Summative Evaluation: CaSTL Boys and Girls Club Afterschool Program
CCI-ISE Supplement (NSF 12-056)
CHE-1243593, supplement to CHE-0802913, CaSTL
September 1, 2012 – August 31, 2013

Lauren M. Shea, Educational Evaluator, Center for Educational Partnerships, UC Irvine
Stacey Freeman, Director of Education, Outreach and Diversity, CaSTL
V. A. Apkarian, PI, CaSTL

Executive Summary

The Center for Chemistry at the Space-Time Limit (CaSTL)'s outreach program in collaboration with the California Science Project at Irvine (CSPI), housed at the Center for Educational Partnerships at UC Irvine designed, created, implemented, and consistently refined a science program for 8 -12 year old students at the Boys and Girls Club (BGC) in Santa Ana, California. The year-long weekly program and 4-day summer camp consisted of hour-long lessons designed to connect to CaSTL's research goals of investigation at the microscopic level. Front-end and formative evaluations were conducted throughout the program in order to measure the success of the lessons, monitor student engagement in the program, and make adaptations as needed. More specifically, the evaluations served to answer the following questions: To what extent does the CaSTL BGC program: (1) Engage students (ages 8-12) in STEM lessons? (2) Allow students to experience hands-on, quality inquiry-science lessons (as defined by CaSTL, CSPI, and the California State Standards)? (3) Increase participating students' interest, knowledge, and excitement in STEM disciplines? and (4) Engage students to consider STEM careers?

Monthly site visits included intensive data collection, such as: (1) formal observations, utilizing two science-education observational protocols, (2) group interviews with participating students, (3) photographs of lessons, and (4) collection of student work. Data were analyzed using mixed-methods approaches: More specifically, quantitative analyses of the observational protocol data and qualitative analyses (specifically magnitude and structural coding) of the other forms of data were employed. Written summaries of all analyses and conclusions were reported to the CaSTL Director of Outreach and the design/implementing CSPI staff. Summative evaluation concludes that the program was successful in allowing students to experience quality, hands-on science lessons, in increasing participating students' interest and engagement in science, and altering students' perceptions of who can become a scientist. Recommendations for future work include: designing lessons to provide sufficient background knowledge and review for students, collaborating and meeting frequently with afterschool directors and staff members to continuously align goals, and ensuring that a consistent group of students participate in the program.

Why Afterschool?

Afterschool programs, often provide an informal setting and schedule, freedom from the prescribed curricula and tests, positive relationships between staff and youth participants, and a strong community connection, all of which make afterschool programs the perfect setting for STEM hands-on learning (Froschl et al., 2003). Research on thirty-five out-of-school time studies indicated that these programs can have positive effects on the achievement of at-risk children in urban settings, including increased time spent on reading and math and time to catch up in their academics (Lauer, Akiba, Wilkerson, Apthorp, Snow & Martin-Glenn, 2006).

Posner and Vandell's (1994) research found that after-school programming, with intensive academic and homework support, improved low-income children's academic achievement. McLaughlin (2000) studied teenagers who attended out-of-school youth development programs; the research found that regardless of content, the youth who participated had stronger education and career aspirations and a stronger sense of social responsibility than youth who did not participate in these community-based out-of-school time programs.

Afterschool programs provide a safe place for children to go after school so they are not left home alone. Many low-income and at-risk youth are unsupervised after school, referred to as latchkey kids. Their parents work many jobs to support the family, with little time to assist with schoolwork or to promote educational enrichment in the after school hours. Since their families work long hours to support the family, these children are often negatively influenced with an overwhelmingly trend towards violence and crime, as well as increased substance abuse with alcohol, tobacco and drugs (Maruyama, 2003; Mott et al. 1999; Mulhall, Stone, & Stone 1996). Researchers (Osgood et al., 1996; Posner and Vandell 1999; Steinberg 1986) have shown that children, who are left alone and unsupervised after school, have an increased likelihood of risky behavior, including falling prey to peer pressure, engaging in antisocial behavior and other risky activities. Not only are latchkey kids more likely to engage in risky behavior, being alone after school leads to "lack [of] developmental and social benefits and diminished social capital that are derived from less-frequent parent-child and adult-child interactions and decreased access to parental networks (Casper and Smith, 2004, p. 285)." Also, many schools do not have the resources to provide low-cost or no-cost after school programs or activities to alleviate the need for children to be left alone at home and families are often unable to subsidize after school care (Roffman, Pagano, & Hirsh, 2001). If children are left on their own after school, they will not have access to extra-curricular activities or an adult support system to assist with their homework or to monitor their time spent out of school. Afterschool programs can solve many of these problems.

CaSTL's Boys and Girls Club Program

The Boys and Girls Club (BGC) of Santa Ana is a 501(c)3 nonprofit organization, whose mission is to promote the positive and healthy development of youth, especially those from disadvantaged circumstances, by providing services that build the skills, civility, and self-confidence necessary to succeed in a competitive world. Of the six total sites operated by the BGC, the CaSTL program took place in the community-based, off-school campus site.

The BGC offers a safe and fun place for youth to go afterschool. The sites are open from 2:00pm to 6:30pm Monday through Friday, and offer 12 hour days on Monday through Friday in the summer. When the youth first arrive, they all are required to participate in the "Power Hour," which is hands-on homework help to ensure all participants complete their homework for the next day. They are broken up into teams based on their grade-level and BGC staff members are assigned to the various groups to assist with homework help. The Boys and Girls Club maintains a 1 to 20 staff to participant ratio so that participants can receive homework help and individualized attention. After Power Hour and snack time, BGC students participate in various rotations, including: physical activity, game time, computer time, and other hands-on learning opportunities. Of the students who attend the afterschool club, 93% qualify for free and reduced lunch and 90% of their youth identify as Latino. Their participants range in age from 5-18, with 73% of their youth ranging from ages 6-11, 21% from 12-14, and 5% from 15-18. Their gender breakdown is 51% male and 49% female. When considering their family household incomes, 63% of the participants' families earn less than $25,000 annually and an additional 31% earn less than $45,000 annually.

Each week from December to June (about 20 weeks total), approximately 50 eight to twelve year old students at the community-based BGC participated in hands-on, inquiry based science (mainly Chemistry) lessons. In the afterschool setting, the students were divided into age-appropriate groups of 8-9 year olds (approximately 25 students) and 10-12 year olds (approximately 25 students). Each lesson lasted on average 45 minutes and took place after the "power hour" homework time.

Dr. Therese Shanahan, Director of the California Science Project at Irvine at the Center for Educational Partnerships at UC Irvine, developed weekly lesson plans that engaged Boys and Girls Club students in hands-on, student-centered STEM activities for all 20 weeks and an intensive four-day summer camp. The curriculum was designed and developed in collaboration with the CaSTL staff, graduate students, and/or faculty. All lessons complemented the California State Standards (for science and language arts) and highlighted the lens through which CaSTL research happens. Figure 1 highlights the trajectory of the lessons, which began with learning about scientists/interrogating the world and ended with the tools that scientists use when learning about CaSTL-type concepts.

Three UC Irvine undergraduate students, each within science majors, trained with Dr. Shanahan each week to practice the upcoming lessons and offer suggestions for implementation. During enactment of the lessons, Dr. Shanahan was the lead science teacher and the three undergraduates supported her teaching, offered individual support, led small group activities, and helped evaluate student progress and understanding.

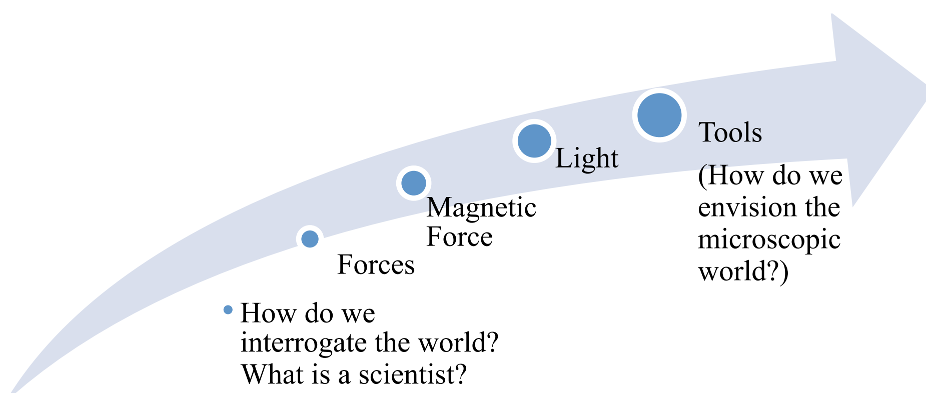


Figure 1. Summary of the lesson trajectory for CaSTL's Boys and Girls Club Program

Evaluation Components

This summative report reflects the evaluation of CaSTL's Boys and Girls Club Afterschool Program. Dr. Lauren M. Shea, with the Center for Educational Partnerships at UC Irvine, conducted the evaluation throughout the year and obtained UC Irvine IRB approval for all evaluation and research components.

