2	2.52	1.250	38.3	3.00	1.083
j. Environment & Natural Resources (such as air pollution, climate and weather, water, wildlife and soil studies)	58.8	2.30	1.168	50.0	2.60	1.198
k. Flight & Space (such as rockets and space travel)	54.6	2.59	1.498	37.5	3.13	1.424
l. Information Technology (using computers to communicate)	68.3	2.05	1.166	40.4***++	2.87	1.191
m. Manufacturing (making products such as cars, toys, and computers)	54.2	2.57	1.355	27.1***++	3.27	1.086
n. Materials (making raw goods such as plastics)	29.7	3.33	1.327	8.7**+	3.80	1.003
o. Medicine & Health (such as a doctor, nurse, researcher, or medical support person)	52.5	2.68	1.408	58.3	2.69	1.386
p. Transportation (such as cars, trucks, trains, and air travel)	45.0	2.82	1.420	29.2	3.33	1.226

[1]Percent of participants who responded "Definitely" or "Maybe" to whether they would like to study and work in the listed activity when they grow up. Percentages are based on those with valid response to item.
[2]Lower mean score indicates a higher level of preference, as "Definitely" was represented by the value of 1 and "Definitely Not" had a value of 5.
*Statistically significant pre-post difference with p-value < .10.
**Statistically significant pre-post difference with p-value < .05.
***Statistically significant pre-post difference with p-value < .01.
+Statistically significant pre-post difference with p-value < .10. North Union, Brookside, and Kilbourne MS were omitted.
++Statistically significant pre-post difference with p-value < .05. North Union, Brookside, and Kilbourne MS were omitted.
+++Statistically significant pre-post difference with p-value < .01. North Union, Brookside, and Kilbourne MS were omitted.

Pre-survey and Post-survey: Teacher Response

Appendix 5: YBSTEMS Teachers – Pre vs. Post – Demographics and Teaching Background

	Pre-survey Teachers *N=18*		Post-survey[1] Teachers *N=14*	
	N	**%**	**N**	**%**
Gender				
Male	5	27.8	4	28.6
Female	13	72.2	10	71.4
Race/Ethnicity				
White (not of Hispanic origin)	18	100.0	14	100.0
Age[2]				
Under 30	1	5.6	0	0.0
31-40	4	22.2	2	14.3
41-50	5	27.8	4	28.6
51-60	7	38.9	7	50.0
Over 60	1	5.6	1	7.1
Highest Degree Received				
Bachelor's Degree	5	27.8	2	14.3
Master's Degree	12	66.7	11	78.6
Doctorate	1	5.6	1	7.1
Degree Areas[3]				
Mathematics or Mathematics Education	2	11.1	0	0.0
Science or Science Education	5	27.8	4	28.6
Technology Education	4	22.2	4	28.6
Other Education (includes Elementary Education)	11	61.1	9	64.3
Other	4	22.2	3	21.4

[1]Post-survey statistics on gender, race/ethnicity, age, highest degree, and degree area are for all teachers who were active at the program's end in June 2009 (N=14), not just survey respondents (N=12).
[2]Age in 2007 (Year 1 – selection in November 2007) and age in 2009 (Year 2 – end of program June 2007).
[3]Total can add to more than 100 percent, as respondent could have response in more than one category.

Appendix 5: YBSTEMS Teachers – Pre vs. Post – Demographics and Teaching Background[1] —Continued—

	Pre-survey Teachers *N=18*		Post-survey Teachers *N=12*	
	N	%	N	%
Years of Teaching Experience				
Less than 1 year	1	5.6	0	0.0
1-5 years	2	11.1	0	0.0
6-10 years	2	11.1	1	8.3
11-19 years	4	22.2	4	33.3
20 years or more	9	50.0	7	58.3
Years in Current Position				
Less than 1 year	2	11.1	0	0.0
1-5 years	7	38.9	3	25.0
6-10 years	2	11.1	3	25.0
11-19 years	4	22.2	4	33.3
20 years or more	2	11.1	1	8.3
Retired	1	5.6	1	8.3
Grade Level Taught[2][3]				
Grade K-4	4	22.2	7	58.3
Grade 5-6	11	61.1	11	91.7
Grade 7-8	6	33.3	7	58.3
Grade 9-12	3	16.7	4	33.3
Special Education Teacher or Intervention Specialist				
Yes	2	11.1	1	8.3
No	14	77.8	10	91.7
Membership in Science/Math Professional Organization[2]				
Member of Science Professional Organization	4	22.2	4	33.3
Member of Math Professional Organization	0	0.0	0	0.0
Member of Technology Professional Organization	5	27.8	3	25.0
Not a Member of Science, Math, or Technology Organization	10	55.6	6	50.0

[1]Percentages are based on those with valid response to item.
[2]Total can add to more than 100 percent, as respondent could have response in more than one category.
[3]Question on Pre-survey, teachers were likely to specify the grades they were currently teaching, as the question was, "What grade levels do you teach?" On the post-survey, the question covered teachers' entire career with, "Enter the number of years you have taught at each grade level and special education."

Appendix 6: YBSTEMS Teachers – Pre-Survey – Additional Teaching Background[1]

	Pre-survey Teachers N=18	
	N	%
Teach Self-contained Classroom		
Yes	4	22.2
No	14	77.8
Previously Taught in After-school Program		
Yes	14	77.8
No	4	22.2
Subjects Taught		
Mathematics	4	22.2
Science	9	50.0
Technology	8	44.4
Other	3	16.7
A Mix of Subjects	6	33.3
Experience with 4-H		
None	6	33.3
Was a student member (Years 1-10)	9	50.0
Was an advisor or other volunteer (Years 1-12)	4	22.2

[1]Percentages are based on those with valid response to item.

