

Evaluation of the After School STEM Program

At

Brooks Elementary School, School District 204

Spring 2016

Prepared By

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In the spring semester of 2016, Aurora University's Institute for Collaboration developed a three unit After School Science Technology Engineering and Mathematics (STEM) Program. Each unit developed four new lessons within the topics of Structure and Function for third grade, Matter and Energy for fourth grade, and Forces and Motion for fifth grade. These units of instruction were implemented at Brooks Elementary School which is part of School District 204, delivered one day a week over the course of four weeks.

## **CURRICULUM DEVELOPMENT**

Each unit was prepared using Aurora University faculty, area teachers, and community partners consisting of area industries and nonprofit organizations with an expertise in STEM education. These units are a part of the curriculum for the John C. Dunham STEM Partnership School at Aurora University, which serves students in grades 3-8. These collaboratively developed units are aligned to the Next Generation Science Standards, the Common Core Standards in Mathematics, and best practices in inquiry-based learning.

## **PARTICIPANTS**

The lessons were presented by a team consisting of an Aurora University adjunct faculty member who is also certified to teach in public schools, a professional educator from District 204, and Aurora University undergraduate students. Seventy-eight students from Brooks were impacted by the instruction; the groups consisted of twenty-six students in each of grades three, four and five. These students were enrolled in the course by their parents and a fee was charged. Attendance was consistent throughout the duration of the program. There was enthusiasm and support for the experiences from both the students and their families.

## **EVALUATION PLAN**

Evaluation consisted of both quantitative and qualitative data. In each unit, students were asked before and after the unit if they liked mathematics and science, if they wanted to take another after school class in mathematics and science, and what type of career they were interested in. To measure gains in content knowledge, students were asked several questions on the most important themes from each unit. Students were presented this material as "questionnaires" and told there was no grade given for the evaluation. This was done to reduce test anxiety and to maintain the enjoyable and "safe" learning environment. Results of these content questions were evaluated using a paired T test.

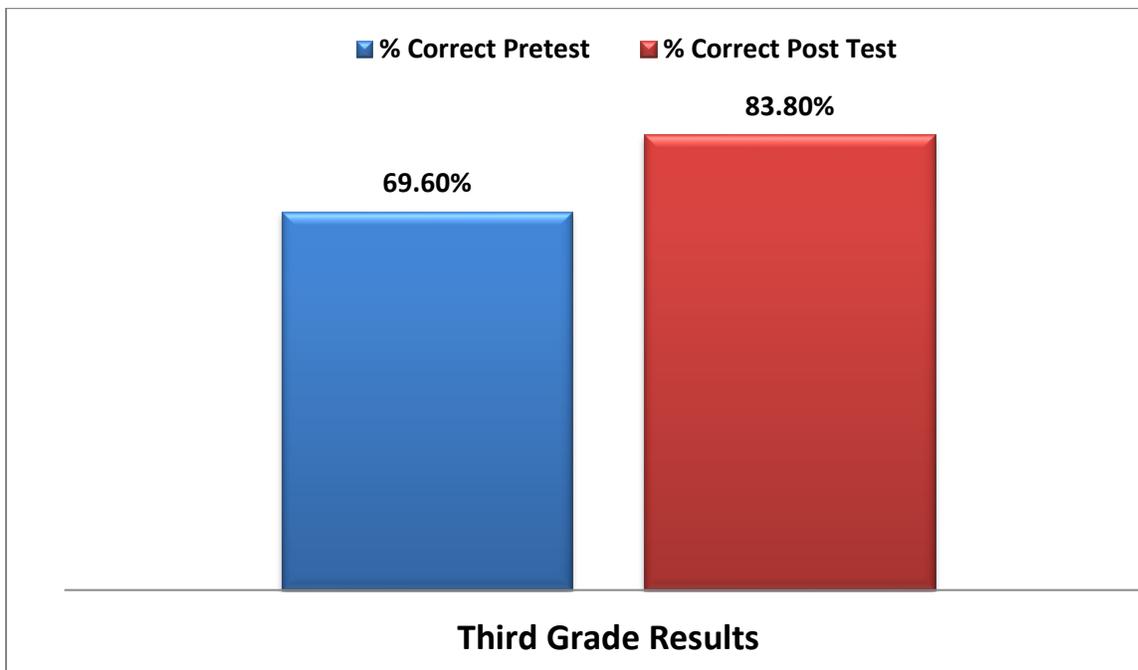
## **THIRD GRADE PROGRAM AND RESULTS**

Third graders were given enriched curriculum based on **Structure and Function of Organisms** called "It's Your Genes, Not Your Jeans!" The students were asked to describe the difference between acquired and inherited traits in humans and discussed how traits are passed from generation to generation. They asked family members questions about different genetic traits- like the ability to roll one's tongue or having "hitchhiker thumb". They then brought their family data to class and developed charts and

graphs to illustrate it. Children then extracted DNA from strawberries and their own cheek cells. They also made “Elephant toothpaste” which was a huge hit.