Evaluation Design

Three types of evaluation were conducted during the program. First, a front-end assessment was conducted to determine baseline characteristics and needs regarding student engagement, knowledge, and interest in STEM fields. Second, throughout the duration of the project, ongoing and formative assessment provided feedback to the program directors and staff to allow for strengthening of the program. Lastly, this summative evaluation serves to assess the success of the program and offer suggestions for future implementation. All evaluation components used both quantitative and qualitative analyses to determine the impact of the program.

Front-end evaluation. At the onset of the project, several forms of data were collected and analyzed to determine baseline characteristics of the students and their experiences in the Boys and Girls Club of Santa Ana. The evaluator conducted observations of the existing program's components to determine students' engagement in the club's distinct activities. Three focus group interviews were conducted to learn about students' experiences in the club. The focus group discussions centered on students' perceptions of their time at the club, their recent club activities, their attitudes toward science, and their career goals. Observation and focus group results were shared with project developers and staff to allow for any adjustments prior to the implementation of the program.

Formative evaluation. The formative assessment examined the quality, usefulness, and implementation of the project's activities to allow for adjustments and to ensure that the project attained its proposed goals. The evaluator conducted four monthly on-site observations of the lessons to assess the project's goals of engaging students in STEM lessons and allowing students to experience hands-on, quality science lessons. For each lesson, Dr. Shea completed observational protocols, took field notes, photographed visual displays, and collected student work. The Peer-Classroom Observation Protocol (PCOP) and the Science Teaching and Environment Rating Scale (STERS) were utilized as the two main observation protocols. Each observation tool is further described below.

Peer-Classroom Observation Protocol (PCOP). Designed by the California Science Project at Irvine, the PCOP protocol used in this evaluation is aligned with the four broad English Learner standards for the state of California as they apply to content-based learning: listening, speaking, reading, and writing. The tool allows the observer to document occurrences of receptive and expressive language through the teachers' use of research-based language learning strategies in content areas (specifically science). Additionally, it captures strategies and tools used by teachers and descriptions of student involvement aligned in 5-minute increments. This tool allows observers to document the instances of strategies that occur during lessons. Thus, scores are noted as percentages in 5-minute increments. For example, if a score of 50% (0.50) is attained, that translates to the event having happened in half of the 5-minute increments of the lesson. This tool allows for quantitative analyses of implementation strategies and engagement levels. A copy of this protocol is included in Appendix A.

Science Teaching and Environment Rating Scale (STERS). Developed by teams from the Education Development Center, the STERS uses classroom observation to rate the extent to which the teaching staff (1) creates a physical environment for inquiry and learning, (2) facilitates direct experiences to promote conceptual learning, (3) promotes use of scientific inquiry, (4) creates a collaborative climate that promotes exploration and understanding, (5) provides opportunities for extended conversations, (6) builds children's vocabulary, (7) plans in-depth investigations, and (8) assesses children's learning. Each of these components is rated using a 4-point rubric (1 = deficient through 4 = exemplary) that describes the sorts of materials and interactions one would find in a classroom that meets each numerical level. See Appendix B for this protocol.

The evaluator conducted bi-monthly grade-level focus group interviews to discuss the project with participating students. Topics included students' perceived engagement, interest in STEM learning, and perceived knowledge of science. For each of the focus groups, between three and five students participated.

Results were used to refine the activities for subsequent lessons. The evaluator attempted to provide timely feedback to the project team so they could improve implementation and increase the impact of the project activities. The guiding questions throughout this portion of the evaluation were:

The questions to guide the evaluation were based on the goals of the Boys and Girls Club program. To what extent does the Boys and Girls Club program:

1. Engage students (ages 8-12) in STEM lessons?
2. Allow students to experience hands-on, quality inquiry-science lessons (as defined by CaSTL, CSPI, and the California State Standards)?
3. Increase participating students' interest, knowledge, and excitement in STEM disciplines?
4. Engage students to consider STEM careers?

Summative evaluation. This current report serves to summarize findings from the other two evaluation types, as well as to assess the program in two ways: (1) How well did the project implement its program? and (2) How were participating students impacted by the program? In order to complete this part of the evaluation, several data sources and analyses were used.

Aggregate strategy scores from the observational protocol were analyzed to determine changes in the program over time. The characteristics of student engagement, as well as other emergent characteristics of the program, are reported.

A final grade-level focus group interview attempted to capture students' perception of the full program. Interview questions focused on the value of the program, students' desire to continue in STEM learning, changes in STEM knowledge, and shifts in attitudes regarding STEM fields.

Analyses

For the front-end assessment and each of the four formative reports, several analyses were completed with the collected data. Percentages of strategy instances were calculated for all PCOP variables. Specific program variables were reported in each evaluation summary. A STERs score was determined. Structural coding, a question-based coding methodology that acts as a labeling and indexing device to both code and categorize (Saldana, 2009), was used to analyze the observation field notes. Coded data, which posed coherent sets of ideas, were organized into categories. NVivo coding software was utilized for this analysis. Student work was reviewed for writing content and program-specific goals. For specific student work examples, magnitude coding, a technique that demonstrates frequency and intensity (Miles & Huberman, 1994), was used to examine the characteristics of the work.

Results

The front-end evaluation revealed that students were most excited by activities at the club that included playing. In early November, the club had many activities in place for the students (such as "Power Hour" homework time, a reading program, a computer program, playground time, etc.), but the most engaging and memorable experiences for the students was the playtime experiences. During the observed activity lesson (a computer lesson), students worked independently for 100% of the time and they did not collaborate or discuss content meaningfully during the observed time (0%). Their engagement levels were low. When reviewing these results with the CaSTL team, many questions arose, such as: How could the program incorporate students' most liked activities (play) with academic content? How could the program increase student engagement? Given students' limited science experiences in school, what steps could be taken to ensure the program gives students sufficient background knowledge to effectively engage in the CaSTL program? Could the program aim to increase student collaboration and discussion? How could the program increase students' learning of science without replicating the traditional school day?

Over the course of CaSTL's program, the formative evaluations provided the team with valuable information regarding the success of the program and where improvements needed to be made. Early on, the CaSTL team recognized their success in supporting students' self-identification as scientists. The team then made more explicit goals of supporting and encouraging these changes in the students. The most significant and important findings from the visits demonstrated to the team that students were excited about and engaged in the science, the program, and believed they could one day be scientists. In summary, the CaSTL BGC program effectively addressed the NSF's impact areas of increasing student awareness of science, their knowledge and understanding of scientific, and their interest and engagement in the discipline.

Observations. Regular observations revealed the students were exposed to many scientific concepts and much conceptual learning. Table 1 below demonstrates key PCOP variables from the front-end assessment and the four formative evaluation visits. Over the course of the program, there was an increase in how often students engaged in meaningful content-related discussions. Students were highly-engaged throughout the program. The CaSTL program used a variety of materials to engage students, such as manipulatives, real objects (realia), and pictures. Students participated in individual activities, as well as investigations in groups, partners, and teams. CaSTL instructors spent approximately half of the observed lessons supporting student learning by orienting students to the material, explaining, modeling, demonstrating, and thinking aloud. Dr. Shanahan and the undergraduates listened to the students and checked their work frequently. They reviewed prior concepts and rephrased students' language in order to ensure scientific language and comprehension.