Appendix 7: YBSTEMS Teachers – Post-survey – Years of Teaching Experience by Grade[1]

	Post-survey N=12			
	Ever Taught Grade		Average Years Taught	
	N	%	Mean	S.D.
Kindergarten	3	25.0	8.00	10.392
Grade 1	5	41.7	6.00	8.093
Grade 2	4	33.3	8.00	8.165
Grade 3	6	50.0	7.50	9.566
Grade 4	4	33.3	7.00	10.677
Grade 5	8	66.7	9.00	10.488
Grade 6	8	66.7	9.00	6.782
Grade 7	7	58.3	12.14	9.353
Grade 8	6	50.0	11.00	8.816
Grade 9	4	33.3	9.40	10.738
Grade 10	4	33.3	8.75	12.285
Grade 11	3	25.0	11.00	14.000
Grade 12	3	25.0	11.00	14.000
Special Education	1	8.3	6.00	0.000

[1]Percentages are based on those with valid response to item.

Appendix 8: YBSTEMS Teachers – Pre vs. Post – Self-reported Preparedness —Questions Ordered by Appearance on Survey—

	Pre-survey Teachers N=18			Post-survey Teachers N=12		
	% Agree[1]	Mean	S.D.	% Agree[1]	Mean	S.D.
1. Address learning needs of individual students.	100.0	1.39	.502	91.7	1.33	.651
2. Anticipate and accept unexpected results in student investigations.	100.0	1.17	.383	100.0	1.33	.492
3. Assist other teachers with science, math or technology content and activities.	100.0	1.61	.502	91.7	1.33	.651
4. Conduct science investigations with students.	94.4	1.39	.608	100.0	1.08	.289
5. Create a classroom environment where all kids can learn science, math and technology.	100.0	1.28	.461	91.7	1.25	.622
6. Develop different levels of questioning.	88.9	1.67	.686	91.7	1.42	.669
7. Develop strategies for differentiating instruction.	88.9	1.67	.686	90.9	1.45	.934
8. Encourage participation of females in science, math and technology.	100.0	1.17	.383	100.0	1.17	.389
9. Encourage participation of underrepresented groups in science, math and technology.	94.4	1.44	.616	83.3	1.67	1.231
10. Engage students in balanced discussions and assignments on the impact of science, engineering and technology on society.	83.3	1.67	.767	100.0	1.33	.492
11. Facilitate or develop a science fair project with your students.	88.9	1.56	.705	100.0	1.33	.492
12. Implement engineering or technological design learning.	55.6	2.28	1.127	100.0	1.17	.389
13. Implement inquiry or discovery learning.	100.0	1.28	.461	100.0	1.17	.389
14. Inform students of career opportunities in math.	66.7	1.94	.873	75.0	1.92	.996
15. Inform students of career opportunities in science.	83.3	1.56	.784	91.7	1.50	.905
16. Involve parents in the science, math or technology education of their children.	88.9	1.67	.686	83.3	1.67	.778
17. Maintain class discipline where you are the primary authority for all decisions.	100.0	1.17	.383	91.7	1.33	.888
18. Make difficult science concepts comprehensible.	94.4	1.67	.594	100.0	1.25	.452
19. Make math concepts comprehensible.	66.7	2.11	.900	83.3	1.83	.718
20. Manage a class of students who are using hands-on/manipulative materials.	100.0	1.11	.323	100.0	1.08	.289
21. Modify traditional or standard textbook activities to include science process skills.	88.9	1.50	.707	91.7	1.50	.674
22. Monitor small group discussions and activities.	100.0	1.17	.383	91.7	1.25	.622
23. Phrase questions to encourage more open-ended investigations.	100.0	1.28	.461	91.7	1.25	.622
24. Prepare science inquiry lessons.	94.4	1.50	.618	91.7	1.25	.622
25. Present the applications of math concepts including probability and statistics.	55.6	2.33	.970	75.0	1.92	.996
26. Present the applications of science concepts.	94.4	1.61	.608	100.0	1.25	.452

[1]Percent of participants who indicated "Very Well Prepared" or "Prepared but Want More" for each statement. Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences. There were no statistically significant differences between pre- and post values for the teachers who responded to both surveys.

[2]Lower mean score indicates a higher level of preparedness, as "Very Well Prepared" was represented by the value of 1 and "Not Well Prepared" had a value of 5.

Appendix 8: YBSTEMS Teachers – Pre vs. Post – Self-reported Preparedness
—Questions Ordered by Appearance on Survey—
—Continued—

	Pre-survey Teachers N=18			Post-survey Teachers N=12		
	% Agree[1]	Mean	S.D.	% Agree[1]	Mean	S.D.
27. Teach groups that are heterogeneous in ability.	100.0	1.33	.485	91.7	1.17	.577
28. Teach in a classroom with one or more ESL students.	55.6	2.28	1.364	83.3	1.67	.985
29. Teach in a classroom with one or more students on IEPs.	100.0	1.33	.485	91.7	1.33	.651
30. Teach students from a variety of cultural or social backgrounds.	94.4	1.56	.616	100.0	1.25	.452
31. Use assessments for planning instruction.	100.0	1.17	.383	91.7	1.25	.622
32. Use cooperative learning groups.	100.0	1.22	.428	100.0	1.17	.389
33. Use math equipment (including information technology) as an integral part of math instruction.	61.1	2.11	.832	83.3	1.67	.985
34. Use science equipment (including information technology) as an integral part of science instruction.	94.4	1.50	.618	100.0	1.25	.452
35. Use technology (not just computers) as an integral part of math instruction.	66.7	2.00	.970	83.3	1.67	.778
36. Use technology (not just computers) as an integral part of science instruction.	83.3	1.72	.752	100.0	1.08	.289
37. Use wait-time and prompts to assist student responses.	94.4	1.22	.548	91.7	1.25	.866
38. Work as a partner with another teacher.	100.0	1.22	.428	100.0	1.17	.389
39. Work with parents on needs of individual students.	100.0	1.28	.461	91.7	1.25	.622

[1]Percent of participants who indicated "Very Well Prepared" or "Prepared but Want More" for each statement. Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences. There were no statistically significant differences between pre- and post values for the teachers who responded to both surveys.
[2]Lower mean score indicates a higher level of preparedness, as "Very Well Prepared" was represented by the value of 1 and "Not Well Prepared" had a value of 5.