Pre and post data was collected from twenty-six students. Percent correct answers from the pretest was 69.8% and percent correct answers from the post test was 83.8%. Statistically significant gains in content knowledge were recorded with a p value < 0.123 (See graph 1). Most students came to the program with a strong interest in mathematics and sciences (Nineteen of twenty-six). The number of those wanting to take another After School STEM class increased from 17 to 21 of the twenty-six students. When comparing the students’ responses to the question “What would you like to be when you grow up?” the students’ answers were widely divergent, but about one half were interested in a STEM oriented career.

Graph 1

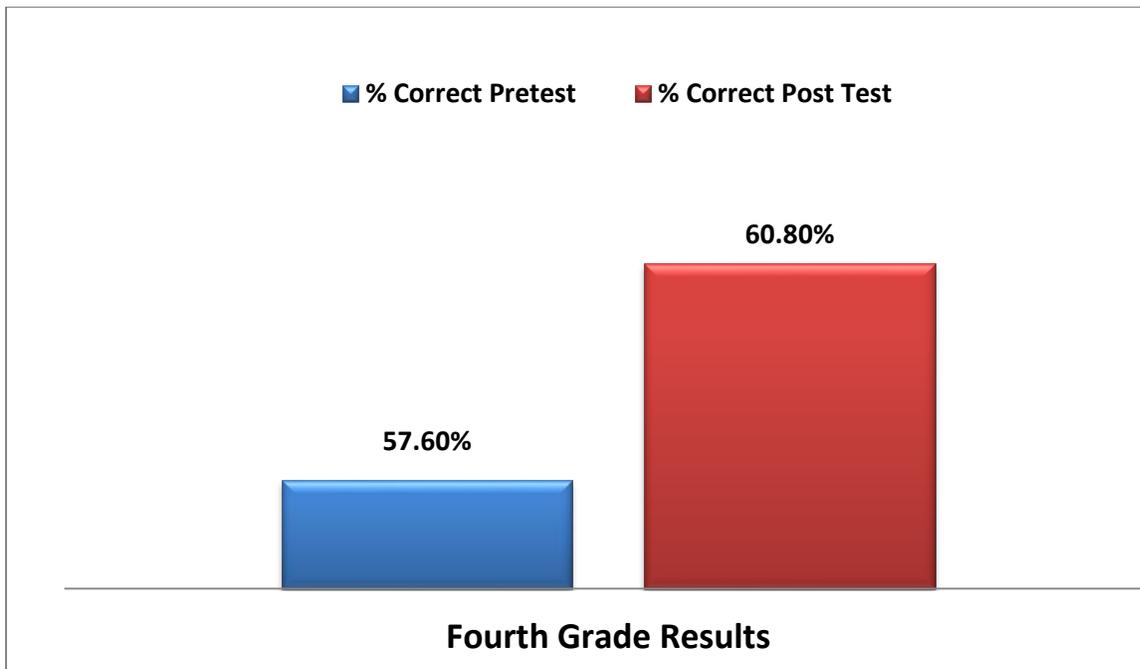


#### FOURTH GRADE PROGRAM AND RESULTS

Fourth grade curriculum was focused on **Matter and Energy**. In this unit, “Matter in Motion” students explored the properties of matter and how different properties can be described. They grew crystals, evaluated many common household crystals and ran basic tests to identify unknown crystals based on what they had learned. They made their own structures using straws and marshmallows, and then tested them on an “Earthquake Shake” table to see what designs resisted the shaking the best. An Aurora Fire Department Captain taught them how heat transmission interacts with the properties of different materials.

The number of correct answers on the pretest was 57.6% and on the post test was 60.8% which was not statistically significant. (See graph 2) Students in fourth grade came with a strong interest in the STEM fields and enjoyed mathematics and science classes. Sixteen expressed a desire to have a STEM related career when they grow up.