Table 1
Averages for PCOP Variables: Front-End and Formative Evaluations

Observation Category	Front-End	Formative Evaluations (December-May)				Average (all formative)
		Eval. 1	Eval. 2	Eval. 3	Eval. 4	
Type of Classroom Involvement by Students						
Student(s) Asking Questions	0.00	0.58	0.33	0.00	0.00	0.18
Student(s) Answering Questions	0.00	0.89	0.69	0.86	0.81	0.65
Group Discussion w/ Teacher	0.00	0.32	0.47	0.08	0.33	0.24
Individual Discussion w/Teacher	0.00	0.55	0.65	0.64	0.56	0.48
Students Discussion w/ Students	0.00	0.11	0.06	0.25	0.25	0.13
Students Working Independently	0.85	0.41	0.53	0.33	0.36	0.49
Students Working In Groups	0.00	0.07	0.47	0.25	0.11	0.18
Intended Level of Task						
Concepts	0.00	0.58	0.88	0.81	0.94	0.64
Engagement Level						
High (67%-100%)	0.62	0.93	0.82	1.00	0.94	0.86
Tools Used in Classroom						
Manipulatives	0.00	0.00	0.52	0.00	0.00	0.10
Pictures	0.00	0.45	0.00	0.00	0.06	0.10
Realia (real objects)	0.00	0.15	0.28	0.33	0.69	0.29
Strategies Used by Teachers						
Context/orienting students	0.37	0.64	0.94	0.53	0.61	0.62
Explaining	0.00	0.51	0.65	0.39	0.58	0.43
Listening/checking work	0.07	0.85	0.76	0.75	0.44	0.57
Modeling/demonstrating/think aloud	0.00	0.65	0.76	0.58	0.53	0.51
Rephrasing	0.00	0.51	0.42	0.69	0.78	0.48
Review	0.00	0.11	0.31	0.36	0.67	0.29

Note. Scores are presented in decimal format and represent the amount of time the event occurred within a 5-minute increment during the lesson. In other words, if a score of 0.50 is attained, that translates to the event having happened in half of the 5-minute increments of the lesson. Each score is averaged from the individual lessons observed that day. For example, most days there were two observed lessons (one per age group). The score represented in this table is the average of those scores.

Table 2 shows the STERS scores over the four formative evaluation visits. In summary, each observed lesson showed sufficient evidence that the CaSTL team created an environment conducive to science learning. All scores consistently met the adequate range (3), with several areas receiving an exemplary score of 4 throughout the formative evaluations. These quality lessons, implementations, and created environments allowed for students to engage in and enjoy science.

Table 2
Formative Evaluation Scores of Observed CaSTL Science Lessons Using the Science Teaching and Environment Rating Scale (STERS)

Components of Science Teaching	**Formative Evaluations (December-May)**			
	Eval. 1 Score	**Eval. 2 Score**	**Eval. 3 Score**	**Eval. 4 Score**
Create a Physical Environment for Inquiry and Learning	3	3	4	4
Facilitate Direct Experiences to Promote Conceptual Learning	3	3	3	3
Promote Use of Scientific Inquiry	n/a	4	3	3
Create a Collaborative Climate that Promotes Exploration and Understanding	4	4	3	3
Opportunities for Extended Conversation	3	3	3	3
Build Children's Vocabulary	3	3	4	3
Plan In-depth Investigations	n/a	4	4	4
Assess Children's Learning	3	3	3	3

Field Notes. The field notes provided rich, qualitative examples of student talk, student discussions with the CaSTL team, and vocabulary building. Furthermore, the notes showed the ways that the investigations encouraged learning. However, the most pertinent theme in the field notes was the consistent examples of how Dr. Shanahan required the students to act, think, and talk like scientists. I believe this teaching style contributed greatly to students' efficacy and understanding that they themselves can be scientists. Below are several examples that took place over the formative evaluations:

- *"My scientist helper here is going to start piling books…"*
  S: Can we try this?
  SS: It's going to break. It's going to fall.
  T: You're acting like a scientist and you're setting it up…

- *T[eacher] encourages students to use scientific words and be accountable for them (T: "What's them? Use your science words"; SS are required to complete the sentence, "I think the staple, paperclip, pin, and the nail are attracted to the magnet and they all have iron in it."*
- *T[eacher]: Thank you for all those great ideas that you shared as scientists.*
- *T[eacher]:"That's what scientists do. They record their observations."*
- *T[eacher]: As a scientist, you're going to use your senses. Which senses will you use?"*
- *T[eacher]: Thank you for being such good scientists!*
- *T[eacher]: Scientists report their information, but they are also good listeners. So we need to listen to the others in the room.*

Interviews. Over the course of the CaSTL BGC program, students discussed their experiences, thoughts, and learning in the program. In each of the interviews, coded themes showed that students consistently found the program fun and engaging. They could remember prior activities and key points from those lessons. Over time, students learned what scientists do and even began to take on the identity of scientists themselves. Many students reported that they would like to be scientists when they grow up. At the last interview of the year, all students said they would like the program to continue. Table 3 shows sample student responses throughout the year.

Table 3
Examples of Student Comments from Interviews (February – June)

The Program is Fun	• *It's really fun. It's really nice. They make you happy. (Feb.)* • *What I like about going to STEM is that we learn more about science and they give us prizes or tickets. And, it's fun to do the laser things. (April)*
Remembering the Activities and Concepts	• *I like the animal noises and you have to find out who was the animal. What kind of animal. I liked the activity because you have to be good listeners and follow the animal, follow the animal to its noise. (Feb.)* • *The up and down. The push and pull force. The up and down force. The gravity force. The magnets and that… (April)* • *Like that light, it travels in straight lines. (April)*
Students have started to understand who scientists are and what they do (April)	• *Scientists are people who study many different things. Like for example, they study the world, the galaxy, history of animals, and the history of the earth too.* • *Scientists are people who study about brains, study about animals, study about people. They study about the earth science, and they study about the weather* • *A scientist is someone who finds out information for something*

	that probably other people don't know.
Identifying as a Scientist	• *You get to do a lot of activities and then the activities help us learn a lot of things. And we could be better scientists. (Feb.)* • *I can be a scientist. If I study and go to college. (June)* • *Us. When we grow up, we can be one. (June)*
They would like to see the program continue (June)	• *Interviewer: Great. Would you like to have this program again at the Boys and Girls Club again next year?* • *Student: Yes!* • *Interviewer: Great. I think the 8-9 year olds will come again next year. Do you think they would like it?* • *Student: Yes!*

Student Work. At the first lesson, the CaSTL team asked the students to draw a picture of a scientist. The purpose of this activity was to determine if students' perceptions of a scientist changed over the course of the program. Through the formative assessments, the interviews suggested that students had started to identify as scientists, so the program leaders conducted a post-activity to document if students' view had changed since they were treated like scientists in the program.

In the pre-program drawing (December), students' pictures of scientists (n=45) were reviewed for specific characteristics. Using magnitude coding, the following results were found. Thirty-five students (78%) drew the scientists as male. Ten (22%) drew the scientists as female. Of the students who included a background, 25 (56%) drew the scientist in a lab and 4 (9%) drew the scientists in the field. Twenty-six students (58%) drew the scientist with goggles/glasses. Thirty-five students (78%) drew equipment in the picture. Students did not have colored crayons, so race/ethnicity of the scientists could not be determined. In June, at the end of the CaSTL program, the post-activity was completed. The results were remarkably different, especially with regard to gender of the scientist. Fifty-seven percent drew the scientist as male, while 43% drew the scientist as female. Figure 2 shows these comparisons. Appendix C shows an example of students' drawings.

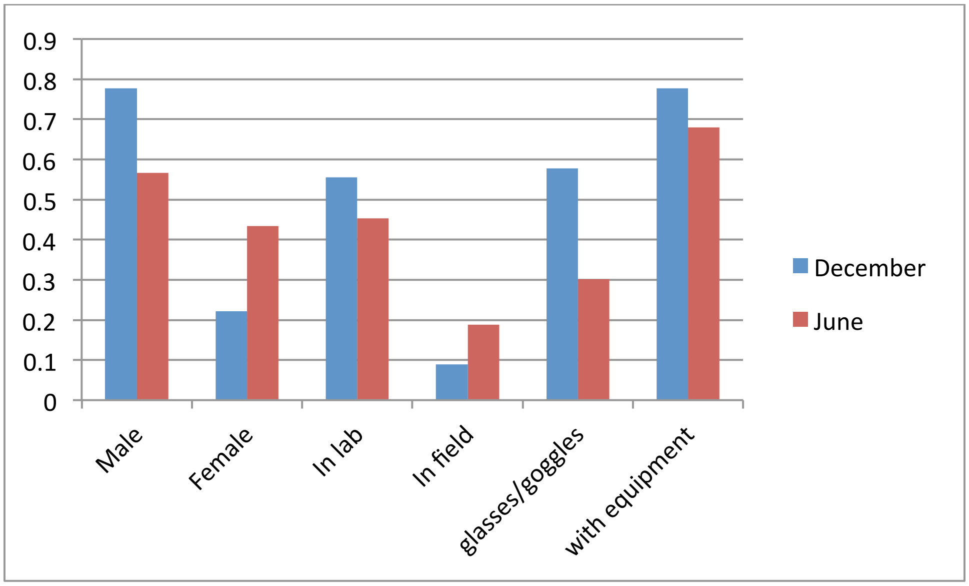


Figure 2. Comparison of students' drawings of scientists from December to June.