Appendix 9: YBSTEMS Teachers – Pre vs. Post – Weekly Classroom Activities —Questions Ordered by Appearance on Survey—

	Pre-survey Teachers N=18			Post-survey Teachers N=12		
	% Agree[1]	Mean	S.D.	% Agree[1]	Mean	S.D.
1. Collect data.	50.0	3.56	1.042	66.7	3.67	.778
2. Complete a long-term class project (entire class; all students contribute).	11.1	2.50	.924	16.7	2.42	1.165
3. Complete a research project on a topic, problem or question that the student selects.	0.0	2.24	.752	0.0	1.92	.669
4. Complete a research project on a topic, problem or question that you select.	11.8	2.24	.903	8.3	2.33	.888
5. Complete a science fair project.	0.0	2.50	4.890	0.0	1.58	.515
6. Complete engineering and/or technological design activities.	22.2	2.39	1.614	16.7	2.33	1.371
7. Complete inquiry activities.	55.6	3.61	1.037	41.7	3.25	1.215
8. Create *PowerPoint*™ presentations.	11.1	1.89	.963	16.7	2.58	.900
9. Create their own electronic databases or spreadsheets.	5.6	1.72	.895	16.7	1.83	1.337
10. Discuss the impact of science, engineering and technology on society.	38.9	3.17	1.295	25.0	3.00	1.128
11. Do hands-on/manipulative activities.	88.9	4.28	1.018	75.0	3.92	.669
12. Engage in reflective thinking/writing about what they are learning in science, math or technology.	55.6	3.50	.924	66.7	3.67	1.155
13. Generate problems or questions for investigations.	44.4	3.33	1.283	50.0	3.17	1.193
14. Go on field trips to places of employment. (Science centers or museums excluded.)	0.0	1.33	.485	0.0	1.50	.522
15. Go on field trips to streams, lakes, the woods or farm fields.	0.0	1.61	.698	8.3	1.92	.996
16. Hear guest speakers on science topics.	0.0	1.83	.786	0.0	2.00	.426
17. Hear guest speakers on STEM careers.	0.0	1.33	.686	0.0	2.00	.739
18. Listen and take notes during presentations by teacher.	44.4	3.17	1.098	50.0	3.25	1.055
19. Locate information in a science/math textbook.	50.0	3.50	1.383	50.0	3.33	1.371
20. Look up a patent by a famous inventor such as Edison or for an invention like BARBIE® doll or the Hula Hoop.	0.0	1.44	.616	0.0	1.42	.515
21. Maintain an electronic portfolio of their work or of completed assignments.	22.2	2.00	1.534	16.7	1.83	1.528
22. Maintain a showcase portfolio of selected assignments/projects.	33.3	3.06	1.474	41.7	2.75	1.765
23. Make predictions and explore possible methods to solve a scientific problem.	50.0	3.39	1.461	50.0	3.25	1.288
24. Make oral and graphic (overhead or PowerPoint™) classroom presentations.	22.2	2.50	1.043	16.7	2.75	.866
25. Participate in dialogue with the teacher to develop an idea.	61.1	3.72	1.179	50.0	3.25	1.288
26. Post work on school or other websites through blogs or other means.	11.8	1.71	1.263	25.0	2.17	1.267
27. Prepare and make poster presentations.	5.6	2.06	.998	0.0	2.58	.669

[1]Percent of participants who indicated that activity occurred in their classes "Once or twice a week" or "Almost daily." Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
[2]Higher mean score indicates a higher level of frequency, as "Almost Daily" was represented by the value of 5 and "Never" had a value of 1.

Appendix 9: YBSTEMS Teachers – Pre vs. Post – Weekly Classroom Activities
—Questions Ordered by Appearance on Survey—
—Continued—

	Pre-survey Teachers N=18			Post-survey Teachers N=12		
	% Agree[1]	Mean	S.D.	% Agree[1]	Mean	S.D.
28. Prepare their own worksheets, charts or diagrams for data gathering and representation.	33.3	3.22	1.060	16.7	2.67	.985
29. Read science or math supplemental magazines or articles in newspapers.	27.8	2.72	1.127	33.3	2.83	1.115
30. Record and organize observations from labs or field trips.	27.8	3.00	1.372	16.7	2.42	1.311
31. Use a public or college library.	11.1	2.00	1.029	8.3	2.00	1.206
32. Use computers.	72.2	3.94	1.392	75.0	4.25	1.215
33. Use evidence to explain the results of scientific investigations.	44.4	3.22	1.309	41.7	3.08	1.240
34. Use Google *Patent Search*™	5.6	1.44	1.042	0.0	1.42	.669
35. Use *Google Scholar*™ to find primary science reference material.	0.0	1.33	.686	16.7	1.67	1.371
36. Use Internet resources to find general or secondary science information.	38.9	2.83	1.339	58.3	3.50	1.446
37. Use the internet for primary science sources like *PubMed* or *Science* magazine.	27.8	2.00	1.372	25.0	2.25	1.288
38. Use local online public or school library catalogs or search mechanisms such as *WorldCat®.org*	22.2	2.06	1.392	41.7	2.42	1.621
39. Use prepared worksheets, charts or diagrams from textbooks or supplemental materials.	44.4	3.39	.916	58.3	3.50	1.000
40. Use science/math equipment (e.g., measurement tools, calculators and other).	72.2	3.83	1.200	66.7	3.75	1.055
41. Use simple statistics to analyze and/or present or display data.	33.3	2.94	1.259	33.3	2.83	1.267
42. Use software to graph data.	5.6	2.00	1.085	8.3	2.00	1.044
43. Use teacher-created lessons.	83.3	4.44	.784	91.7	4.67	.651
44. Use the school library references for completing assignments.	33.3	2.89	.963	25.0	2.92	.793
45. Watch the teacher demonstrate a scientific principle.	33.3	3.11	.758	25.0	2.75	.965
46. Work in class on a project that takes a week or more.	27.8	3.06	1.259	25.0	2.83	1.030
47. Work in pairs/teams/small groups.	83.3	4.39	.778	75.0	4.00	1.128
48. Write abstracts of their results or findings from experiments.	5.6	2.11	.963	33.3	2.50	1.243
49. Write hypotheses.	27.8	2.72	1.127	33.3	2.75	1.215
50. Write in a bound notebook or journal.	66.7	3.61	1.720	58.3	3.17	1.528
51. Write qualitative observations.	38.9	2.78	1.437	41.7	3.00	1.206
52. Write summaries or abstracts of their reading assignments that might include ones from supplemental science news magazines, newspaper or web articles.	11.1	2.00	1.138	8.3	2.58	1.084
53. Write their reasoning about how to solve a scientific problem	27.8	2.67	1.328	8.3*	2.58	.793

[1]Percent of participants who indicated that activity occurred in their classes "Once or twice a week" or "Almost daily." Percentages are based on those with valid response to item. Chi-square measure of association was used to test pre- and post-differences.
[2]Higher mean score indicates a higher level of frequency, as "Almost Daily" was represented by the value of 5 and "Never" had a value of 1.
*Statistically significant pre-post difference with p-value < .10 of teachers who responded to both surveys.

