Building Capacity to Integrate Science into Afterschool, Home, and Community

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Introduction

Founded in honor of Americaâ▤▤s first great scientist, Benjamin Franklin, The Franklin Institute (TFI) is one of Americaâ▤▤s oldest and most renowned centers of science education and development in the country.Â TFI is dedicated to public education and to creating an understanding of and a passion for science and technology. To accomplish this, TFI offers new and innovative ways to access science learning opportunities in the community, throughout the museum, and in digital spaces.Â Additionally, TFI supports science learning through community-based partnerships such as the Philadelphia Science Festival, LEAP into Science, and the Philadelphia/Camden Informal Science Education Collaborative (PISEC).Â A recent, innovative example of this commitment is the *STEM 3D: Integrating Science into Afterschool, Home, and Community* project (STEM 3D).

STEM 3D, funded by the National Science Foundation, combines TFIâ▤▤s strengths in hands-on, interactive

science learning, community-based collaborations, and inquiry-based professional development with the strong project-based infrastructure already in place across Out-of-School Time (OST) Network funded by the City of Philadelphia Department of Human Services (DHS). STEM 3D offers an innovative, holistic approach to engaging underserved minority youth and their families in STEM learning opportunities that extends across multiple contexts and settings.Â The STEM 3D strategy includes:

- Embedding project-based science learning into the program offerings of four afterschool sites serving children in grades 3-5;
- Developing thematically-linked home-based activities designed to engage significant adults in the continuation of childrenâ▤▤s science learning from the afterschool setting into the home setting;
- Piloting family-friendly community events hosted by both the afterschool programs and the museum that are focused on building STEM career linkages in relevant and meaningful ways.

The Importance of Informal Learning Environments for Engaging Underserved, Minority Youth in STEM and 21st Century Learning

The STEM 3D approach draws on evidence-based research demonstrating the proven ability of informal environments to act as an entry point to STEM and 21st

Century skills for elementary-aged youth, as well as the value of involving significant adults and local communities when providing STEM learning opportunities for minority youth. This article will describe significant research findings that provided the foundation for our innovative approach to STEM learning, and highlight the partnerships formed OST programs to leverage the context of informal learning environments.

Scenes from a recent site visit to a STEM 3D pilot site in North Philadelphia provide meaningful examples of research moving to practice.Â Afterschool facilitators point out a fourth-grade African-American boy and whisper, â▤▤He has never worked this hard and long at something before.â▤▤Â The boy has been working for nearly an hour to figure out how to design a mechanism that will turn a rod in a mechanical â▤▤puppet,â▤▤ or automaton, that he is building as part of this springâ▤▤s STEM 3D project.Â His neighbor connects the prior knowledge about electrical circuits he learned during the fall STEM 3D project when he suggests attaching a â▤▤button to a wire so this thing [a small plastic tube] will spin like gear.â▤▤Â A girl who had begun the afternoon project refusing to leave the computer area, rolling her eyes, and demanding why she had to do this stupid project is now exclaiming â▤▤It moves up and down like an elevator!â▤▤ as she puts the finishing touches on her automaton prototype.

The deep engagement shown by these youth as they

solve problems and create working designs is not a fluke.Â The STEM 3D project is based on the belief that the low-stakes, supportive environments of informal settings, like afterschool programs and museums, can â≣≣serve as an â≣≣on rampâ≣≣ to help the learner build familiarity with the natural and designed world and to establish the experience base, motivation, and knowledge that fuel and inform later science learning experiencesâ≣≣ (NRC, 2009). Additionally, extensive research has shown that OST programs that incorporate relevant, hands-on science learning opportunities support the sustained development of science interest, especially for youth of minority and low-income status who are historically underrepresented in STEM professions (Peterson, 2013; Falk & Dierking, 2010; NRC, 2009), and that early interest in a science-related career greatly increases the likelihood that a student will earn a degree in a science field. (Tai et al. 2006).Â