Interestingly, when the post-program data were disaggregated and only the female students' work was evaluated, an overwhelmingly large percentage of the young girls showed the scientist to be female. One student even said while drawing, "there is no law that says the scientists can't be girls." Figure 3 shows the results for only the female students' drawings.

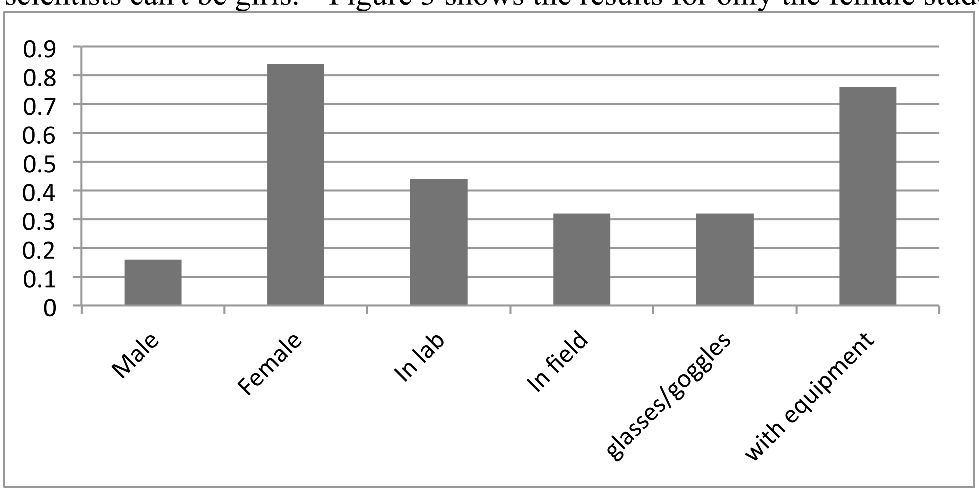
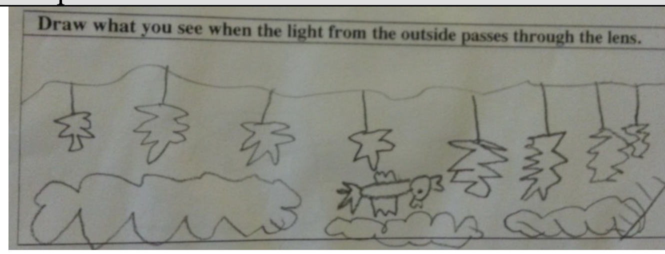
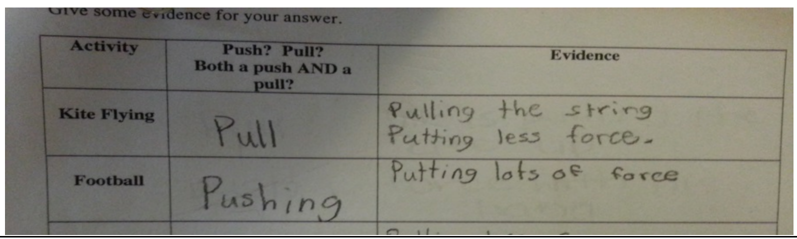


Figure 3. Female students' drawings of scientists in June

Review of many other samples of student work over the course of the program showed that students were involved in various other reading and writing activities. Often, students had to demonstrate their learning and document their experiences by drawing, labeling, or writing about their activities. Students performed such literacy and science learning skills such as observing, predicting, classifying, seeking information, comparing, and synthesizing. Table 4 shows examples of students' successful answers to questions that demonstrated these skills.

Table 4

Student Work Examples of Science Literacy Skills

Science Literacy Skill	Response from Student Work
Observing	 "We saw more dots."
Predicting	"I think that the both balls will fall because by gravity, they fall at the same time." "I predict that the magnet will attract the iron."
Classifying	 Give some evidence for your answer. Activity / Push? Pull? Both a push AND a pull? / Evidence Kite Flying / Pull / Pulling the string Putting less force. Football / Pushing / Putting lots of force
Seeking Information	"Does two persons [scientists] think about what kind of whale it is?"
Comparing	"I see a rainbow with the flashlight, but I only see red with this."
Synthesizing	"When I made the opening of the mirrors bigger, I saw fewer images."

Summer Program

The academic-year long program was designed to meet each week for approximately 45 minutes to one hour. During that time, approximately 18 lessons were completed. At the close of the program, students in grades 2-3 (approximately 25 students) were asked if they would like to continue in the program by attending a 4 half-day long (9am-12pm) summer science camp. Invitations and flyers were sent home with students and 22 students returned them signed. Each of those students received a confirmation acceptance letter, along with reminders of dates and times.

Unfortunately, in the first morning of the program, only three students were present. The team and some BGC staff called each parent individually; only one student's parent offered to bring their child in for the program. It turned out that none of the other students who had submitted summer camp forms were continuing at the BGC for the summer.

This led to recruiting a new group of 8-9 year old students, none of whom had participated during the school year. The total group included 4 previously-participated students and 14 new students. The program was implemented as close to fidelity as possible, with several additional review components included. Investigations centered on light, prisms, microscopes, and scientists who use the tools and study these concepts.

Throughout the week, student participation rates were high. Each day, between 16-18 students were present, with the week's average being 94.4% attendance. At the end of the week, students were given an evaluation survey to reflect upon their experience in science summer camp. Students were asked how much they liked the program (with a smiley face rating of ☺:3,

😐:2, or ☹:1). The average was 2.94 (n=17). Fourteen students said they enjoyed the program so much that they would like to continue learning about science during the school year. Table 5 exemplifies students' survey answers to questions regarding what they learned in camp and why they want to continue learning about science. Appendix E shows several pictures of the program.

Table 6
Suggestions Aligned with CaSTL BGC Program's Experiences/Challenges

Summer Survey Question	Sample Student Responses
What did you learn from Science Camp?	• Diffraction and refraction • Salt is [viewed under the microscope] in squares • That the light travel in a straight line and go fast • I learned how to use a microscope
Why do you want to learn more science?	• Because I love science • Because I want to be a chemist when I grow up • I want to learn more about science because it is fun

Note. N=17

Recommendations or Suggestions for Improvement

The CaSTL Boys and Girls Club Program had many successes and engaging moments. However, throughout the year, the program encountered many challenges that led to recommendations and suggestions for future implementation or design for differing afterschool programs. These challenges and their implications were easy to identify throughout the evaluation process because all members of the implementation and evaluation teams believed in continuous improvement of the program throughout the formative evaluation stage. Table 6 aligns the suggestion with the program's experience and/or challenge.