Appendix 10: YBSTEMS Teachers – Pre vs. Post – Participation in Science and Math Programs[1] —Questions Ordered by Appearance on Survey—

Science and Math Programs	Teachers' Regular Classroom Students Participated[2]				Participation by YBSTEMS Students	
	Pre-survey Teachers N=18		Post-survey Teachers N=12		Number of Students Reported in Site Reports[3] N=8	
	N	%	N	%	Year 1	Year 2
4-H Club	11	61.1	10	83.3	219	176
District Science Day	8	44.4	8	66.7	0	34
Family Math at school	4	22.2	0	0.0	0	0
Family Science at school	2	11.1	1	8.3	0	0
Invention Convention	3	16.7	2	16.7	0	6
J.E.T.S/TEAMS	0	0.0	1	8.3	1	0
Local School science fair or Science Day	6	33.3	7	58.3	0	80
Math Counts	4	22.2	2	16.7	0	4
Robotics Competition, including Lego® Mindstorms	4	22.2	4	33.3	5	6
4-H County Fair	NA	NA	7	58.3	79	7[4]
State Science Day	3	16.7	4	33.3	0	2
Any other science, math, or technology activity or event	5	27.8	1	8.3	2	0

[1]Percentages are based on those with valid response to item.
[2]Regular classrooms may include YBSTEMS students.
[3]The 4-H Club, 4-H County Fair, and local Science Day counts are from the OAS database counts. The 4-H Club counts are the enrollment numbers for the beginning of each project year, as all the YBSTEMS students took part in 4-H Club meetings. The other counts are from the site's Progress Reports submitted to the external evaluator.
[4]Sites expect a high level of participation in the 2009 4-H County Fair. This is the official OAS count for YBSTEMS through June 2009.

Appendix 11: YBSTEMS Teachers – Pre vs. Post – Professional Development Activities[1] —Questions Ordered by Appearance on Survey—

	Pre-survey Teachers N=18		Post-survey Teachers N=12	
	N	%	N	%
a. Attended any national or state science/math/ technology teacher association meetings?	6	33.3	3	25.0
b. Taught any in-service workshops or courses in science or science teaching?	8	44.4	3	25.0
c. Taught any in-service workshops or courses in math or math teaching?	0	0.0	1	8.3
d. Taught any in-service workshops or courses in technology or related areas?	NA	NA	3	25.0
e. Made an addition to your personal professional portfolio?	9	50.0	8	66.7
f. Planned differentiated lessons and/or activities?	16	88.9	10	83.3

[1]Percentages are based on those with valid response to item. Period of time covered was past 12 months.

Appendix 12: YBSTEMS Teachers – Pre vs. Post – Professional Development Hours[1]

	Pre-survey Teachers *N=18*		Post-survey Teachers *N=12*	
	N	**%**	**N**	**%**
Total Professional Development Hours				
None	1	5.6	2	16.7
1-9 hours	4	22.2	3	25.0
10-19 hours	5	27.8	2	16.7
20-29 hours	1	5.6	2	16.7
30 or more hours	7	38.9	3	25.0
Science Professional Development Hours				
None	6	33.3	6	50.0
1-9 hours	6	33.3	4	33.3
10-19 hours	3	16.7	1	8.3
20-29 hours	0	0.0	0	0.0
30 or more hours	3	16.7	1	8.3
Math Professional Development Hours				
None	12	66.7	10	83.3
1-9 hours	6	33.3	1	8.3
10-19 hours	0	0.0	0	0.0
20-29 hours	0	0.0	0	0.0
30 or more hours	0	0.0	0	0.0
Technology Professional Development Hours				
None	4	22.2	4	33.3
1-9 hours	8	44.4	3	25.0
10-19 hours	4	22.2	1	8.3
20-29 hours	1	5.6	3	25.0
30 or more hours	1	5.6	1	8.3

[1]Percentages are based on those with valid response to item. Period of time covered was past 12 months.

Pre-survey: Parent Response

Appendix 13: YBSTEMS Parents/Guardians – Pre-Survey – Educational Background[1]

	Parents *N=121*	
	N	**%**
Father/Male Guardian		
None	4	3.3
H.S. Diploma	48	40.5
Associate (2-year degree)	14	11.6
Bachelor of Science	14	13.2
Bachelor of Arts	16	13.2
Master's	8	6.6
Professional degree (e.g., medicine, law)	3	2.5
Doctorate	3	2.5
Other	4	3.3
No Response	4	3.3
Mother/Female Guardian		
None	1	.8
H.S. Diploma	37	30.6
Associate (2-year degree)	19	15.7
Bachelor of Science	13	10.7
Bachelor of Arts	15	12.4
Master's	18	14.9
Professional degree (e.g., medicine, law)	4	3.3
Doctorate	2	1.7
Other	7	5.8
No Response	5	4.1
At least one parent – Highest degree is H.S. Diploma or less	66	54.5

[1]Parents who had received both a Bachelor of Science and Bachelor of Arts degree are counted only in the Bachelor of Science category in this table.