**Graph 2**

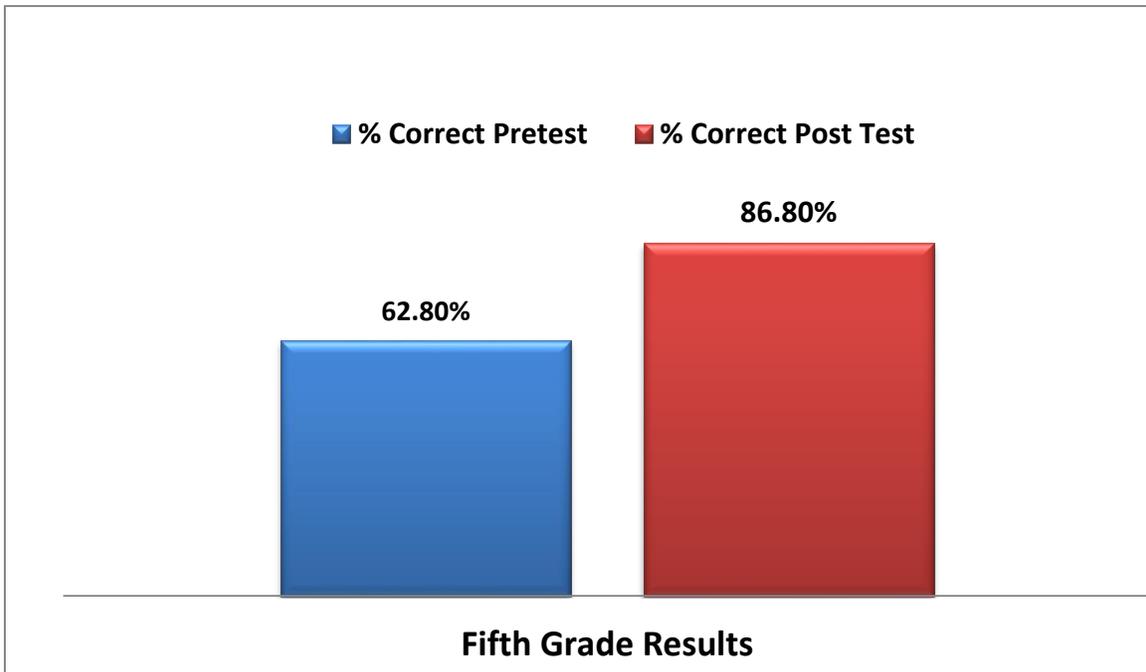


#### **FIFTH GRADE PROGRAM AND RESULTS**

The fifth graders' curriculum focused on **Forces and Motion**, "Polymers: Stretchy, Bouncy, Edible" and emphasized the properties of polymers. Students learned the basic concepts and vocabulary dealing with forces and motion and the different types of polymers and their uses. The lessons included a visit by a firefighter who explained the use of polymers in firefighting. Students made their own bouncy balls and silly putty. They sampled Edible Slime and did a "Diaper Dissection" to test what part of a diaper gives it its absorbency, which turned out to be the polymers!

Correct pretest values were 62.8% and correct posttest values were 86.8%. Statistically significant content knowledge increases were noted with a P value of 0.017 (See graph 3). As evidenced by the questionnaire, the strong interest in STEM field careers in twenty-one of the twenty-six children and enjoyment of math and science classes by students was unchanged throughout the experience.

**Graph 3**



**AURORA UNIVERSITY FACULTY, DISTRICT TEACHER, AND STUDENT LEADER EXPERIENCE**

Undergraduate Aurora University Student Leaders felt adequately prepared for their position, and they enjoyed working with Aurora University faculty and school district teachers. They felt the communication between the faculty, teacher, and themselves was well managed. They also felt they were more aware of the commitment and preparation necessary to be a successful educator upon finishing the program. Both their knowledge of and interest in STEM content increased, and they felt their ability to deliver the STEM content in a relevant way to the students also increased. The college student and elementary student interaction was very positive. This year, more than the preceding year, Student Leaders took on a larger role in delivering curriculum and in classroom management. They respectfully asked to take on these larger roles, and performed them very well.

The Aurora University faculty and the Student Leaders were grateful to have a school district teacher on the team who could provide developmentally appropriate learning experiences and classroom management techniques. The content knowledge provided by the Aurora University faculty and the curriculum materials were very helpful. The connection between the student leaders and the faculty from Aurora University was also beneficial. Faculty also had the opportunity to get to know undergraduates outside of the classroom, and mentor them in workplace and instructional skills. This year was very successful in the collaboration and collegiality developed by the team, and it may have laid a foundation for future STEM educators among the Student Leaders.

Not surprisingly, the hands on experiences and the guest speaker from the fire department had the most impact. Each student had project development and collaborative experience; and each learned how STEM principles are embedded in everything from rolling your tongue, to successful firefighting, to developing a more absorbent diaper.

## **CONSTRUCTIVE COMMENTS**

Based on survey responses and a focus group, instructors and student leaders agreed that the scheduled time was too long for the elementary aged children and at least one half hour less program time would be better after a long day at school. The snacks provided also need to include some appropriate for children who are vegetarians. The instructors would also like to reverse the order and have the oldest children first.

Communications have improved over the years that the program has run, but an easier way to contact parents would be helpful. This year there was an improvement in planning and accessing materials.

The interest and engagement level of the student leaders is an essential component in this program. This year included two exceptional Student Leaders and collaborative and collegial adults who made the experience fun each week for all the participants. One survey quote was quite telling; "Every class was full of anticipation and smiling faced students. There was a sense of wonder and satisfaction in learning about our world through science, math, technology, and engineering practices."

## **CONCLUSIONS**

An Aurora University adjunct faculty member worked with a school district teacher and student leaders to implement curriculum units from the John C Dunham STEM Partnership school with seventy-eight elementary students at Brooks Elementary School in District 204. The collaboration of Aurora University and the Brooks Elementary School Parent STEM Group to bring an after school STEM experience to these students was beneficial to the partners and students. Content knowledge was gained in every grade level program. Students maintained an interest in the STEM fields and learned more about STEM careers. Aurora University student leaders increased both their STEM content knowledge and their knowledge of STEM education. Professional educators both in the public school and the Aurora University faculty reported an increase in their STEM field knowledge and excitement about teaching STEM. Successful activities and experiences have been noted, and suggestions for improvement have also been documented. As this program has matured, it continues to bring STEM opportunities to the broader community and to empower university students to become experienced leaders in STEM education, along with their adult mentors.