Table 6
Suggestions Aligned with CaSTL BGC Program's Experiences/Challenges

Suggestion	CaSTL BGC Program's Experiences/Challenges
Each implemented afterschool program should begin with providing students with sufficient science background knowledge (such as teaching students how to observe, discuss findings, collaborate, etc.).	The program provided students with investigations and activities to learn how to use their five senses. This was helpful in setting expectations and allowing student-participants to be prepared to begin the program with some common background knowledge.
It is important to have consistent collaboration and discussions with the afterschool program (directors and staff) to	• Despite attempts to ensure that the same group of students consistently attended the program, students' participation rates were radically

ensure that the same group of students attends consistently.	inconsistent. In future implementations of the program, it will be important to stress consistency of participation and discuss the program frequently with afterschool staff and directors. • Conflicting Programs: There were many conflicting programs at the club. Science program students were often told to go to different programs (sports, music, cheerleading) that occurred at the same time as the CaSTL program. This was one cause for erratic participation levels and attrition. • Implementing Lessons: Although pickup time and consistent attendance in an afterschool program are always concerns, the varying class size made it somewhat challenging to plan and implement lessons. Furthermore, it became a challenge to design and enact lessons for three groups of students; (1) consistent participants, (2) newcomers, and (3) inconsistent participants. • Time: Because of the conflicting programs, time was often a factor. The CaSTL teams worked hard to fit lessons into much shorter time blocks than originally planned. • Promotion of the Program: Had more BGC staff at the club been involved with/been invested in the program, it is possible that it might have been easier to communicate, through the BGC staff, with the students' parents (i.e. promote the program, encourage visits to the program, keep parents aware of commitments to the science summer camp, etc.). • Evaluating Participation Rates: Because of lack of time and many students entering/exiting the lessons, it was difficult to track students' participation rates in the program.
Try to have staff training days with all afterschool staff before the program begins and factor in afterschool staff turnover.	Halfway through the program, the site director at the Santa Ana BGC left the club. This meant that the CaSTL staff had to communicate with new staff and attempt to describe the program to new leadership in the middle of the year. When beginning the program again, the CaSTL program

	should consider training programs to engage and involve the staff in the program from the onset.
Have a designated "science space".	The CaSTL BGC program had many materials. At each lesson day, the team transported the materials and decorated the room to prepare for students. Having the room set up as a "science room" allowed for an environment of learning- previous work on the walls, records of class discussion on the board, etc. In the future, it would be recommended that these posters/materials could be safely stored and/or hung at the club to allow student to interact with the materials between lessons.
Design an afterschool program that includes a year-long and summer component.	Having a cohort of student-scientists made for a fun and engaging learning experience for participants. When debriefing the evaluations, the CaSTL leadership team agreed that having both academic year and summer sessions helped achieve that goal.

Appendix A
The Peer Classroom Observation Protocol (PCOP)

PEER CLASSROOM OBSERVATION PROTOCOL (PCOP)

Date:____________ Starting Time:__________ Ending Time:___________ Grade Level:___ Class Level: __
School Name:______________________________ District:________________ Course Subject:______________
Observed Teacher's Name:___________________ # of Students:___________ Conducted by:______________

DIRECTIONS

All information recorded on this form should remain confidential.

Use this space to take notes and/or to record teacher talk or student talk.

Time Segment	*Field Notes*

Observation Category	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	55 min.	60 min.
Write Actual Time Here→												
Type of Classroom Involvement by Students												
Class Listening to Teacher												
Group Listening to Teacher												
Individual Listening to Teacher												
Student(s) Presenting to Class												
Student(s) Asking Questions												
Student(s) Answering Questions												
Student(s) Using Kinesthetic Movement												
Class Discussion w/ Teacher												
Group Discussion w/ Teacher												
Individual Discussion w/Teacher												
Students Discussion w/ Students												
Students Working Independently												
Students Working In Groups												
Students Reading Aloud												
Students Reading Silently												
Students Writing												
Students Taking an Exam												
Intended Cognitive Level of Task												
Memorization/ Comprehension												
Skills/Procedures												
Concepts												
Relational Knowledge												
Not applicable												
Level of Student Engagement (% of Students Engaged)												
Low (0%-33%)												
Moderate (34%-66%)												
High (67%-100%)												
Tools Used in Classroom												
Audio/visual media												
Manipulatives												
Pictures												
Realia (real objects)												
Textbooks												
Worksheets												
Other: ______________________												
Not applicable												
Strategies Used by Teachers												
Administrative tasks/prep work												
Classroom management												
Context/orienting students												
Explaining												
Formative assessment												
Graphic organizers/ visuals												

Kinesthetic movement												
Lecture												
Listening/checking work												
Modeling/demonstrating/think aloud												
Positive reinforcement												
Questions: Higher order												
Questions: Lower order												
Random selection												
Reading aloud												
Rephrasing												
Review												
Other: ____________________												

Appendix B

Science Teaching and Environment Rating Scale

Chalufour, I. Worth, K. & Clark-Chiarelli, N. (2003). *Science teaching and environment rating scale.* Unpublished manuscript.

STERS – Observation and Interview Record

Science Teaching and Environment Rating Scale Observation and Interview Record

STERS

STERS Toolkit, Research Edition

Teacher and Classroom Profile

Program or district: ______________________ Center or school: ____________________

Teacher: ______________________________ Observer: ______________________

Date of observation: ____

Time and duration of observation: _____________________________________

Duration of entire classroom day: ____________________________________

Number of teachers (e.g. teachers, co-teachers, aides): ________________________

Number of other adults: ____

Number of girls: ________________________ Number of boys: __________________

Ages/grade of children: ____

Number of students with identified special needs: __________ Number of English language learners: ______________

Primary language used by teacher: _________________________ Observer: ________________________

Primary language spoken in classroom: ____

Languages spoken by other students: ____

General comments:

Observations Completed

- ☐ Pre-Interview
- ☐ Classroom Observation
- ☐ Teacher Interview

Scheduling Phone Call

Content to cover in phone call: | **Notes:**

1. **Introduce yourself and explain:**
   - **The purpose of your visit is** to observe science teaching and/or to observe children and teachers engaging in science experiences in or out of the classroom.
   - **What you would like to observe is** a sample of science teaching that they consider typical of their approach.
   - **Why you are observing:** this is one way that we are collecting information for the research project.
2. **Tell the teacher that during this phone call you would like to:**
   - Get some general background information about the children.
   - Arrange a time for the visit that works for both of you.
   - Talk about what science experience you will see when you come.
   - Also arrange a time to talk with the teacher for about one half hour after your visit
3. **Ask the teacher: Is science a part of your curriculum right now?**
   - **If yes, science IS a part of the curriculum:**
     - Is there a current science topic in process?

     If yes, there IS a current science topic:

     — What is the topic?

     — Has the topic just been introduced, is it on-going, or is it coming to an end?

     — What are the teacher's goals for children's learning on the topic?

     — What can you expect to see when you observe?

     If there is NOT a current science topic:

     — What types of science activities are children currently engaged in?

     — What are the teacher's goals for children's science learning?

     — What can you expect to see when you observe?

Content to cover in phone call:	**Notes:**
○ Do they plan their own science curriculum or do they use a pre-packaged curriculum that includes science activities? **If they do use a pre-packaged curriculum:** — What curriculum is used? — How much flexibility does the teacher have to extend activities, add activities, or change activities in the curriculum? • **If no, science is NOT part of the curriculum:** ○ Will the teacher be willing to present a science activity for the purposes of your visit? 4. **Schedule a visit:** Suggest a day and time for the visit: • Is that a good time to observe science teaching (or children's science exploration)? • Is there a time of day that the teacher would especially like you to see? 5. **Schedule the post-visit interview:** • Tell the teacher that this will take about one half hour. • It will be a chance to talk about any science happening that you did not have a chance to see, or any other activities she is doing on this topic that she would like to share 6. **Ask teacher to bring to this interview:** • Any documentation (drawings, photographs, or notes and teacher observations) that shows children's interests and/or learning in science • Any curriculum on the current topic s/he would like to share. • If s/he uses pre-packaged curriculum, ask her/him to bring a sample of this as well.	

Science Teaching and Environment Rating Scale Rubrics

Components of Science Teaching:

1. Create a Physical Environment for Inquiry and Learning
2. Facilitate Direct Experiences to Promote Conceptual Learning
3. Promote Use of Scientific Inquiry
4. Create a Collaborative Climate that Promotes Exploration and Understanding
5. Opportunities for Extended Conversations
6. Build Children's Vocabulary
7. Plan In-depth Investigations
8. Assess Children's Learning

