Building Systems from Scratch

Principal Investigators: Gilly Puttick, Eli Tucker-Raymond

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Website: buildingsystems.terc.edu

Computing has been a central tool in the development of modern understanding in many fields of science and engineering. Skills such as modeling, data visualization, and computational thinking are all necessary for building a diverse scientific workforce that will secure a strong future for the United States. The *Building Systems from Scratch* project will develop and study an education program that integrates computing into middle school Earth systems science by interweaving game design and science learning. It aims to develop skills among diverse groups of young people in two crucial fields central to national interest and safety. More importantly, the project brings these two fields together to create a learning environment in which young people learn thinking from a systems perspective, essential to solving complex scientific problems. Specifically, students will engage in computational practices such as modeling, abstraction, management of complexity, and creative design, as well as iterative testing and debugging, as they design their games. The project contributes to practical models for developing science content learning and computer skills, creating positive attitudes toward science, and broadening participation in the sciences among middle school students in diverse settings.

The program will include:

1. a standards-aligned curriculum focused on systems thinking practices,
2. a teacher professional development workshop with supporting materials,
3. a teacher leader guide for sustainable implementation of the program, and
4. a website to support program materials, activities, and communication.

Specifically, as students build their own games, they will engage in computational practices such as modeling, abstraction, management of complexity, and creative design, as well as iterative testing and debugging. The project seeks to understand how and what young people learn when they engage in interdisciplinary learning in technology-rich environments. It will further seek to understand how curricular structural supports influence student learning and self-efficacy. The project will address specific needs of middle school students and teachers with regard to relevant disciplinary content, science practices, and computation as specified in NGSS and CSTA standards. It will work with fifteen 8th grade teachers in three MA districts across three years, reaching approximately 1,840 8th grade students, over half of whom are from groups underrepresented in STEM and computer science fields.