If we hope that middle school students consider STEM careers, it is important to provide early opportunities inside and outside of school for children to envision themselves as STEM professionals.Â STEM 3D targeted programs that serve elementary youth because most afterschool programs lack the resources and training necessary to implement effective science programming, particularly in low-income populations (Chi, Freeman, & Lee, 2008).Â We wanted afterschool facilitators with limited knowledge of and facilitation with STEM skills to

feel confident and comfortable with the STEM learning opportunities provided during the project.Â Activities based on elementary science and technology concepts allow youth and adults to experience and test real scientific phenomena and learn more about the world around them through experimentation and problem solving without needing to be content experts.Â The STEM 3D project emphasizes that significant adults have the potential to be important and influential â▤▤STEM Role Modelsâ▤▤ who are comfortable saying to a child, â▤▤I donâ▤▤t know the answer.Â How could we find out together?â▤▤Â

STEM 3D pilot site staff members are beginning to truly embrace the connection between inquiry-driven, project-based activities and youth development. To promote this, STEM 3D employed an innovative approach to professional development, offering several Â½ day training workshops that build off of one another (rather than full-day sessions).Â The STEM 3D approach to professional development gives afterschool providers time between workshops to think about project implementation, and to consider site-specific needs and concerns. By the end of the workshop series, these afterschool facilitators have had multiple opportunities to think deliberately about how to engage youth in the project, what types of questions and experiences will extend childrenâ▤▤s learning during throughout the project, and how to use youthâ▤▤s ideas when

transitioning to the next project.Â

One of the challenges the STEM 3D pilot sites are wrestling with is the understandable tension between the time allotted to homework completion and to project-based learning modules such as STEM 3D.Â As the project moves forward, museum and pilot site staff members are discussing ways to integrate STEM projects into free play time, and ways to use STEM 3D, and informal science experiences in general, to support school-based learning such as writing, math, arguing from evidence, and personal reflection through the integration of data analysis, graphs, and science notebooks (or journals) into the project pilot.Â Finally, STEM 3D pilot sites are beginning to plan and implement take-home science learning extensions and STEM-career family days at the museum in order to meaningfully connect with parents and caregivers about the importance of informal learning experiences.Â These strategies have been shown by prior TFI efforts to broaden adult perceptions of what â▤▤countsâ▤▤ as science, and enhance adult knowledge of approaches for facilitating childrenâ▤▤s learning.

Conclusion

The opportunity to learn what works and what is challenging across informal settings is an invaluable experience for both museum and afterschool staff involved in the STEM 3D project.Â

Letâ▤▤s return to the STEM 3D pilot site in North Philadelphia.Â TFI staff observed one student whose mechanism design was not working the way he wanted.Â He walked away from his project at least ten times over the course of the afternoon, but after a few minutes of watching his peers work on their designs, he continually returned to his own project.Â Facilitators characterized him as â▤▤easily frustratedâ▤▤ but what became evident was his determined persistence.Â STEM 3D professional development sessions emphasize the idea that scientists and engineers constantly revise their original ideas in the face of new data and peer analysis. Coaching youth to tackle design challenges through brainstorming and trial and error is a key ingredient to STEM success.Â

STEM 3D project staff members do not expect to turn every child in the pilot into a STEM professional.Â Rather, STEM 3D staff members hope to increase youth engagement in STEM, and most importantly, help youth build habit of minds in elementary school that develop their ability to persist and communicate effectively before they enter middle school.Â Likewise, STEM 3D strives to invite critical discussion about the relationship of inquiry-based STEM learning and youth development, encourage the adaptation of resources, and build collaboration between the significant adults that enter and exit childrenâ▤▤s live as they move between afterschool, home, and community settings.Â The projectâ▤▤s

ultimate goal is to create habits of mind around science and learning that travel across these settings and are sustained far beyond the lifetime of the grant.

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Citations

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