1. Create a Physical Environment for Inquiry and Learning

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence of an intentional approach to the organization of space, selection of materials and displays related to the current science study.	There is **sufficient** evidence of an intentional approach to the organization of space, selection of materials and displays related to the current science study.	There is **limited** evidence of an intentional approach to the organization of space, selection of materials and displays related to the current science study.	There is **minimal** evidence of an intentional approach to the organization of space, selection of materials and displays related to the current science study.
▪ Materials and tools are organized into conceptual groupings related to the current science study that are appealing and suggest particular purposes to children. For example, the science area may contain bins of water, funnels, and clear tubing for recording and observation.	▪ Materials and tools are organized into conceptual groupings related to the current science study that suggest particular purposes to children, although they may be less well organized and/or less appealing.	▪ Materials and tools are not organized into conceptual groupings related to the current science study. For example, a science area might contain disparate items such as magnets, shells, and flashlights.	▪ Materials and tools are not available. There is inadequate space for children to engage in science experiences.
▪ Materials are in excellent condition, easily accessible, and in ample supply.	▪ Materials are in excellent condition, easily accessible and in ample supply.	▪ The condition of materials is variable. Moreover, the quantity of essential materials may be limited (e.g., few blocks to build structures)—limiting accessibility.	▪ Materials are in poor condition, insufficient supply and/or storage makes materials inaccessible to children.
▪ Materials allow for exploration, and include tools that aid observation (i.e. magnifiers) and support data collection (i.e. rulers, scales, etc.)	▪ Materials allow for exploration, but tools that aid observation or measure data may not be available.	▪ Materials offer some possibility for exploration, but restrict the full potential (e.g., flashlights are provided for an investigation of shadows, but no other materials such as screens are available).	▪ Materials do not allow for exploration. For example, plastic plants or worms are available to study living things or Legos to learn about structural stability.
▪ Use of space allows for maximum engagement of the participating children and supports purposeful engagement in science inquiry.	▪ Use of space allows for maximum engagement of the participating children and supports purposeful engagement in science inquiry.	▪ Arrangement of space inhibits full engagement of children or restricts number or children who can be engaged (e.g., long side of the water table is up against a wall).	▪ There is inadequate space for children to engage in science experiences.
▪ There are many and varied books related to current science topic easily available to children as they engage in science explorations.	▪ There are a few books related to the current science topic. These books may be in the library area.	▪ There is a lack of quality and quantity of books related to current science topic.	▪ There are no books related to current science topic.
▪ Displays related to important science concepts being taught are at children's eye level and include a variety of documents (photos, representations, dictation, teacher text) that serve to make the children's learning visible to them.	▪ Displays that relate to current science topic are at children's eye level and include documents that make the children's learning visible to them, such as photos.	▪ Displays related to the current science topic are informative, but do not reflect children's inquiry or learning.	▪ Displays are decorative, but are not informative about the science topic of the study.

1. Create a Physical Environment for Inquiry and Learning

Sources of Evidence:

- Organization of the classroom
- Placement and characteristics of materials and tools
- Content of displays

NOTE:
Consider outdoor environment if it is being used for science learning during observation.

EVIDENCE: ______________________________

SCORE: ______

2. Facilitate Direct Experiences to Promote Conceptual Learning

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence that teachers facilitate direct experiences with important science phenomena in ways that promote conceptual learning.	There is **sufficient** evidence that teachers facilitate direct experiences with important science phenomena in ways that promote conceptual learning.	There is **limited** evidence that teachers facilitate direct experiences with important science phenomena in ways that promote conceptual learning.	There is **minimal** evidence that teachers facilitate direct experiences with important science phenomena in ways that promote conceptual learning.
▪ Teachers structure science experiences that provide a high level of engagement allowing children to directly experience scientific phenomena.	▪ Teachers structure science experiences that provide children with a high level of engagement, but not directly linked to any specific scientific phenomena.	▪ Teachers structure science experiences for children but limit engagement by completing tasks for children.	▪ Teachers structure science experiences for children that do not provide an opportunity to directly experience scientific phenomena. For example, teachers may conduct a demonstration or read a science book.
▪ Teachers intentionally observe and document children's science exploration.	▪ Teachers intentionally observe, but do not document children's science exploration.	▪ Teachers observe children's science exploration in an unintentional manner.	▪ Teachers do not observe children's science exploration.
▪ Teachers' facilitation promotes development of science concepts and is responsive to children's related behaviors and comments. Including: - Calling attention to children's experiences - Encouraging careful observation - Helping children learn to use materials and tools - Adding or taking away materials - Drawing out and acknowledging children's observations and questions ▪ Teachers help make connections between children's experiences and science concepts by posing questions and problems to solve, or challenging a misconception.	▪ Teachers' facilitation focuses on children's experience of particular science phenomena. Including: - Calling attention to children's experiences - Encouraging observation - Helping children learn to use materials - Adding or taking away materials	▪ While some facilitation may focus on children's science experiences, most focus on dramatic play or concepts such as color, number shape, or social skills.	▪ Facilitation consists of casual chat, intention to manage behavior, or there is no interaction at all.

2. Facilitate Direct Experiences to Promote Conceptual Learning

Sources of Evidence:	EVIDENCE:
• Structure of experiences • Teacher-child interactions • On-going adjustment of environment and instruction	

SCORE:

3. Promote Use of Scientific Inquiry

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence that children are encouraged to use scientific inquiry to refine their science understandings.	There is **sufficient** evidence that children are encouraged to use scientific inquiry to refine their science understandings.	There is **limited** evidence that children are encouraged to use scientific inquiry to refine their science understandings.	There is **minimal** evidence that children are encouraged to use scientific inquiry to refine their science understandings.
▪ Teachers intentionally enact a cycle of scientific inquiry that provides children with opportunities to formulate and investigate questions, collect and analyze data, and reflect.	▪ Teachers support specific scientific inquiry skills such as exploration, observation, and sharing but these skills are not linked into a full cycle of inquiry.	▪ Teachers provide children with science experiences that afford them isolated opportunities for inquiry.	▪ There is no evidence of intentional support for inquiry skills.
▪ Teachers involve children in planning investigations of their questions and engage them in predicting outcomes when appropriate.	▪ Teachers plan investigations and invites children to predict outcomes when appropriate.	▪ Teachers plan science activities. They may invite predictions without embedding them within the context of an on-going science study and children's background knowledge.	▪ Teachers use demonstration instead of promoting inquiry.
▪ Teachers encourage close observation of science phenomena using tools.	▪ Teachers encourage observation of science phenomena, but miss opportunities to call children's attention to relevant details.	▪ Teachers do not encourage close observation of phenomena but observation may happen incidentally.	▪ Teachers do not encourage close observation of phenomena.
▪ Data are collected through discussing and documenting observations. Teachers encourage children to represent observations and ideas using drawing, modeling, symbols and print. In addition, teachers make charts to help children see patterns and relationships.	▪ Data are collected primarily through conversations that encourage children to describe their experiences and observations. Teachers may do some documentation but miss opportunities to involve children.	▪ Charting or conversations about experiences are not designed to promote inquiry, but are limited to talking about or documenting an experience.	▪ Data are not collected by teachers or children in relation to science activities.
▪ Teachers use documentation to encourage children's analysis of data looking for patterns in order to refine children's science understandings.	▪ Teachers encourage discussion/reporting on science experiences but do not encourage children to look for patterns in order to refine their science understandings.	▪ Teachers talk about science experiences with the children as a way of providing information or giving instructions.	▪ Teachers do not converse with children about science experiences.

3. Promote Use of Scientific Inquiry

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence that children are encouraged to use scientific inquiry to refine their science understandings.	There is **sufficient** evidence that children are encouraged to use scientific inquiry to refine their science understandings.	There is **limited** evidence that children are encouraged to use scientific inquiry to refine their science understandings.	There is **minimal** evidence that children are encouraged to use scientific inquiry to refine their science understandings.
▪ Teachers intentionally enact a cycle of scientific inquiry that provides children with opportunities to formulate and investigate questions, collect and analyze data, and reflect.	▪ Teachers support specific scientific inquiry skills such as exploration, observation, and sharing but these skills are not linked into a full cycle of inquiry.	▪ Teachers provide children with science experiences that afford them isolated opportunities for inquiry.	▪ There is no evidence of intentional support for inquiry skills.
▪ Teachers involve children in planning investigations of their questions and engage them in predicting outcomes when appropriate.	▪ Teachers plan investigations and invites children to predict outcomes when appropriate.	▪ Teachers plan science activities. They may invite predictions without embedding them within the context of an on-going science study and children's background knowledge.	▪ Teachers use demonstration instead of promoting inquiry.
▪ Teachers encourage close observation of science phenomena using tools.	▪ Teachers encourage observation of science phenomena, but miss opportunities to call children's attention to relevant details.	▪ Teachers do not encourage close observation of phenomena but observation may happen incidentally.	▪ Teachers do not encourage close observation of phenomena.
▪ Data are collected through discussing and documenting observations. Teachers encourage children to represent observations and ideas using drawing, modeling, symbols and print. In addition, teachers make charts to help children see patterns and relationships.	▪ Data are collected primarily through conversations that encourage children to describe their experiences and observations. Teachers may do some documentation but miss opportunities to involve children.	▪ Charting or conversations about experiences are not designed to promote inquiry, but are limited to talking about or documenting an experience.	▪ Data are not collected by teachers or children in relation to science activities.
▪ Teachers use documentation to encourage children's analysis of data looking for patterns in order to refine children's science understandings.	▪ Teachers encourage discussion/reporting on science experiences but do not encourage children to look for patterns in order to refine their science understandings.	▪ Teachers talk about science experiences with the children as a way of providing information or giving instructions.	▪ Teachers do not converse with children about science experiences.