Appendix 14: YBSTEMS Parents/Guardians – Pre-Survey – Employment Background

	Parents *N=121*	
	N	**%**
Father/Male Guardian		
Science or science education professor	3	2.5
Engineer	11	9.1
Research and Development	8	6.6
High school teacher	5	4.1
Middle school teacher	4	3.3
Elementary school teacher	3	2.5
Farmer or helped on farm	32	26.4
No, father has never worked in job listed above.	60	49.6
Mother/Female Guardian		
Science or science education professor	5	4.1
Engineer	1	0.8
Research and Development	8	6.6
High school teacher	4	3.3
Middle school teacher	4	3.3
Elementary school teacher	15	12.4
Farmer or helped on farm	19	15.7
No, mother has never worked in job listed above.	68	56.2

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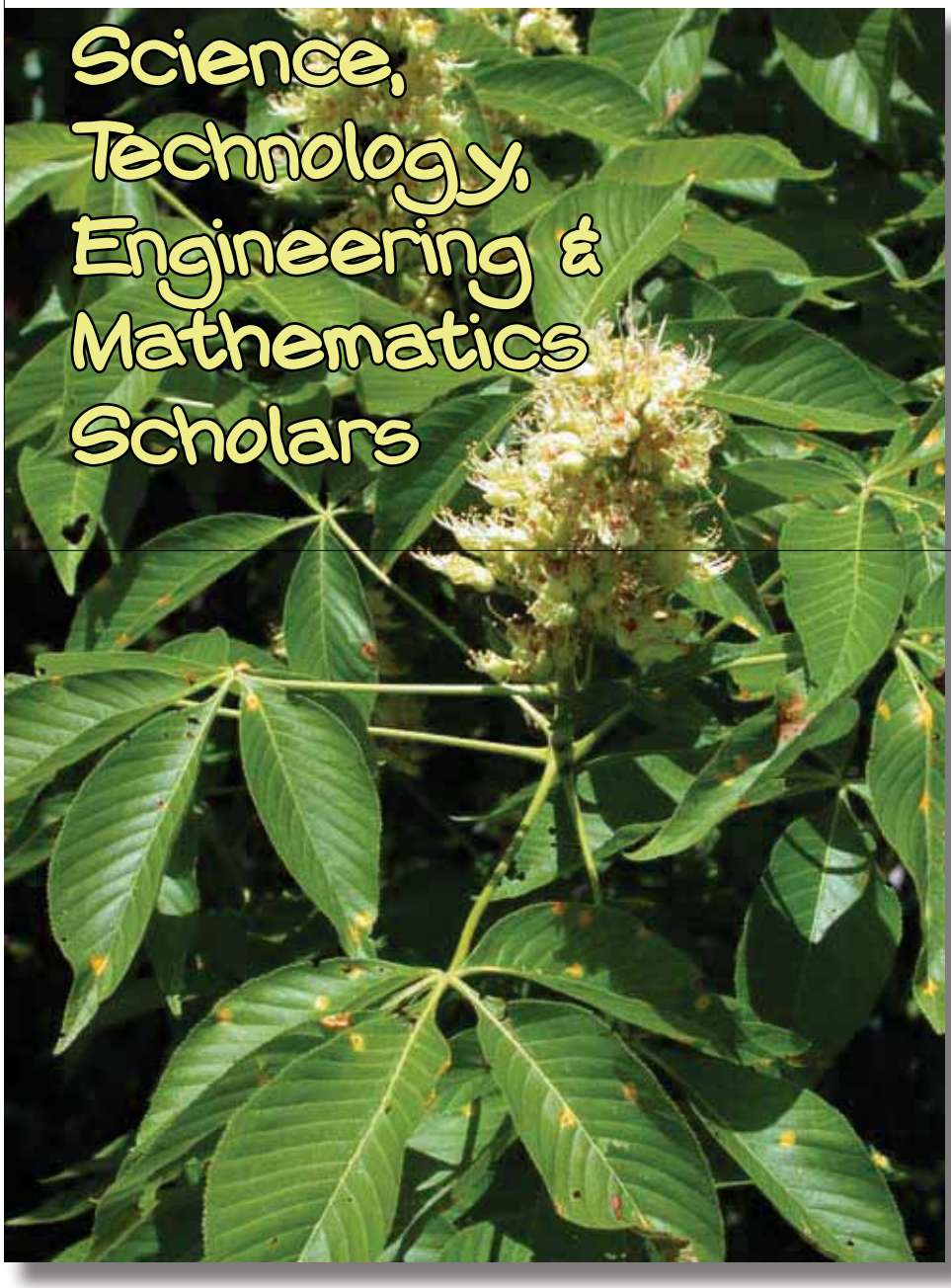
5th-6th graders ...

Application available online at: http://www.ohiosci.org/YBSTEMSApplication.pdf

Enroll Now as a Young Buckeye STEM Scholar

$400 Student Incentives ...

Young Buckeye STEMS



Young Buckeye STEM Scholars is an after-school, project-based program that incorporates scientific inquiry, technological design, teamwork, communications and leadership development. STEM is science, technology, engineering and mathematics. This program is open to all interested **5th and 6th grade students** from Big Walnut and Buckeye Valley in Delaware County, North Union in Union County, River Valley in Marion County, Teays Valley in Pickaway County, Upper Sandusky in Wyandot County and Colonial Hills, Brookside and Slate Hill elementaries, Worthington Schools, in Franklin County.

Rotunda of Ohio Statehouse

Young Buckeye STEM Scholars is a partnership of The Ohio Academy of Science, Ohio 4-H, local schools, public libraries and TECHColumbus supported by The Ohio General Assembly through a grant to the Academy from The Ohio Department of Education.

For more information contact
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oas@iwaynet.net
www.ohiosci.org

Young Buckeye STEM Scholars

Activities and Objectives

As members of an after-school-based 4-H club, students will select and complete one science or technology related project of their choice from the *4-H Ohio Family Guide* or from other 4-H sources on websites in other states. Contemporary 4-H projects span virtually all STEM disciplines.

To improve their oral presentation skills, students will display and demonstrate knowledge achieved from their 4-H-originated project to classmates in after school sessions and in public at a county fair, the Ohio State Fair, local library or shopping mall.

