



SOME FREQUENTLY ASKED QUESTIONS AND THEIR ANSWERS

WHAT IS STEM MATRIX?

STEM Matrix is a 501(c)(3) nonprofit organization whose mission is to provide quality science and STEM education to children in underserved communities. The many goals of STEM Matrix include improving student curiosity and self-efficacy in STEM disciplines, increasing student content and process skills in STEM; building student awareness of careers in STEM fields, and to very essentially help build children's self-esteem. In addition, the Stem Matrix teaching team comprised of a classroom teacher and a carefully selected then trained college student, co facilitate classroom sessions further developing their respective abilities to connect with students around STEM learning, disciplines and fields as the STEM Matrix model uniquely facilitates professional development.

WHAT IS THE STEM MATRIX PROGRAM?

The STEM Matrix program provides excellent STEM learning opportunities for students in grades 4–5 by engaging students in problem-centered, hands-on, inquiry-based STEM (Science, Technology, Engineering, and Mathematics) learning. The program is closely aligned with new Illinois State Standards for Science (NGSS), and it has a strong emphasis on building students' science and engineering practices; deep, conceptual understanding of crosscutting concepts; and 21st century skills—especially the four Cs (Collaboration, Communication, Critical thinking and Creativity). Participants in the program learn to problem solve and explore in small team settings some of our current and future global community and environmental challenges, such as: the unique properties of water, its limited availability, and its essential roles in living cells and beings; water filtration processes; irrigation of crops; plant growth; effects of acid rain; food safety; food packaging; building and testing structures; and constructing simple and more complex machines to perform work. Students develop their skills in using technology, design and perform their own experiments to answer questions and to deepen their conceptual understanding, and apply these concepts as they engage in the engineering cycle and work collaboratively in small teams to solve problems.

WHEN IS STEM MATRIX IMPLEMENTED?

The STEM Matrix program can be implemented as an after-school and/or an in-school program. The program begins in late January and includes 16 weeks of STEM-centered investigations and challenges in a school classroom setting. Each lesson is designed to be 90 minutes long, but each lesson can be customized so that it can be implemented in 60 minutes or two 45-minute sessions depending on the needs of a school. STEM Matrix remains flexible to move forward with lessons so they optimally align with existing school district programming. In addition to 16 weeks of STEM Matrix sessions, students participate in the program's signature, STEM Matrix culminating event, our end-of-year interschool competition that takes place in May. During this culminating event, students use their new knowledge and skills to engage in collaborative inquiry as they work together in teams to solve three new STEM challenges that draw on information learned in the previous 16 weeks. Class size typically runs between 25 and 30 children and districts are encouraged to bring multiple schools and classrooms into the program.

HOW DOES STEM MATRIX ENCOURAGE FAMILY INVOLVEMENT?

Throughout the STEM Matrix program period, students are encouraged to share their learning at home. In most cases, children bring home a day's lesson to share what they have learned. An interactive parent information session, available to all families, is provided by STEM Matrix staff where families are encouraged to become more meaningfully involved in their child's education. Parents are encouraged to volunteer during the classroom program and at the competition, and to engage regularly with their children by sharing in their learning. Students can invite two family members to the end-of-year interschool competition event. Families love watching their children during the competition event while both competing and shopping the Stem Matrix Store with their earned program currency. At the competition, students have the opportunity exchange Matrix Money—their hard-earned fun, program currency—for “very cool” and instructional STEM learning toys, so they can continue to engage in STEM learning experiences outside of school. Matrix Money has significant and real value as the market value of the STEM learning toys taken home by each student ranges between \$40 and \$90. Matrix Money is earned throughout the program for performance, good citizenship, and positive attitude.

WHO FACILITATES STEM MATRIX SESSIONS?

Stem Matrix sessions are cofacilitated by carefully selected and trained undergraduate students from local colleges, who serve as STEM mentors to students, along with classroom teachers. The training is provided by the STEM Matrix Director of Programs, who is a seasoned educator, professional development specialist, and curriculum and assessment development expert in problem-centered,



Greenwood Elementary School student Jordan Wood, 11, participates in a STEM Matrix challenge with her team on Tuesday. (Image credit: Yadira Sanchez Olson / Lake County News-Sun)

collaborative-inquiry-based, STEM-focused teaching and learning that addresses the new learning standards. The undergraduates that serve as STEM mentors prepare, under supervision, the materials needed for each session and are prepared to lead the learning activities in the absence of a cofacilitator. Their enthusiasm for STEM learning and their future careers, their youth, and the fact that most of the STEM Mentors come from local neighborhoods and similar backgrounds, feeds the mentoring process and helps increase participants' self-efficacies in STEM learning and career options. Importantly, cofacilitating classroom teachers in the STEM Matrix program learn from and are energized by the program's STEM mentors. Stem Matrix cofacilitation provides an immersive professional development experience for both facilitators.