4. Create a Collaborative Climate that Promotes Exploration and Understanding

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence of a positive climate that actively engages children in science explorations and conversations that facilitate the mutual exchange of experiences, observations, and ideas.	There is **sufficient** evidence of a positive climate that actively engages children in science explorations and conversations that facilitate the mutual exchange of experiences, observations, and ideas.	There is **limited** evidence of a positive climate that actively engages children in science explorations and conversations that facilitate the mutual exchange of experiences, observations, and ideas.	There is **minimal** evidence of a positive climate that actively engages children in science explorations and conversations that facilitate the mutual exchange of experiences, observations, and ideas.
▪ Teachers deliberately foster a climate in which science exploration and expression of individual ideas is valued. Children are encouraged to work together during explorations.	▪ Teachers observe and listen to children, acknowledge their experiences and ideas, and elicit their thoughts. The nature of the science experiences leads children to work together.	▪ Opportunities for the exchange of ideas between teachers and children and among children are missed.	▪ There are few or no opportunities for children to explore and express their own ideas.
▪ Teachers observe and listen attentively to children and encourage them to notice, listen, and respond to one another.	▪ Teachers' deliberate efforts to connect their exploration and ideas with those of others are less evident.	▪ Teachers may, at times, be unresponsive to children or focus on promoting their own ideas at the expense of the children's.	▪ Teachers may discourage children's personal explorations or contributions to conversations.
▪ Teachers explicitly and appropriately encourage the participation of all children, including those from differing linguistic, gender, racial, and cultural groups.	▪ Teachers appropriately encourage the participation of all children, including those from differing linguistic, gender, racial, and cultural groups. However, efforts to explicitly involve particular children may be less evident.	▪ Opportunities to draw out contributions from children of differing gender, racial and cultural groups are missed. Teachers may appear unaware of varying levels of involvement of particular children in conversations.	▪ Teachers' patterns of interaction reflect preferential treatment of children from certain gender, racial or cultural groups.
▪ Teachers build on similarities and differences in children's observations and ideas to foster further exploration and discussion.	▪ Teachers' efforts to further exploration and discussion by drawing attention to similarities and differences in children's observations and ideas are few and most opportunities are missed.	▪ Teachers do not make efforts to further exploration and discussion by drawing attention to similarities and differences in children's observations and ideas.	▪ Teachers make no effort to further exploration and discussion. Children are expected to watch and/or listen to the teachers, and most interactions focus on procedural or managerial topics. The teachers' manner may be harsh or punitive.

4. Create a Collaborative Climate that Promotes Exploration and Understanding

Sources of Evidence:	EVIDENCE:
• Efforts to engage children • Collaboration	

SCORE:

5. Engage in Extended Conversations

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence that teachers understand the role that extended conversations play in children's science learning.	There is **sufficient** evidence that teachers understand the role that extended conversations play in children's science learning.	There is **limited** evidence that teachers understand the role that extended conversations play in children's science learning.	There is **minimal** evidence that teachers understand the role that extended conversations play in children's science learning.
▪ Teachers select topics and use strategies that engage children in conversations about their ideas, science activities, and questions about the current science study. These support broader intellectual engagement (e.g., connections to past experiences in order to make predictions or see patterns; reflecting on science learning).	▪ Teachers select topics and use strategies that engage children in conversations about science activities. The focus of conversations is typically context specific (e.g., description of what each child might do next to build a tower) and does not require broader intellectual engagement (e.g., discussion of how various blocks might affect the stability of the tower).	▪ Conversations consist of a series of teacher questions and student responses. The subject of teachers' comments is often informational and rarely extends science learning. (e.g., "You did a good job filling that baster!")	▪ The subject of most discussions is procedural, directing children to the next activity or task.
▪ Teachers create varied opportunities for interaction that engage a range of children in a balance of individual, small-group, and large-group conversations. They take advantage of opportunities for informal and formal exchanges.	▪ Teachers make consistent efforts to engage a range of children in conversations, though the balance may favor certain settings (e.g., predominantly large groups) or conversational types (e.g., listing items used). Teachers regularly engage in informal conversations with children.	▪ Teachers' attempts to talk about science with children are generally formulaic and are not conducive to an exchange.	▪ Teachers' efforts to engage children in extended conversations are minimal across formal and/or informal settings in the classroom.
▪ Conversations and exchanges maximize talk that informs science learning. For example, teachers orchestrate a discussion about how the class will build a vivarium for snails, including brainstorming and listing the supplies they will need.	▪ While most conversations lead toward learning, they are not as extended (i.e., they do not contain as many turns or are less complex).	▪ Management talk is commonplace, although teachers may make an occasional attempt to focus discussion on a topic related to the science study, such as a question posed during circle time.	▪ Management talk predominates, with occasional efforts to quiet children and limit children's attempts to engage in productive conversation.

5. Engage in Extended Conversations

Sources of Evidence:

- Selection of topics
- Varied opportunities
- Promotion of science learning

EVIDENCE: ____________________

SCORE: ______

6. Build Children's Vocabulary

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence of instructional efforts to expand children's science vocabulary.	There is **sufficient** evidence of instructional efforts to expand children's science vocabulary.	There is **limited** evidence of instructional efforts to expand children's science vocabulary.	There is **minimal** evidence of instructional efforts to expand children's science vocabulary.
▪ New and challenging words are introduced, discussed, and infused in classroom activities. For example, words that may be introduced in the context of children's science exploration are heard and seen in conversations, dictations, and observational drawings.	▪ New and challenging words are introduced and discussed. New words are somewhat less integrated in ongoing classroom activities. However, opportunities are not taken to use words in multiple contexts.	▪ Efforts to introduce and use new vocabulary are limited either by the quality of words selected or by the infrequency of vocabulary building activities. Thus vocabulary building does not appear to be an instructional focus.	▪ Observed instructional efforts to introduce and use new vocabulary are either not evident or ineffective.
▪ There are age-appropriate efforts made to elucidate the meanings of new words with children, with careful consideration given to English language learners. This may be done by promoting children's use of new words in ways that help them arrive at their own definitions and understanding of word meanings. For example, teachers might focus children's attention on words describing water flow, *drops, stream, or trickle* and relate them to their own experience.	▪ There are age-appropriate efforts made to elucidate the meanings of new words with children, although the strategies used may be somewhat less varied or engaging. In addition, there may be less consideration to adjustments made for English language learners in the class.	▪ Definitions, when offered, may be inappropriate, that is either too easy or too complicated for children to understand. Attention to language acquisition needs of English language learners in the class is limited.	▪ Teachers may neglect to provide definitions for new words or may not even acknowledge when a word is not understood by children in the class, including English language learners.
▪ Teachers show their excitement for words through their playful interactions with children. They model challenging language and acknowledge children's own experimentation.	▪ Teachers show their interest in words as they interact with children and acknowledge their experimentation, but there may be somewhat less evidence of their modeling.	▪ Teachers rarely use new and challenging vocabulary in their interactions with children.	▪ Teachers' vocabulary with children is restricted and simplistic.