To enhance their use of science inquiry skills, students will refine and expand their 4-H originated project, individually or as a member of a team, by modifying the project to meet contemporary guidelines for inquiry-based projects suitable for local, district, State and International Science Fairs. Or, students may select a new topic of their interest for an inquiry-based project. Students will enter a local science day by the 7th grade.

To enhance their skills of observation, note-taking, documentation and citation, written communications and self-reflection, students will keep bound journals and electronic portfolios, updated biweekly, detailing their experiences throughout their enrollment.

Through 200 hours of out-of-school classes and field trips during the academic years and summers from January 1, 2008 through June 30, 2009 students will: 1. gain science content knowledge related to student projects; 2. improve their oral and written communication skills; 3. understand and apply basic knowledge of statistics, sampling and data presentation; 4. understand research risks and ethical scientific and safety practices associated with the use of vertebrate animals, human subjects, potentially hazardous biological agents, and hazardous chemicals, activities or devices; and 5. develop student research plans and begin to understand basic technologies required and academic preparation needed for success in STEM academic and business careers.

Industry, academia and governmental science and technology-based agencies will (a) identify STEM role models and (b) host STEM content and career related field trips for students, teachers and parents.

$400 Worth of Student Enrollment Incentives

Each scholar will receive $215 worth of bookstore gift cards, 104 weekly issues of *Science News,* 24 monthly issues of *Scientific American,* high quality journals and laboratory notebooks and a 2 gigabyte flash drive with FM radio and MP3 player.


To enable and engage entire classes of students and teachers to appreciate the challenge of designing STEM-based solutions to social, economic, environmental and health problems, each class, over a period of 12+ months, will identify a problem, design a solution, create and test a prototype or model and present the results at a capstone experience.

To provide recognition of student achievement and to recognize the contribution of their teachers, the Ohio 4-H Center will host a capstone educational and graduation/social experience and luncheon in June 2009 at the end of the enrollment that will focus on the future of STEM and STEM related careers.

The entire Young Buckeye STEM Scholars program will align with (a) the 4-H Science Inquiry Model, (b) contemporary student research guidelines and (c) Ohio Educational Standards in Science, Technology, Mathematics, Library, Social Studies and English Language Arts. Each after school class will have two science, mathematics or technology teachers.

This project will include at least seven technologies, and will integrate mathematics with each of these STEM disciplines and technologies, especially as the mathematics relates to future employment in technology-based industries.

What are students expected to do?

Attend all after-school classes, summer field trips and capstone graduation experience from January 1, 2008 to June 30, 2009; approximately 200 contact hours.

Complete and display a 4-H project of your choice in 2008.

Keep accurate notebooks up to date for classes, field trips and projects (4-H and student research).

Complete approximately 36 out-of-class short writing assignments that will include summary reports on supplemental readings in science news magazines from January 1, 2008-June 30, 2009.

Participate in class activities and teams including a long-term class technological design project in 2008-2009.

Communicate with a research mentor.

Select, complete and display an individual or team student research project in 2008-2009.

Each student is expected (1) to positively interact with fellow students in order to create an environment in which all students have an opportunity to learn; (2) to be attentive, courteous, and cooperative; 3) to be prepared for class and to complete all assignments; (4) and to actively participate in class discussions, labs, projects, presentations, field trips etc.

How will students be selected?

A total of 225 students (25/school) will be selected by lottery with nearly equal participation of males and females. STEM students will ***not*** be selected by intellectual ability, measures of achievement or aptitude. Reasonable efforts will be made to accommodate students on IEPs and ESL students.

An additional 90 (10/school) **alternates** will be chosen to fill in if any initially selected students cannot continue. Alternates will receive perodic updates by mail and email and receive 24 issues of *Scientific American* magazine. Alternates may attend field trips on a space-available basis.

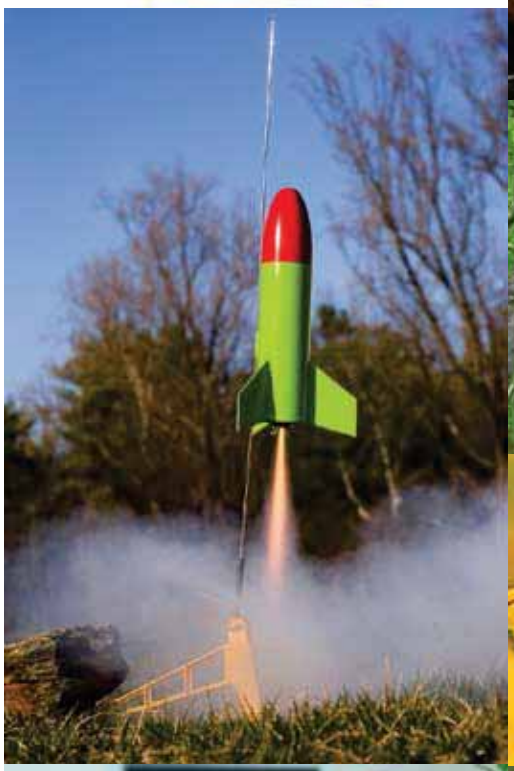
An actual young Buckeye stem (opening terminal bud)

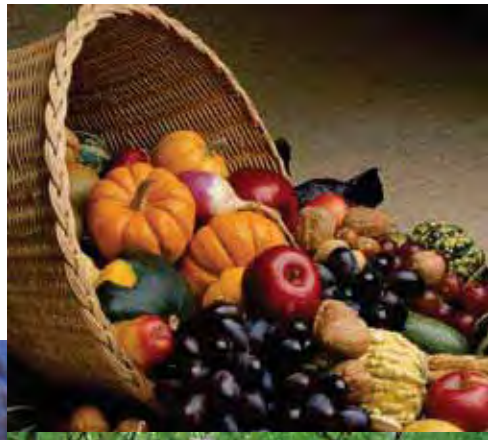
4-H Projects

As members of an after-school-based 4-H club, students will select and complete one science or technology related project of their choice from the *4-H Ohio Family Guide* or from other 4-H sources on web-sites in other states. **Contemporary 4-H projects span virtually all STEM disciplines.**

4-H is a community of young people across America who are learning leadership, citizenship and life skills.