HOW MANY STUDENTS HAVE EXPERIENCED THE STEM MATRIX TEACHING AND LEARNING MODEL?

STEM Matrix's unique STEM teaching and learning model was launched within the Chicago Public Schools in 2009. It has experienced continuous yearly refinements since then as some 5000 children have been served by this model to date.

WHAT MAKES THE STEM MATRIX PROGRAM MODEL UNIQUE?

Stem Matrix is unique in that it combines a strong and flexible curriculum of weekly STEM investigations and challenges with a carefully selected and trained team of college age "near peer" classroom Science Mentors; a valuable, weekly awarded currency; and a signature end-of-year interschool competition where students must apply content, process, and the 21st century skills they have learned throughout the program. The program provides opportunities for parent and family engagement and develops and fosters students' positive dispositions for STEM fields and STEM disciplines. Children earn and then exchange program currency for valuable science learning toys that go home with them. In STEM Matrix, participants essentially step into the world of *gamification* as they must successfully navigate, in small-team

settings, numerous academic and critical-thinking hurdles to play in areas of learning students find exciting and interesting. The synergy and impact of the program's components and its operating at a very cutting-edge place in the evolving world of gamification make the STEM Matrix difference.

DOES STEM MATRIX REFLECT A CONSTRUCTIVIST APPROACH AND ADDRESS BEST PRACTICES?

To accomplish the goals of the STEM Matrix program, all lessons are problem-centered, engage students in collaborative inquiry, include hands-on investigations, and are constructivist based. In a constructivist-based approach, lessons are designed to draw on learners' existing beliefs, knowledge, and skills. Through student-centered inquiry investigations, students then synthesize new conceptual understanding from their prior learning experiences and new information. The constructivist approach is widely regarded as a foundation for best practices in science education, and it comes from many research studies that address different facets of science education, including: problem-solving, deep conceptual learning, real-world applications, meaningful evaluation, and positive dispositions and attitudes toward science. The constructivist model used to guide the STEM Matrix lessons is the 5-E model [first developed by BSCS (Biological Sciences Curriculum Study)], in which each “E” (engage, explore, explain, elaborate, and evaluate) describes a phase of learning. This model allows learners to build on prior experience and knowledge, to construct meaning, and to continually evaluate their understanding of a concept. Numerous studies demonstrate that the 5-E instructional model is an effective, student-centered approach for teaching STEM concepts.

HOW DOES STEM MATRIX MEASURE PROGRAM EFFECTIVENESS ?

To evaluate the effectiveness of the STEM Matrix program, student participants complete pre- and post-assessments on science content and process skills and on attitudes toward science. A highly qualified external evaluator and science education assessment expert determined that participants in STEM Matrix programs have shown statistically significant ($p < 0.001$) average gains of 11 percentage points as compared to very similar groups of students who did not receive the program, which represents a large, positive effect. This finding is consistent for data analyzed from multiple schools.

Also, from qualitative and anecdotal evidences collected from teachers and administrators there has been an overwhelming belief that the STEM Matrix program encourages positive attitudes toward science and builds self-confidence in addition to cultivating desirable skills related to critical thinking and small-group collaboration. An example of feedback from a seasoned teacher regarding the STEM Matrix program is presented here:

I've been teaching for 17 years, and this curriculum is the most unique way to teach STEM I've seen. It's such a fun way to teach and learn the academic language that they've built from when they started the program until today. —Greenwood Elementary School teacher

What is the dollar value of program deliverables and what is provided to schools?

The dollar value for deliverables in connection with a Stem Matrix Program delivered to each classroom of up to 30 students in grades 4 and/or 5 for approximately 16 weeks is \$20,000. This cost includes at least one trained STEM Mentor for each classroom (two when necessary); spiral-bound student books and student journals for all participants; classroom equipment (such as electronic balances, digital thermometers, glassware, and other measurement and observation tools) and supplies needed for all 16 learning investigations; Three STEM challenges within the context of the Stem Matrix exciting end-of-year signature competition event held at a major offsite venue; all costs for students, parents, and additional guests and other school participants, all mainstream and popular science toys that go home with each child as all children also shop with their program currency on event day at the Stem Matrix Store; professional media coverage, including press releases; ongoing weekly oversight and support from the STEM Matrix leaders; and truly amazing learning experiences for all participants.

Where can I learn more about the STEM Matrix program?

Please visit our STEM Matrix website at www.stemmatrix.org to view STEM Matrix classrooms in action and to learn more about this program.