6. Build Children's Vocabulary

Sources of Evidence:

- Science vocabulary in multiple contexts
- Strategies to build understanding
- Modeling

EVIDENCE: ______

SCORE: ______

7. Plan In-depth Investigations

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence that teachers have planned an in-depth study of an appropriate science topic.	There is **sufficient** evidence that teachers have planned an in-depth study of an appropriate science topic.	There is **limited** evidence that teachers have planned in-depth study of an appropriate science topic.	There is **minimal** evidence that teachers have planned in-depth investigation of appropriate science topic.
▪ The science study focuses on a topic central to a domain of science (e.g., liquids and solids have specific characteristics that distinguish them from one another) and teachers have goals for conceptual learning and inquiry skills development.	▪ The science study focuses on an appropriate topic, but goals may be more focused on process. Goals for conceptual learning may be general or vague.	▪ The science study focuses on an appropriate topic, but goals are more general learning goals rather than focused on science concepts or the scientific process. (e.g., cooperation; fine motor skills)	▪ The science study focuses on an inappropriate or inconsequential topic.
▪ Topic is extended over time and intentionally sequenced in order to deepen understanding.	▪ Topic is extended over time, but there is limited evidence of the intentionality of the sequencing.	▪ Duration of study limits opportunity for in-depth investigation.	▪ Duration of study is not sufficient; the study consists of a few loosely connected or unconnected experiences.
▪ Teachers provide sufficient uninterrupted time (at least 45 minutes) for exploration of phenomena several times a week.	▪ Teachers provide sufficient uninterrupted time (at least 45 minutes) for exploration several times a week.	▪ Time for science within the day is brief or science instruction during the week is minimal.	▪ Science instruction consists solely of children's accessing materials in the science center during choice time.
▪ Teachers have strong knowledge of science content being taught and may report strategies for increasing own knowledge.	▪ Teachers have some knowledge of the science being taught.	▪ Teachers believe they can learn the science with the children or don't assess their own knowledge of the science.	▪ Teachers lack science knowledge on topic and may have misconceptions.

7. Plan In-Depth Investigations

Sources of Evidence:
- Goals for learning
- Extended time for learning
- Teacher knowledge

NOTE:
Evidence comes from observation and interview.

EVIDENCE: ______________________

SCORE: ____

8. Assess Children's Learning

Exemplary (4)	Adequate (3)	Inadequate (2)	Deficient (1)
There is **compelling** evidence that appropriate, ongoing techniques are used to document and assess science learning.	There is **sufficient** evidence that appropriate, ongoing techniques are used to document and assess science learning.	There is **limited** evidence that appropriate, ongoing assessment techniques are used to document and assess science learning.	There is **minimal** evidence that appropriate, ongoing techniques are used to document and assess science learning.
▪ Assessment is driven by clearly identified goals for science learning that include building children's conceptual understandings and skills of science inquiry. Goals are appropriate for children's stage of development.	▪ Teachers have identified learning goals focused on science processes but they do not strongly address conceptual learning.	▪ Learning goals are general, not specific to science content or process.	▪ There are no goals for science learning or the goals are inappropriate
▪ Teachers value multiple sources of information about individual children's learning, interests, and questions including observation of their behavior, ideas shared verbally, and representational work done by the children.	▪ Teachers value observation as the primary source of assessment information. Some capacity to notice individual children's learning, interests, and questions is displayed, although it may be primarily through informal observations.	▪ There is little evidence that teachers notice science related learning. Expressed observations seem incidental rather than intentional aspects of assessment.	▪ Teachers do not relate or interpret children's behavior or comments in relation to science learning.
▪ Teachers provide concrete evidence of collecting and documenting a variety of kinds of information about all children's growth in relation to science learning goals. These might include observational notes, tapes, photos, and children's work samples.	▪ Evidence of documented assessment may be limited, such as a few notes and/or photographs but teachers are able to talk more extensively about what they have noticed.	• Science specific assessment information resides in the teachers' head and is not documented. This information is limited in quantity and quality. Documentation focuses on use of prepackaged tool (probably a checklist format). There may be items related to science learning, but are not specific to the current curriculum.	▪ There is no documented assessment of science learning, nor are the teachers able to talk about observations of science learning.
▪ Information gained from on-going assessment of children's current interests, ideas and questions is taken into account when making decisions about science teaching. Attention is given to individual children.	▪ Teachers use on-going assessment of children's interest and learning when planning, but there is little or no attention to considering differences in children.	▪ There are no obvious connections between assessment information and planning.	▪ There is an absence of assessment of science learning connected to the science study, therefore, there are no connections to planning.

8. Assess Children's Learning

Sources of Evidence:

- Goals for assessment
- On-going collection and documentation
- Teacher reflection

NOTE:
Evidence comes from observation and interview.

EVIDENCE: ______________________________

SCORE:

Post Observation-Interview Notes

Start the interview by reviewing what the teacher said in the pre-observation interview about the science she would be teaching and the learning she was hoping for. Proceed to the questions asking for specifics when answers are vague. This interview relates to rubrics 7. Plan In-depth Science Investigations and 8. Assess Science Learning. Questions 5 and 6 will also support scoring of rubric 3: Promote Use of Scientific Inquiry, as the teacher may provide context to inquiry you may have observed.

Interview Questions for Rubric 7 & 8:	Notes:
1. Was today's science activity <u>typical</u> for your class regarding the: ▪ Amount of time usually spent on science per day? ▪ Kinds of learning experiences children have? ▪ Amount of time children are engaged in direct, hands-on experiences? ▪ Amount of time teachers spend talking with children about science experiences and ideas? If today's science activity was not typical, find out why and what is typical. How much time is typically spent on science per week?	
2. Why did you choose this topic? What are your goals for the children's learning?	
3. What experiences related to this topic preceded those I observed today? ▪ Draw out descriptions of each (or a good sampling) that include the materials used and what the children actually did.	

4. What have you learned about children's understanding of this topic up to this point? (Ask to see samples of assessment records as you talk.)
   - How have you learned this?
   - Do you document this learning in any way? (Review sample documents if possible.)
   - How do you keep and use your information about children's science learning?
   - Do you use this information in planning? (If yes, ask for examples.)

Questions 5 and 6 may be helpful in scoring rubric 3: Promote Use of Inquiry.

5. What additional experiences do you plan to provide related to this topic?
   - What do you want the children to get out of these experiences?
   - How will you design them to support this kind of learning?
   - Do you plan to use any books? What book(s)? How will you use it/them? What do you want the children to gain?
6. Can you explain why you sequence the experiences this way?

7. What did you know about this topic before you presented it to the children? Did you feel you needed to do any research? If so, what did you do? (Get as many specifics as you can.)

If you want additional information for rubric 7:

8. When we talked on the phone you said you wanted the children to be learning (repeat goals for children's learning). What are the most important strategies you use to support this learning? Probe for examples of these strategies and how they connect to their goals for science learning.

Science Teaching and Environment Rating Scale Score Form

Teacher: ______________________ **Observer:** ______________________

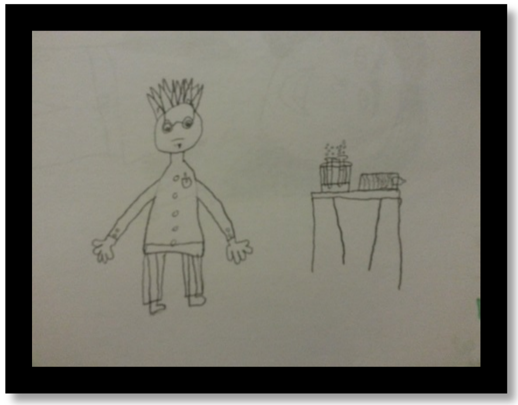
Date(s): ______________________

Assign a score between 1 and 4, using the rubric for each component. Consider the data gathered during the observation and the answers to the related interview questions. Total and average the eight scores.

Elements of Science Teaching	Score	Comments/Dates
1. Create a physical environment for inquiry and learning		
2. Facilitate direct experiences to promote conceptual learning		
3. Promote use of scientific inquiry		
4. Create a Collaborative Climate that Promotes Exploration and Understanding		
5. Opportunity for Extended Conversations		
6. Build Children's Vocabulary		
7. Plan In-depth Investigations		
8. Assess Children's Learning		
TOTAL/AVERAGE		

Appendix C

Examples of Student of a Scientist Drawing in December and June

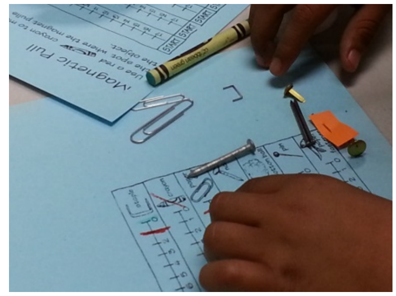


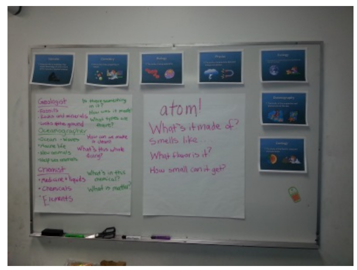
December Example

June Example

Appendix D
Sample Pictures of the CaSTL Science Program







Appendix E
Pictures of CaSTL Summer Science Program