Aerospace science • Agriculture • Animals • Aquatic Science • Beef cattle • Beekeeping • Birds • Cats • Dairy cattle • Electronics • Energy and power • Field crops • Food Science and nutrition • Forestry • Gardening • Goats • Grazing Management • Health • Horses • Insects • Lawn Care • Let's Explore the Outdoors • Natural resources • Petcare • Photography • Plant science • Ponds • Poultry • Rabbits • Radio Controlled vehicles • Sheep • Small engines • Swine • Tractor and Machinery Maintenance • Veterinary Science • Water Science • Welding • Woodworking and many other projects that can be selected from websites in other states.





A ripening Ohio Buckeye fruit (hull) with three buckeyes (seeds or nuts) Scientific name: *Aesculus glabra*

Ms. Rachel Yoho, Big Walnut High School

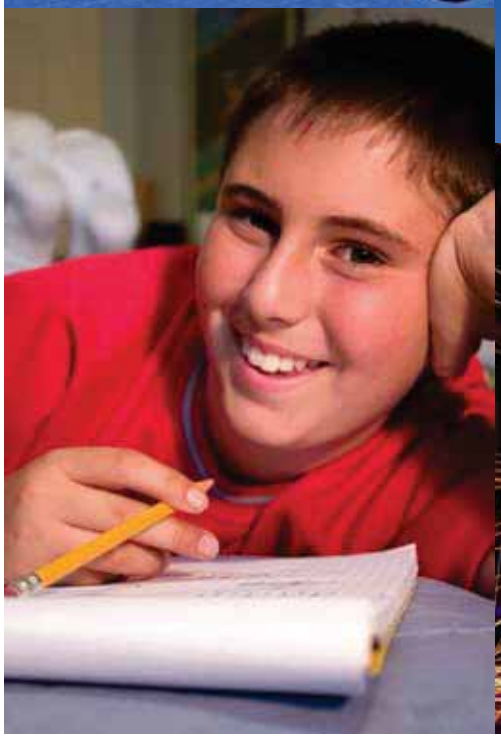
Science Fair Projects

TO ENHANCE THEIR USE of science inquiry skills, students will refine and expand their 4-H originated project, individually or as a member of a team, by modifying the project to meet contemporary guidelines for inquiry-based projects suitable for local, district, State and International Science Fairs. Or, students may select a new topic of their interest for an inquiry-based project. Students will enter a local science day by the 7th grade.

Actual buckeyes (seeds or nuts)

Summer Field Trips

STUDENTS WILL ATTEND technology and career-related field trips to employers in the following technology areas: Agriculture & Food Technology; Flight & Space; Construction; Energy; Environment; Communications & Information Technology; Manufacturing; Materials; Medicine & Health and Transportation.



Lessons to be learned at science fairs

There is something about doing that makes learning easier.

If someone tells you something and you make a point of remembering it, chances are, if you're like us, you will forget.

But, if someone tells you something and you write it down, there's a good chance that you will remember without ever referring to your scribbled notes.

Why? Because doing is learning.

That's why we like science fairs.

The North Central District Science Day and the Marion Area Science and Engineering Fair, both scheduled for March 17 at the Alber Student Center, are not educational extras.

Lessons learned at the science fair are the kind of lesson that sticks with students long after they leave school.

Students learn to test theories, to evaluate data and to measure credibility. Maybe most importantly they learn to present their findings in a coherent manner and they get to practice public speaking.

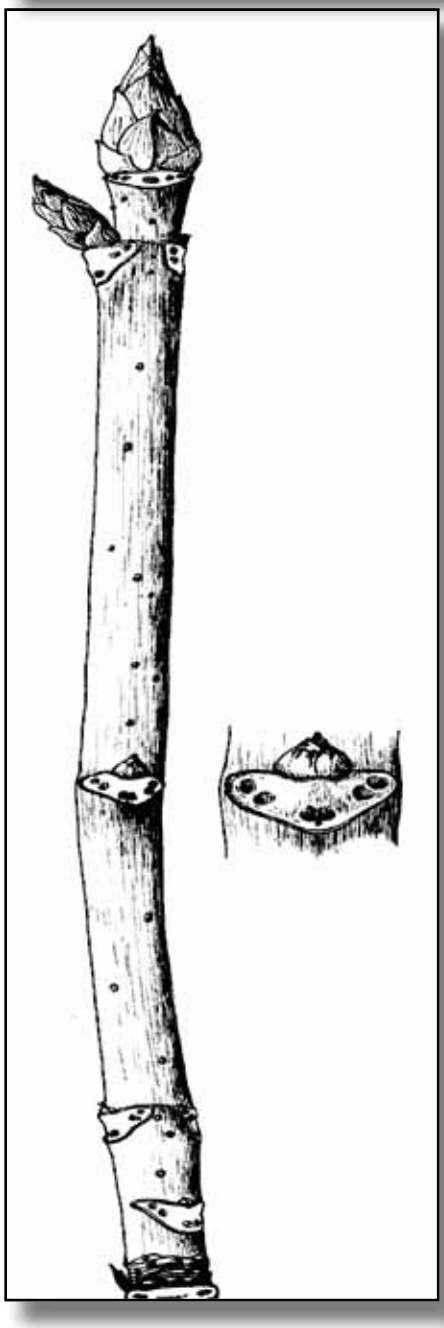
If someone came to us looking for a job with the skills listed above, they would immediately move to the "possible hire" list.

We know that when we were in school we mumbled and griped about learning things we would never use again.

What we didn't know was, while we would likely never solve another quadratic equation, the skills we used to learn how to solve them, would be used almost every day of our working lives.

Congratulations to all the students in the upcoming science fairs. And a special congratulations to the teachers and school districts that see the value in this type of education.

As we have said before, the Three R's might have been good enough for grandpa but today's future workers need and deserve much, much more.



Scientific drawing of Buckeye stem with lateral and terminal buds in winter condition

How to apply to become a Young Buckeye STEM Scholar

Application available online at: http://www.ohiosci.org/YBSTEMSApplication.pdf

1. Talk to your parents about the program. 2. Complete the section **About You**. 3. Sign the form (Student signature). 4. Have your parents complete the **Parent or guardian information** section. 5. Have your parents sign the Consent Form available at http://www.ohiosci.org/consent.pdf and this application (Parent signature). 6. Mail application ***and*** Consent Form First Class **postmarked by January 11, 2008 to: YBS, PO Box 12519, Columbus OH 43212.**

About you

I am applying to become a Young Buckeye STEM Scholar in an after school and summer program from January 1, 2008 until June 30, 2009.

I attend _____ school in grade _____ 5 _____ 6 in the following public school district: ____ Big Walnut ____ Buckeye Valley ____ North Union ____ River Valley ____ Teays Valley ____ Upper Sandusky

Worthington City (select one): ___ Colonial Hills ___ Brookside ___ Slate Hill

Title: ____ Ms. ____ Mr. Date of birth _____

First Name _____Middle initial ___ Last Name _____

Home Address _____

City/State/Zip _____

Home Phone (____) _____ Cell (____)_____

Preferred Email Address _____ or ____ I do not have email

Which best describes you? ____ American Indian or Alaskan Native ____ African-American ____ Asian or Pacific Islander ____ Hispanic, regardless of race ____ White (not of Hispanic origin) ____ Mixed race ____ Other _____

Student's signature _____ **Date** _____

Parent or guardian information

Title: ____ Ms. ____ Mrs. ____ Mr. ____ Dr.

First Name _____Middle initial ___ Last Name _____

Home Address _____

City/State/Zip _____

Home Phone (____) _____ Cell (____)_____

Office Phone (____) _____ Fax (____) _____

Preferred Email Address _____

LATE PICK-UP FEE POLICY- Parents are responsible for transportation to and from after school classes or to bus locations for summer field trips for the Young Buckeye STEM Scholars. Ending times will be specified in advance by the teacher in charge. We ask that all children be picked up by that time. Since staff have other responsibilities and are not expected to remain after the ending time, a fee of $10 will be assessed for each five (5) minutes after ending time a parent is late. The school clock will be used to assess the fee (e.g., 6:06 PM arrival for a 6:00 PM pick up time will result in a $20 fee). If a child has not been picked up by 30 minutes after the specified time and attempts to contact parents and emergency contacts have been unsuccessful, the police and county children's services may be called. The Ohio Academy of Science reserves the right to terminate enrollment for recurrent late pick-up. The late pick-up fee will be assessed beginning one hour after the time a parent is contacted to pick up a child for any reason including illness, behavior, etc.

I agree to the application of my child, named above, to participate in the Young Buckeye STEM Scholars Program directed by The Ohio Academy of Science. I further agree to the conditions in the Consent Form that I have signed, and I agree to accept the conditions in the Late Pick-Up Fee Policy stated above. I agree to assure transportation for my child to and from all after-school classes and to bus pick up locations for summer field trips.

Parent signature _____ **Date** _____

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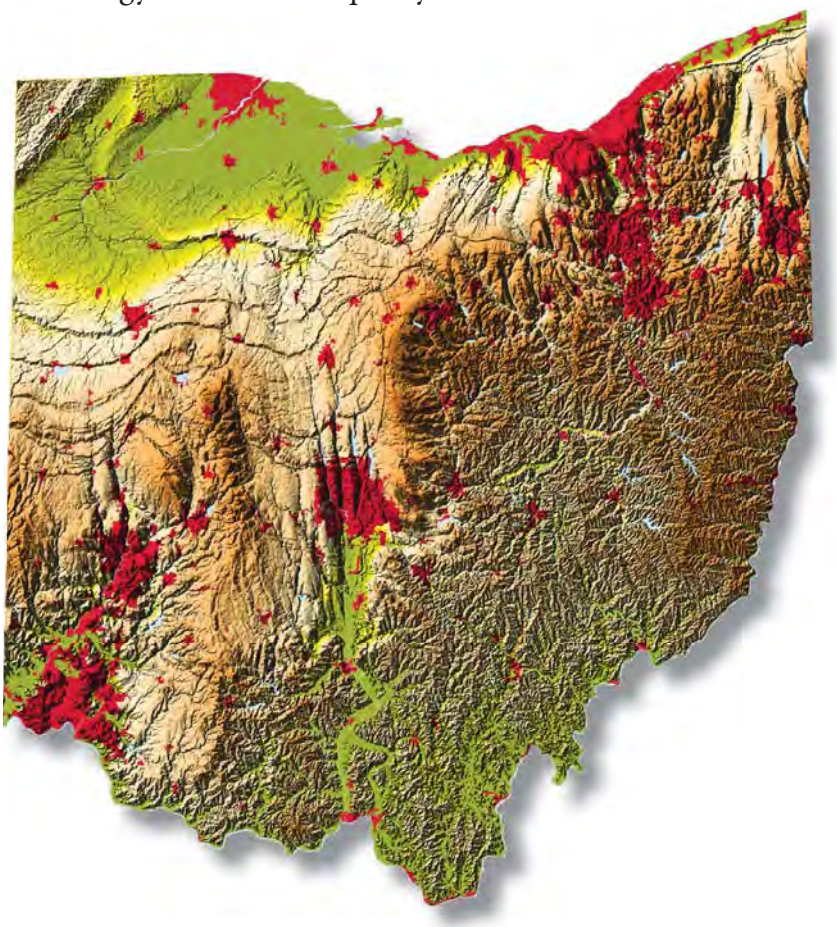
Curiosity? Discovery. Innovation!

The Ohio Academy of Science

Founded in 1891, The Ohio Academy of Science is a membership-based, volunteer-driven, not-for-profit organization. The Academy is the leading organization in Ohio to foster curiosity, discovery, and innovation and to unite all who value education, science, engineering, technology, or their applications to benefit society. The Academy conducts an annual professional meeting and science days, publishes an international, multidisciplinary, scientific journal, conducts and improves STEM education and informs state science, technology and education policymakers.



You are cordially invited to support The OHIO ACADEMY *of* SCIENCE

The OHIO ACADEMY *of* SCIENCE *fosters curiosity, discovery and innovation to benefit society.*

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